The Indiana Department of Transportation

Office of Geotechnical Engineering
120 South Shortridge Road P.O. Box 19389
Indianapolis, Indiana 46219-0389
Phone: (317) 610-7251 Fax: (317) 356-9351

Driving Indiana's Economic Growth

October 5, 2006

Mr. Bart Mueller
Consultant Services Manager – Vincennes District
3650 S. US 41
Vincennes, IN 47591

Subject:
Des No: 0200775
Project No: STP-6647 (002)
Structure No: NA
Hamilton Boulevard in Mitchell
County: Lawrence
District: Vincennes

Gentlemen:

The Geotechnical Investigation for the subject project has been completed and copies of the Geotechnical Report in CD Format are being forwarded to those listed below.

If you have any questions concerning this matter, please call us.

Very truly yours,

Athar A. Khan
Chief Geotechnical Engineer

S. S. Hiremath
Somanath S. Hiremath
Geotechnical Engineering Group Leader

SSH/JF/nd
Cc: Mitchell City Commissioners – Attachment
Strand Associates – Attn: Mr. E. Brunn - Attachment
Mr. J. Wright – Attachment
Ms. L. Painter - Attachment (2)
Ms. S. Languell – Attachment
Mr. D. Cohen – Attachment
Mr. J. Paauwe – Attachment
File
Joey: Itemization letters/LPA-sendout-10-copies

GEOTECHNICAL EVALUATION

PROJECT NO. STP-6647(002)
DES. NO. 0200775
HAMILTON BOULEVARD
FROM SR 37 TO MERIDIAN ROAD
MITCHELL, LAWRENCE COUNTY, INDIANA

Prepared for

STRAND ASSOCIATES, INC.
629 WASHINGTON STREET
COLUMBUS, INDIANA 47202

By

EARTH EXPLORATION, INC.
7770 WEST NEW YORK STREET
INDIANAPOLIS, INDIANA 46214-2988

October 4, 2006

EARTH EXPLORATION INC.

EARTH EXPLORATION, INC.
4310-C Technology Drive
South Bend, Indiana 46628-9752
574-233-6820 (FAX) 574-233-8242

October 4, 2006

Mr. Marc A. Rape, P.E.
Strand Associates, Inc.
629 Washington Street
Columbus, IN 47202

Re: Geotechnical Evaluation
Project No. STP-6647(002)
Des. No. 0200775
Hamilton Boulevard from SR 37
to Meridian Road
Mitchell, Lawrence County, Indiana
EEI Project No. 1-04-132

Dear Mr. Rape:

We are pleased to submit our geotechnical evaluation for the above-referenced project. This final report presents the results of our subsurface exploratory program and provides geotechnical recommendations for the proposed roadway and bridge improvements. As you are aware, the work for this project was formally authorized by the city of Mitchell on April 15, 2004 and August 2, 2004, via acceptance of Earth Exploration, Inc. (EEI) Proposal Nos. P1-02-340.1 (geotechnical) and P1-02-340.2 (geophysical), respectively. A draft copy of this evaluation was sent to the Indiana Department of Transportation (INDOT) on September 27, 2006, for their review and comment. We have incorporated those comments, as appropriate.

We appreciate the opportunity to provide our services to you on this project. Please contact our office if you have any questions or need further assistance with the project.

Sincerely,

EARTH EXPLORATION, INC.

Curtis R. Bradburn, P.E.
Senior Geotechnical Engineer

Scott J. Ludlow, Ph.D., P.E.
Principal Engineer

SUMMARY OF RECOMMENDATIONS[1]
GEOTECHNICAL EVALUATION
PROJECT NO. STP-6647(002); DES. NO. 0200775
HAMILTON BOULEVARD FROM SR 37 TO MERIDIAN ROAD
MITCHELL, LAWRENCE COUNTY, INDIANA

Bridge Foundation Recommendations

Due to known voids observed at the boring locations and the potential for voids as observed throughout the area, we recommend that consideration be given to supporting the bridge structure on drilled shafts in lieu of driven piles, as planned. We recommend that the conditions immediately beneath the foundation grade for the shafts be evaluated via proof-testing as indicated in the text of the report. This scheme permits the structural loads to be transferred to the underlying sound rock and by proof-testing the concern of voids being present just below the tip of the shaft is not an issue. For design, we recommend the use of a straight-shaft element (minimum diameter of 3 ft) socketed into sound rock and proportioned using an average allowable skin friction of 2,500 psf (i.e., no end bearing) for the rock socket (sound rock only). We also recommend that test shafts (located between Pier No. 6 and Pier No. 10) with Osterberg load cell be utilized (well before work is let) to more accurately estimate the unit skin friction and end bearing and to further revise the shaft lengths. **Once the Osterberg load cell(s) have been complete, EEI should be retained to check and/or modify the previously mentioned skin friction and to provide an allowable end bearing pressure.**

Pavement Design Considerations

The pavement subgrades are anticipated to consist primarily of naturally-occurring cohesive soils or engineered fill similar to those soils observed at the test boring locations. Based on the laboratory results, the nature of project, and projected traffic volume, we recommend using a CBR value of 4 with a Type II subgrade treatment for design of asphaltic or Portland cement concrete. Water infiltration into cohesive subgrade soils can reduce the life of a pavement section. Since these soils have a low permeability, we would anticipate that any water which may infiltrate the subgrade would affect the long-term performance of the pavement. Under these conditions, we recommend that consideration be given to the use of subsurface pavement drains with screened outlets in the design of the pavement system. In our opinion, the drains should be surrounded by a permeable drainage medium consisting of a uniformly-graded aggregate. In addition, due to the presence of an appreciable amount of silt, filter fabric should be used in conjunction with the subsurface drains to prevent the contamination of the permeable backfill around the drains.

Earth Cut and Fill Considerations

The maximum earth cut and fill heights for the roadway on the project are generally anticipated to be about 14 ft. Based on the information obtained at the boring locations, we anticipate that soft to very stiff cohesive soil will be encountered in subgrade areas. Where soft soils are encountered, they should be aerated to reduce the moisture content and recompacted. In other areas, standard embankment construction practices outlined in the ISS and as discussed above should provide an adequate subgrade for embankment construction. In addition, as mentioned in the report, topsoil ranging from 1 in. to 13 in. in thickness (averaging 8 in. in thickness) is anticipated throughout the length of the project. Additionally, we anticipate an average of 2 ft of undercutting of soft soils (observed at the location of about 40 percent of the borings) could be required along the project alignment. Therefore, we recommend a line item be provided in the contract documents for an unspecified quantity of removal and replacement of unsuitable soils. Based on information provided by others and observations during a site visit, a possible "hidden" sinkhole may exist (in the form of a depression) about 120 ft north of the proposed roadway. This possible sinkhole/depression appears to have been filled with "uncontrolled fill" (i.e., trees, stumps, soil, etc.) likely to bridge a low area to simplify the growing of crops. Consequently, some of this "uncontrolled" fill is anticipated to be located within the proposed roadway alignment either as a result of the actual placement of the fill and/or partially "dragged" over during plowing of the field. Where uncontrolled fill is encountered, voids may exist which may lead to settlement. To provide adequate support of the roadway and to minimize the risk of excessive settlement, we recommend that the uncontrolled fill be completely removed and the subgrades be re-established with granular fill ("B" Borrow). To further delineate the limits of the uncontrolled fill, consideration could be given to performing a number of test pits and providing additional recommendations based on the results of those observations.

---

[1] **The purpose of this summary is to provide an abbreviated discussion of our recommendations contained in the attached evaluation. In our opinion, the recommendations in this summary are the "most significant" geotechnical issues affecting the proposed construction. For additional discussion and recommendations, our geotechnical report should be consulted and/or Earth Exploration, Inc. should be contacted.**

TABLE OF CONTENTS

PAGE

LIST OF TABLES

LIST OF APPENDICES

GEOTECHNICAL EVALUATION
PROJECT NO. STP-6647(002)
DES. NO. 0200775
HAMILTON BOULEVARD FROM SR 37 TO MERIDIAN ROAD
MITCHELL, LAWRENCE COUNTY, INDIANA
EEI PROJECT NO. 1-04-132

1. INTRODUCTION

This report presents the results of our subsurface exploration for a new roadway (i.e., Hamilton Boulevard) between SR 37 and Meridian Road in the north part of Mitchell, Indiana. This report presents the results of our subsurface exploratory program and provides geotechnical recommendations for the proposed roadway construction. The work for this project was formally authorized by the city of Mitchell on April 15, 2004 and August 2, 2004, via acceptance of Earth Exploration, Inc. (EEI) Proposal Nos. P1-02-340.1 (geotechnical) and P1-02-340.2 (geophysical), respectively.

The opinions and recommendations submitted herein are based in part on the interpretation of the subsurface conditions revealed by the test borings at the locations shown on plans in Appendix C. The report does not reflect variations in the subsurface conditions between or beyond these borings. Variations in conditions can be expected between the boring locations, and fluctuation of groundwater levels may occur with time. The nature and extent of the variations may not become evident until the time of construction. If subsurface variations become apparent at a later date, it may be necessary for EEI to re-evaluate the recommendations of this report. Other, important information regarding this evaluation is contained in Appendix A.

2. PROJECT DESCRIPTION

We understand that the city of Mitchell, in assistance with federal funds, is planning to construct a new roadway to be known as Hamilton Boulevard from SR 37 to Meridian Road. Refer to Drawing No. 1-04-132.B1 in Appendix C for the general location of the project. From our understanding, the project is generally anticipated to include the construction of a new two-lane undivided roadway with paved shoulders, and a multiple-span bridge over an existing railroad (i.e., CSX Railroad). It should be noted that a preliminary design was proposed to include a single-span bridge over the railroad with mechanically-stabilized earth (MSE) wingwalls and abutments. However, based on our initial exploratory activities, the structure has been modified to a multiple-span structure (likely a nine- or ten-span bridge). Furthermore, drainage improvements consisting of ditches are planned throughout the project.

Based on plans provided by Strand Associates, Inc. (SAI), Hamilton Boulevard is planned to follow Line "A" beginning near Station 10+45 and ending near Station 106+51. Improvements are also planned along Rabbitville Road on Line "S-1-A" beginning at Station 7+00 and ending at Station 12+00, and along Meridian Road on Line "S-2-A" beginning near Station 8+52 and ending near Station 11+37 for a total project length of about 10,390 ft (1.97 mi). Maximum earth cuts and fills are anticipated to be on the order of about 14 ft (in ditch areas) near the east end of the project and about 5 ft of earth fill at the end bents of the proposed bridge (note that the previous design planned to have fill depths of up to 36 ft). In addition, the earth slopes are not planned to exceed a grade of 3 horizontal to 1 vertical (3H:1V). Furthermore, the roadways are anticipated to consist of both Portland cement concrete and asphaltic concrete, and from information provided on the plans, the projected (i.e., year 2025) annual average daily traffic (AADT) is estimated to be about 2,020 vehicles per day.

Based on information shown on recently revised plans, the new bridge is planned to consist of a nine- or ten-span prestressed concrete box-beam structure having a length of about 1,230± ft and constructed at a skew of about 23 degrees to the left (of the railroad). In addition, the bridge is anticipated to be designed for HS20-44 loading and be supported on a deep foundation scheme.

At this time, other information such as anticipated construction schedule and source of borrow is not known. In the event that the nature, design or location of the proposed construction changes, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions are modified or confirmed in writing.

3. PURPOSE AND SCOPE OF WORK

The general purpose of this evaluation was to develop geotechnical recommendations to aid in the design and construction of the project. Our scope of services included:

1. Performing test borings and soundings along the project to observe the conditions at the respective locations;

2. Evaluating the physical properties of soils encountered at the test boring locations, by performing field and laboratory tests;

3. Summarizing the results of the subsurface exploration;

4. Analyzing the data from the geophysical survey, and the field and laboratory tests to provide geotechnical recommendations; and

5. Preparing an engineering report containing information on the subsurface conditions and conclusions and recommendations regarding:

   a) Foundation design and construction recommendations for the proposed bridge structure;

   b) Embankment construction;

   c) Pavement design considerations;

   d) Site preparation, including recommendations for improvement of in-situ soils; and

   e) Potential construction problems due to subsurface conditions (i.e., excavations and dewatering).

4. FIELD EXPLORATION AND LABORATORY TESTING

4.1 General

Subsurface conditions for the improvements were initially explored by performing thirty-two borings and thirteen soundings (to help in delineating potential sinkholes). Upon completion of the initial exploratory activities along with a subsequent geophysical survey, nine additional borings and two soundings with rock cores (i.e., at the opposite end of the proposed bents) were completed at the proposed pier/bent locations of the revised structure. Refer to the following table for the number, type and depth of the borings and soundings.

TABLE 1 - TEST BORING AND SOUNDING DESIGNATIONS

Proposed Element	Test Boring Designation	Number of Test Borings	Depth of Test Borings (ft)
Bridge Structure	TB-1 and TB-2	2	33 and 56½
Revised Bridge Structure	Pier 1S through Pier 11S**	9	25 to 95
Road	RB-1 through RB-13	13	7½ to 37
Retaining Wall	RW-3 through RW-5	3	23½ to 32½
Embankment*	B-1 through B-14	14	20 to 56½
Soundings	S-1 through S-14	14	26 to 40
Hand-auger Sounding	HAS-1	1	4½

* The embankment boring locations were determined based on karstic features determined via the previously mentioned geophysical survey.

** Borings were alternated between the north and south ends of each bent (designated N or S on the attached boring logs) with additional sounding performed where conditions warranted.

Note that although three retaining wall borings were completed along the edge of the right-of-way in the embankment area, these retaining walls have been eliminated and the embankment height and location has been changed. The number and location of the borings and soundings were selected by Earth Exploration, Inc. (EEI), in conjunction with Indiana Department of Transportation (INDOT), Division of Materials and Tests, Geotechnical Section. Additionally, the borings were located in the field by EEI personnel referencing identifiable features shown on the previously mentioned plans. Ground surface elevations at the boring locations were interpolated to the nearest ½-ft based on topographic information provided on the plans. The boring locations and elevations should be considered accurate only to the degree implied by the methods used.

4.2 Exploratory Methods and Sample Collection

4.2.1 Test Borings and Soundings

Geotechnical field activities were performed by EEI during the period of May 3 through 11, 2004, April 11 through May 9, 2005, and May 3 through June 14, 2006. In general, these activities were performed using hollow stem augers to advance the boreholes and rock sounding to determine the depth to rock. Representative samples of the soil conditions using Standard Penetration Test (SPT) procedures (AASHTO T 206) were obtained at predetermined intervals within the boreholes. In addition, sampling of rock using diamond core drilling methods (AASHTO T 225) was performed. After obtaining final groundwater observations, each borehole was backfilled with auger cuttings and bentonite chip plug (i.e., in accordance with the "Aquifer Protection Guidelines" [revised October 30, 1996] developed by INDOT). Additional details of the drilling and sampling procedures are provided in Appendix B.

4.2.2 Geophysical Survey

Geophysical field activities (i.e., seismic reflection) were performed in the area of the original proposed embankment (currently the location of the proposed structure) to determine the location and extent of voids within the underlying rock. This survey was performed along five traverses (refer to Drawing No. 1-04-132.B2), i.e., four west of the existing railroad (Line 01 through 04) and one east of the railroad (Line 05). Lines 01 through 03 were performed parallel to the proposed alignment from the west side of the existing railroad to approximately 1,200 ft to the west (near Station 48+00 "A"). Lines 04 and 05 were performed parallel to the existing railroad with 04 being on the west side and 05 on the east side. Seismic measurements were recorded using a 48-channel StrataView seismograph and 30-Hz geophones using standard Common Depth Point

(CDP) methods. A 12-gauge Betsy Seisgun was used to fire a 60 dram blank charge of black powder into the subsurface. Shot holes were excavated to a typical depth of about 2 ft with a hand auger. Because blanks were used, no lead shot remained in the subsurface soil. Once the geophysical data was processed, potential sinkhole areas were identified, and the previously mentioned Borings B-1 through B-14 were performed in these areas.

4.3 Laboratory Testing

Following the geotechnical exploratory activities, the soil and rock samples were visually classified by an EEI engineering technician and later reviewed by an EEI geotechnical engineer. After visually classifying the soils, representative samples were selected and submitted for laboratory testing. These tests included: natural moisture content (W%; AASHTO T 265); grain size analysis (AASHTO T 88); Atterberg limits (LL%, PL%, and PI%; AASHTO T 89 and T 90); soil pH; unit density (γ_d); and hand penetrometer readings (q_p). Other tests included, unconfined compression tests (q_u, AASHTO T 208), moisture-density relations (AASHTO T 99) and California Bearing Ratio (CBR) (AASHTO T 193) performed on a bulk sample. The results of the tests are provided on the boring logs in Appendix D and/or respective summary sheets in Appendix E. For your information, soil descriptions on the boring logs are in general accordance with the AASHTO system [AASHTO designation, e.g., A-7-6(22)] and the INDOT Standard Specifications (ISS[1]) (textural classification, e.g., silty clay loam). The final boring logs represent our interpretation of the individual samples and field logs, and results of the laboratory tests. The stratification lines on the boring logs represent the

[1] References the Indiana Department of Transportation (INDOT) Standard Specifications, 2006 Edition.

approximate boundary between soil types; although, the transitions may actually be gradual.

5. SITE CONDITIONS

5.1 Surface Conditions

Based on our observations, the topography in the project area is gently sloping. The elevation of the existing ground surface for the proposed alignment varies from approximately Elevation 655 (near the end of the project) to Elevation 703 (at the beginning of the project). Presently the proposed alignment mainly consists of agricultural land (i.e., crops) with some wooded areas. It should also be noted that an existing railroad bisects the project near Station 60+00 "A."

In addition, the Mitchell area is known to contain numerous "sink holes" and other karstic features (i.e., blind rivers, caves, etc.). Based on information provided by others, six potential "sink holes" were mapped along the alignment of the proposed right-of-way (located on the eastern portion of the project). In general, sinkholes are derived from the solutioning of the underlying limestone-type rock and the subsequent collapse or migration of soil into the solutioned void.

5.2 Soil Conditions

Based on the information gathered during our field activities, the subsurface profile was somewhat similar with the exception of the depth to rock. Generally, the soils consisted of cohesive silty clay loam (both A-7-6 and A-6 [AASHTO classification]), silty clay, and clay, underlain by weathered rock and rock (i.e., sandstone, siltstone, limestone, and dolomite) to the maximum depth explored. (Note that granular soil [described as soil fill] was observed at the location of Boring RB-1 from 3 to 5½ ft.) In addition, the surficial

conditions encountered at the boring locations consisted of topsoil ranging from 1 in. to 13 in. in thickness (averaging 8 in. in thickness).

From our observations, the consistency of the A-6 silty clay loam was very soft to very stiff based on N-value criteria established by INDOT. Moisture contents were on the order of 19 to 33 percent, and hand penetrometer readings typically ranged from ¾ to 3½ tons/sq ft (tsf). In addition, an unconfined compression test was performed on a split-spoon sample of the A-6 silty clay loam. Results from this test indicated a peak undrained shear strength (i.e. using the Ø=0 concept) of approximately 1.6 ksf at an axial strain of about 4 percent. The consistency of the A-7-6 silty clay loam and silty clay was generally soft to medium stiff. Moisture contents were typically on the order of 21 to 40 percent, and hand penetrometer readings generally ranged from ½ to 2¾ tsf (averaging 1½ tsf). In addition, an unconfined compression test was performed on a split-spoon sample of the silty clay. Results from this test indicated a peak undrained shear strength of approximately 2.4 ksf at an axial strain of about 3 percent. The consistency of the clay was typically medium stiff to very stiff based on N-value criteria. Moisture contents were typically on the order of 21 to 40 percent, and hand penetrometer readings generally ranged from ¾ to 3¼ tsf (averaging 2 tsf). In addition, unconfined compression tests were performed on split-spoon samples of the clay. Results from these tests indicated peak undrained shear strengths of approximately 1.2 to 4.4 ksf at axial strains of about 2 to 11 percent. The unit weights (i.e., dry density) performed on the tube samples of the silty clay loam were determined to be about 86 to 93 lbs/cu ft. The relative density of the granular soil fill was medium dense with an SPT N-value of 12 blows/ft. Several samples were also tested for pH level, (i.e., hydrogen-ion content), and these results indicated that the pH levels ranged from 6.2 to 7.5. The results of these tests are provided in the Summary of Special Laboratory Test Results in Appendix E.

5.3 Rock Conditions

Rock consisting of limestone, dolomite, sandstone, and siltstone were observed below the overburden soils. Observations of the rock cores indicated RQD values ranging from as low as 0 (at 20 locations) to as high as 100 percent (at 7 locations), averaging 33 percent. Generally, the lower RQD[1] values (0 to about 40 percent) were identified with rock that formed a "roof" structure over a void or contained numerous small voids. At locations where voids were not present or beneath the void, the quality of the rock mass was typically better with RDQ values ranging from about 60 to 100 percent. However, at a couple test boring locations, the quality of the rock mass was less than the range previously stated. It should be noted that both clay filled and air/water filled voids were observed within the limestone rock (as shown on the attached Test Boring Logs). From the field observations, the thickness of the voids varied considerably, ranging from about 0.2 to 5.6 ft (refer to following table [i.e., Summary Of Voids Observed At The Boring Locations] for additional details on the depth and thickness of the voids at the respective exploratory locations).

TABLE 2. SUMMARY OF VOIDS OBSERVED AT THE EXPLORATORY LOCATIONS

Boring No.	Depth to Rock, ft	Depth of Void(s), ft	Thickness of Void(s), ft	Depth of Void(s) Below Top of Rock, ft
B-1	17.0	20.5→21.0 24.0→24.1	0.5 0.1	3.5→4.0 7.0→7.1
B-2	15.0	None	N/A	N/A
B-3	13.0	16.5→17.0 18.0→20.1	0.5 1.9	3.5→4.0 5.0→7.1
B-4	17.0	17.6→18.5 19.0→22.0	0.9 3.0	0.6→1.5 2.0→5.0
B-5	26.0	29.0→30.0	1.0	3.0→4.0
B-6	26.5	29.5→32.0	2.5	3.0→5.5

1 RQD refers to Rock Quality Designation and is often used as an index to define engineering characteristics of an intact rock mass. RQD is evaluated by determining the percentage of core recovered in lengths greater than twice the diameter (e.g., for NX core, lengths greater than 100 mm).

TABLE 2. SUMMARY OF VOIDS OBSERVED AT THE EXPLORATORY LOCATIONS

Boring No.	Depth to Rock, ft	Depth of Void(s), ft	Thickness of Void(s), ft	Depth of Void(s) Below Top of Rock, ft
B-7	23.5	24.0→53.0*	0.2→0.7*	0.5→29.5*
B-8	19.5	None	N/A	N/A
B-9	26.5	None	N/A	N/A
B-10	8.5	10.3→10.5 11.8→15.5 16.3→20.5	0.2 3.7 4.2	1.8→2.0 3.3→7.0 7.8→12.0
B-11	14.5	17.3→19.5 21.0→21.5	2.2 0.5	2.8→5.0 6.5→7.0
B-12	9.5	10.0→21.5*	0.2→0.7*	0.5→12.0*
B-13	28.0	28.6→34.2 35.9→37.0	5.6 1.1	0.6→6.2 7.9→9.0
B-14	28.0	39.0→40.2	1.2	11.0→12.2
TB-1	28.0	None	N/A	N/A
TB-2	38.0**	None	N/A	N/A
Pier 1S	15.0	None	N/A	N/A
Pier 2N	20.5	None	N/A	N/A
Pier 3S	23.0	None	N/A	N/A
Pier 4N	23.5	None	N/A	N/A
Pier 5S	16.0	28.0→28.3 30.0→30.9 32.0→32.6	0.3 0.9 0.6	12.0→12.3 14.0→14.9 16.0→16.6
Pier 6N	20.0	27.0→36.0 44.5→45.4	0.2→0.7* 0.9	7.0→16.0 24.5→25.4
Pier 7S	24.5	28.5→33.5 44.5→56.0	0.2→0.7* 0.2→0.7*	4.0→9.0 20.0→31.5
Pier 7N	33.0	33.4→33.7 41.9→42.3 46.5→51.5	0.3 0.4 0.2→0.7*	0.4→0.7 8.9→9.3 13.5→18.5
Pier 10N	37.0	37.3→55.0 62.0→62.5 66.0→67.0	0.2→0.7* 0.5 1.0	0.3→18.0 25.0→25.5 29.0→30.0
Pier 10S	28.0	28.3→65.0	0.2→0.7*	0.3→37.0
Pier 11S	28.0	30.0→75.0	0.2→0.7*	2.0→47.0

* Alternating thin layers of rock and voids (2 to 8 in. in thickness).
** 38 ft to the weathered sandstone and siltstone and 51.5 ft to the limestone.

This is somewhat indicative of karstic features in areas where an overlying soil mass is thick enough to restrict water flow to an underlying limestone rock. In general,

voids located in the Mitchell plain are not located in a certain orientation (or lineament) and are somewhat scattered in location. The karstic features in this area are typically formed by surface water percolating though the soil mass and penetrating into the underlying limestone (causing solutioning) through small cracks or faults, or may "pond" within the rock (likely causing thin alternating layers of interbedded limestone and clay filled voids [such at those observed at the locations of Borings B-7, B-12, Pier 6N, Pier 7S, Pier 10N, Pier 10S, and Pier 11S]) or on the rock causing the upper portions or the rock to solution. Once a drainage path is developed into the limestone, larger voids are possible and caves or underground streams can form. However, at the location of the proposed bridge and bridge approaches, well defined karstic features are not observed at the surface due to the thickness and permeability of the overlying cohesive soils. Drawing Nos. 1-04-132.D3, D4, D5, and D6 in Appendix C illustrates four subsurface profiles at the proposed bridge location depicting the variable locations and sizes of the voids encountered at the boring locations, the inferred top of rock and stratigraphic contacts. In addition, Drawing No. 1-04-132.B7 in Appendix C shows/illustrates the potential karstic features as determined from information obtained from the previously mentioned geophysical survey.

5.4 Groundwater Conditions

Groundwater level observations made up to 24 hrs after completion of the exploratory activities are shown at the bottom of the logs. Based on the observations, groundwater was initially encountered at twenty-nine of the forty-three boring locations at depths ranging from the surface to 25 ft (Elevation 655½ to 680) below the existing ground surface. Up to 24 hrs after completion, groundwater was observed at sixteen of the boring locations ranging from the surface to 10 ft (Elevation 667½ to 681) below the

existing ground surface. Refer to the following Table (Summary of Water Level Observations), for additional information.

TABLE 3. SUMMARY OF WATER LEVEL OBSERVATIONS

Boring No.	While Drilling (ft)	Upon Completion (ft)	24 hr Water Level (ft)
RB-1	5½	NW	NW
RB-2	NW	NW	NW
RB-3	NW	NW	NW
RB-4	12½	NW	4
RB-5	14	NW	2½
RB-6	NW	NW	2
RB-7	NW	NW	NW
RB-8	NW	NW	NW
RB-9	NW	NW	NW
RB-10	NW	NW	NW
RB-11	20	11	7
RB-12	NW	NW	NW
RB-13	NW	NW	--
TB-1	21	22	--
TB-2	18	NW	NW
RW-3	22	NW	--
RW-4	23	13	8
RW-5	8	19½	10
B-1	NW	(1)	--
B-2	Surface	(1)	½
B-3	NW	(1)	--
B-4	Surface	(1)	Surface
B-5	19½	(1)	--
B-6	18	(1)	--
B-7	NW	(1)	Surface
B-8	Surface	(1)	Surface
B-9	NW	(1)	7½
B-10	Surface	(1)	7½
B-11	NW	(1)	8
B-12	10	(1)	7
B-13	21	(1)	10½
B-14	8	(1)	8½
Pier 1S	3	(1)	--
Pier 2N	18	(1)	--
Pier 3S	5	(1)	--

TABLE 3. SUMMARY OF WATER LEVEL OBSERVATIONS			
Boring No.	**While Drilling (ft)**	**Upon Completion (ft)**	**24 hr Water Level (ft)**
Pier 4N	5	(1)	--
Pier 5S	4	(1)	--
Pier 6N	2	(1)	--
Pier 7S	6	(1)	--
Pier 7N	7	(1)	--
Pier 10N	23	(1)	--
Pier 10S	12	(1)	--
Pier 11S	25	(1)	--
NW - No water encountered. (1) - Water introduced during rock coring			

In our opinion, these water elevations likely represent a perched condition and the actual "piezometric" groundwater level is deeper than the maximum depth explored. This is also somewhat consistent with the generalized information published in a reference titled *Hydrogeologic Atlas of Aquifers in Indiana* (U.S. Geological Survey, Water-Resources Investigations Report 92-4142) which indicates the groundwater in this area to be about 50 to 100 ft below the existing ground surface. It should be recognized that groundwater levels either static or perched can fluctuate due to changes in precipitation, infiltration, surface run-off, and other hydrogeological factors.

6. DISCUSSION AND RECOMMENDATIONS

6.1 General

Based upon our understanding of the revised improvements (i.e., replacement of the embankment with a nine- or ten-span structure) and information obtained from the test boring locations, we concur with the use of drilled shafts to support the bridge structure. Due to the somewhat random presence of karstic features (voids) within the underlying rock, it is our opinion that confirmation testing/proof testing will be required at the location of each drilled shaft. Conditions outside the area of the approach

embankment and bridge are generally conducive for the support of the proposed roadway.

As mentioned previously, the design originally consisted of an embankment with a maximum height of about 36 ft. Due to the karstic features within the underlying rock and the presence of soft to medium stiff cohesive soils above the rock, a potential for collapse and/or movement/settlement was a concern. Although the embankment could be constructed, the cost was anticipated to be excessive, and therefore, a cost analysis was performed by SAI for two different alternatives. Upon completion of this analysis, the alternative of extending the structure over the area of known karstic features was chosen. The following is a list of other alternatives considered. Many of these options were eliminated due to excessive cost and/or the level of risk still present upon completion. These original alternatives included:

1) Complete removal and replacement of all soft soils;
2) Partial removal and replacement of soft soils;
3) Place embankment on existing grade and anticipate settlement/movement;
4) Establishing the embankment on drilled shafts extending through the karstic features and soft soils and into sound rock;
5) Adjusting the roadway design to avoid or partially avoid karstic features and soft soils;
6) Construct the embankment with lightweight ESP (Expanded Polystyrene [EPS] blocks), and reduce the amount of right-of way;
7) Extending the structure over the carstic features and eliminate the embankment, embankment fill and a portion of the right-of-way.

It should be noted that alternatives 1, 2, 3, and 6 do not address any potential movement due to the collapse or partial collapse of voids within the underlying rock, and alternatives 1 and 2 would likely require extensive dewatering and importing soil fill. In addition, settlement is anticipated to occur for alternatives 2 and 3. Additionally, due to the amount of karstic features in the vicinity of the project, an alternate route (alternate 5) to avoid these features may or may not be feasible. Furthermore, alternative 4 which was originally considered was determined to be expensive due to the extent of the karstic features and number of drilled shafts needed to support the embankment. Therefore, a cost analysis (as mentioned previously) was done by SAI to determine the cost of alternates 6 and 7. Based on their analysis, the cost for each would be somewhat comparable; however, some risk of collapse of the block may still exist, and therefore, alternate 7 was chosen.

6.2 Bridge Foundation Recommendations

6.2.1 General

Due to known voids observed at the location of the borings performed at the proposed bent/pier locations, we recommend that consideration be given to supporting the bridge structure on drilled shafts. We recommend that the conditions immediately beneath the foundation grade for the shafts be evaluated via proof-testing as indicated in the previous section. This scheme permits the structural loads to be transferred to the underlying sound rock and by proof-testing the concern of voids being present just below the tip of the shaft is not an issue. For design, we recommend the use of a straight-shaft element (minimum diameter of 3 ft [refer to the Laterally Loaded Pile Analysis in Appendix F) socketed into sound rock and proportioned using an average allowable skin friction of 2,500 psf (i.e., no end bearing) for the rock socket (sound rock only). We also

recommend that test shafts (located between Pier No. 6 and Pier No. 10) with Osterberg load cell be utilized (well before work is let) to more accurately estimate the unit skin friction and end bearing and to further revise the shaft lengths. (Note that end bearing is not being considered until results of Osterberg load cell are known.) **Once the Osterberg load cell(s) have been complete, EEI should be retained to check and/or modify the previously mentioned skin friction and to provide an allowable end bearing pressure.** For preliminary planning purposes, the depths of the drilled shafts are anticipated to extend to the elevations (from existing ground surface) shown on the following table (note that these depths are estimated and are approximate and should only be used as such.)

TABLE 4. ANTICIPATED/APPROXIMATE DEPTH/ELEVATION OF DRILLED SHAFTS

Bent/Pier No.	Depth to top of rock (ft)*	Anticipated Depth/Elevation of Drilled Shafts (ft)**
Bent/Pier 1	15	20± / 660±
Pier 2	20.5	25± / 665±
Pier 3	24.5	30± / 649±
Pier 4	23.5	30± / 650±
Pier 5	16	20± / 659±
Pier 6	20	50± / 629±
Pier 7	25 and 33	35± / 640±
Pier 8	28	35± / 644±
Pier 9	40	55± / 623±
Pier 10	28 and 37	75± / 605±
Pier 11	28	80± / 598±

* Refer to the Test Boring Logs for depth where rock was initially encountered.
** For preliminary planning purposes only. Should be confirmed through proof-testing, as discussed in Section 6.2.3.

However, it should be noted that the borings and soundings performed at the bent/pier locations were performed at the ends (i.e., north or south ends) of the bents and although this distance is on the order of about 40 ft, considerable variation of void thicknesses and locations was observed (refer to Test Boring Logs Pier 1S through Pier 11S and Borings TB-1 and TB-2). Therefore these estimates should be used for preliminary planning purposes only.

6.2.2 Construction Considerations

Due to the subsurface conditions, permanent casing (i.e., full-length) will be necessary for safety precautions and to seal the void(s) from loss of concrete during construction. Common practice is to use permanent casing 6 in. in diameter larger than the diameter of the rock socket. Considering the presence of water, wet method construction techniques are anticipated, and therefore, concrete will be placed using a tremie method beginning at the bottom of the shaft. When concrete is placed by tremie methods, INDOT specifications require integrity testing of the shaft by crosshole sonic and impulse response testing. Refer to Section 6.2.3 for additional details on testing.

Construction sequence and methods should be coordinated to allow concrete placement immediately upon completion of drilling and, in no case, should an uncased shaft be left open overnight. Any loose rock fragments on the bearing surface must be completely removed immediately prior to concrete placement. Verification of the cleanliness of the bearing surface should be performed using a weighted tape.

As a result of the weathered condition and bedding characteristics of the rock, it is also possible that blocks of the more competent layers (i.e., those layers which are anticipated to be relied upon for lateral stability if required) could become dislodged (yet not removed) during the excavation process. If this condition does occur, we recommend that the loosened blocks be removed or the rock mass be treated via pressure grouting with a cement following placement of concrete. Furthermore, difficulty is possible during the excavation process because of the likely sloping nature of the rock surface. Therefore, the contractor should be prepared to alter their drilling techniques for the given condition. Furthermore, a special provision for the construction of drilled shaft foundations is included in Appendix F.

6.2.3 Confirmation Testing

It should be noted that since only a limited number of exploratory borings were performed within and/or adjacent to the suspected void areas, close monitoring of the subsurface conditions (depth and size of voids) during the excavation of the shafts is recommended. In addition, as mentioned previously, test shafts with Osterberg load cells should be utilized to more accurately estimate the unit skin friction and end bearing within the rock.

We recommend that conditions immediately beneath the foundation grade for the shaft be evaluated via proof-testing to verify the rock integrity. Proof-testing of rock usually consists of drilling an exploratory hole, approximately 2 in. in diameter and 5 ft deep and observing such indicators as speed of drilling under a given drill pressure, dropping or clogging of the drill bit and loss of drill water (if used). At least 5 ft of sound rock should be ascertained. It is important that qualified personnel observe the proof-testing. Furthermore, we recommend that an EEI representative be present during all phases of foundation construction to observe that our recommendations are properly interpreted and implemented.

As mentioned previously, when concrete is placed by tremie methods, INDOT specifications require integrity testing of the shaft by crosshole sonic and impulse response hammer testing. However, caution should be exercised when evaluating the data. This is because of the risk of apparent problems detected during crosshole sonic testing which are not then substantiated by coring the shaft. Poor transmission of the crosshole signal can result where there is poor bond between the water-filled tubes and the shaft concrete. Potential difficulties in verification testing can lead to delays and cost overruns. Nevertheless, we recommend crosshole sonic testing be utilized, because otherwise, there is no verification of the concrete continuity other than comparison of the

theoretical and actual volume of concrete place. The impulse response tests should also provide validation of the crosshole sonic logging, although due to the mass of the concrete, the impulse-response results may be limited near the bottom of the shaft.

6.3 Embankment Considerations

Given the bridge profile, the maximum earth fill placement height for the approach embankment will be about 4 to 5 ft. Based on the information obtained at the borings, we anticipate that soft to hard cohesive soils will generally be encountered to depths of about 13½ to 33 ft in subgrade areas of fill placement for the proposed embankment. We recommend that where unstable or softer soils are encountered (observed at 29 of the 30 boring locations [approximately 95 percent] at the location of the original embankment) in the uppermost 2 ft of the subgrade within the footprint of the embankment which will not readily compact, be stabilized in-place or removed and replaced with compacted B-borrow possibly in combination with a Type 1 geogrid. If removal and replacement is needed in the soft soils, we recommend a minimum removal depth of 2 ft and replacement with compacted "B" Borrow in accordance with ISS. For subgrade preparation outside of the embankment area (i.e., majority of the roadway), refer to Section 6.5.

6.4 Pavement Design Considerations

The pavement subgrades are anticipated to consist primarily of naturally-occurring cohesive soils or engineered fill similar to those soils observed at the test boring locations. The results of a California Bearing Ratio (CBR) test performed on a sample of the silty clay loam obtained from Boring TB-1A, indicated CBR values of 7.1 at 97 percent, 5.0 at 95 percent, and 3.5 at 93 percent of the maximum dry density (Standard Proctor,

AASHTO T 99). Based on these results, the nature of project (construction along the existing alignment), and projected traffic volume, we recommend using a CBR value of 4 with a Type II subgrade treatment for design of asphaltic or Portland cement concrete.

Water infiltration into cohesive subgrade soils can reduce the life of a pavement section. Since these soils have a low permeability, we would anticipate that any water which may infiltrate the subgrade would affect the long-term performance of the pavement. Under these conditions, we recommend that consideration be given to the use of subsurface pavement drains with screened outlets in the design of the pavement system. In our opinion, the drains should be surrounded by a permeable drainage medium consisting of a uniformly-graded aggregate. In addition, due to the presence of an appreciable amount of silt, filter fabric should be used in conjunction with the subsurface drains to prevent the contamination of the permeable backfill around the drains.

6.5 Roadway Considerations

6.5.1 Site Preparation

We recommend that in all areas to receive pavement components, all topsoil, wet or soft near-surface soils, and existing pavement components (if any) be removed from within the construction limits. In addition, we recommend that existing underground utilities be appropriately relocated. Where utilities are relocated, we recommend that the resulting excavations be backfilled with "B" borrow in accordance with Section 203.09 of the ISS.

After removal and where feasible, we recommend that exposed soils in pavement areas and areas to receive fill be proof-rolled in accordance with the ISS, Section 203.26. Where encountered, we recommend that soft soils (such as those observed at the

location of Borings RB-2, 4, 6, 11 and 13 [near a depth of 2 ft], and RB-11 near a depth of 4 ft), or otherwise unstable soils encountered during the proof-rolling operations which will not readily compact, be aerated (if feasible) to reduce the moisture content and be recompacted. However, if construction takes place during fall, winter or early spring, reducing the moisture content may be difficult if not impossible to achieve. If adverse weather conditions exist or if the underlying subgrade begins to "pump," other means of stabilization such as undercutting and replacement with granular fill (e.g., "B" Borrow), possibly in conjunction with a geogrid, or chemical modification may be required. Additionally, if/where granular soils are encountered, they should be adequately compacted to densify those soils loosened during the excavation process. The final decision regarding stabilization should be made at the time of construction, based on the observed actual conditions.

6.5.2 Engineered Fill Placement and Compaction

We recommend that engineered fill used to raise grades or backfill of undercut areas be placed in loose lift thicknesses not exceeding 8 in. and be compacted to 95 percent of the maximum density obtained in accordance with AASHTO T 99 as specified in the ISS. In our opinion, the soils as observed at the test boring locations are suitable for reuse as engineered fill. However, the natural moisture content of the cohesive soils typically exceeds the optimum. Therefore, it is likely that some drying (by aeration) of the fill will be required before placement in order to satisfy the ISS if these soils are utilized. Aeration of the soils will also be required where encountered within the range of subgrade treatment. Under some climatic conditions, such as cold or rainy weather, or in confined areas, adequate moisture conditioning may be difficult to achieve, and in this case, granular fill could be required to expedite construction activities.

6.5.3 Earth Cut and Fill Considerations

The maximum earth cut and fill heights for the roadway on the project are generally anticipated to be about 14 ft in ditch areas (as mentioned previously in Section 2). Based on the information obtained at the boring locations, we anticipate that soft to very stiff cohesive soil will be encountered in subgrade areas. Where soft soils are encountered, they should be aerated to reduce the moisture content and recompacted. In other areas, standard embankment construction practices outlined in the ISS and as discussed above should provide an adequate subgrade for embankment construction. However, it should be noted that organic matter and roots were observed at the location of Boring RB-11. In addition, as mentioned previously, topsoil ranging from 1 in. to 13 in. in thickness (averaging 8 in. in thickness) is anticipated throughout the length of the project. Additionally, we anticipate an average of 2 ft of undercutting of soft soils (observed at the location of 5 of the 13 road borings [i.e., approximately 40 percent of the borings]) could be required along the project alignment. Therefore, we recommend a line item be provided in the contract documents for an unspecified quantity of removal and replacement of unsuitable soils.

Based on information provided by others and observations during a site visit, a possible "hidden" sinkhole may exist (in the form of a depression) about 120 ft north of the proposed roadway. This possible sinkhole/depression appears to have been filled with "uncontrolled fill" (i.e., trees, stumps, soil, etc.) likely to bridge a low area to simplify the growing of crops. Consequently, some of this "uncontrolled" fill is anticipated to be located within the proposed roadway alignment either as a result of the actual placement of the fill and/or partially "dragged" over during plowing of the field. Additional, rock soundings were performed within this area to determine if the possible sinkhole extended under the proposed roadway alignment. Based on these soundings (refer to the

summary of soundings in Appendix D) the elevation to the top of rock (as defined by auger refusal) appears to be somewhat consistent, and therefore the sinkhole does not appear to extend to the roadway alignment. Where uncontrolled fill is encountered, voids may exist which may lead to settlement. To provide adequate support of the roadway and to minimize the risk of excessive settlement, we recommend that the uncontrolled fill be completely removed and the subgrades be re-established with granular fill (e.g., "B" Borrow). To further delineate the limits of the uncontrolled fill, consideration could be given to performing a number of test pits and providing additional recommendations based on the results of those observations.

6.6 Construction Considerations

6.6.1 Excavations

Excavations made for the project will require: 1) cut slopes adequate enough to prevent cave-ins/subsidence; or 2) braced excavations for safe construction operation. Based on the soil conditions at the boring locations, it is our opinion that shallow (i.e., less than 5 ft) temporary construction excavations can be cut with sideslopes nearly vertical provided minor sloughing is tolerable. However, all excavations should conform to Occupational Safety and Health Administration (OSHA) requirements (i.e., 29 CFR Part 1926). Additionally, excavated soil should not be stockpiled immediately adjacent to the top of the excavation nor should equipment be allowed to operate too closely to excavations. In our opinion, the cohesive soils are typically classified as Type A and B (according OSHA) and should be treated accordingly.

6.6.2 Groundwater Control

Based on the subsurface information, it is likely that shallow excavations will require dewatering in some areas. Where water or surface water enters an excavation, this can likely be controlled by means of sump pumps and collection trenches. Proper site drainage of surface runoff will also help to alleviate unwanted water from entering into the excavation during the construction process.

6.7 Additional Information

Due to the sequencing of this project, a number of additional analyses were completed and are included in Appendix G. These analyses include: shaft supported embankment analysis, rock socket analysis for drilled shafts (i.e., for the original shaft supported embankment), embankment settlement analysis, and an MSE abutment wall analysis. This information is provided for informational purposes only.

7. CONCLUDING REMARKS

We recommend that EEI be provided the opportunity to review the final design and project specifications to confirm that earthwork and foundation requirements have been properly interpreted and implemented in the design and specifications. We also recommend that EEI be retained to provide construction observation services during the earthwork phases of the project. This will allow us to verify that the construction proceeds in compliance with the design concepts, specifications and recommendations. It will also allow design changes to be made in the event that subsurface conditions differ from those anticipated.

This evaluation has been conducted in accordance with generally accepted soil and foundation engineering practices. The recommendations in this report are based on

the subsurface information from the few, widely-spaced borings performed for this project. It is important to recognize that subsurface conditions can vary over relatively short distances. If unanticipated conditions are encountered during construction, we recommend that EEI be contacted to re-evaluate the conclusions and recommendations contained in this report.

APPENDIX A

IMPORTANT INFORMATION ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

Important Information About Your Geotechnical Engineering Report

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

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

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

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

Read the full report

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

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

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

A Geotechnical Engineering Report Is Subject To Misinterpretation

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

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Rely on Your Geotechnical Engineer for Additional Assistance

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

ASFE

8811 Colesville Road Suite G106 Silver Spring, MD 20910

Telephone: 301-565-2733 Facsimile: 301-589-2017

email: info@asfe.org www.asfe.org

UGER1000.10M

APPENDIX B

FIELD METHODS FOR EXPLORING AND SAMPLING SOILS AND ROCK

FIELD METHODS FOR EXPLORING AND SAMPLING SOILS AND ROCK

A. Boring Procedures Between Samples

The boring is extended downward, between samples, by a hollow stem auger (AASHTO* Designation T251-77), a continuous flight auger, driven and washed-out casing, or rotary boring with drilling mud or water.

B. Penetration Test and Split-Barrel Sampling of Soils

(AASHTO* Designation: T206-87)

This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140 pound weight falling freely through a distance of 30 inches. The sampler is first seated 6-inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance or N-Value. The blow counts are reported on the Test Boring Records per 6 inch increment. Recovered samples are first classified as to texture by the driller. Later, in the laboratory the driller's classification is reviewed by a soils engineer who examines each sample.

C. Thin-walled Tube Sampling of Soils

(AASHTO* Designation: T207-87)

This method consists of pushing a 2-inch or 3-inch outside diameter thin wall tube by hydraulic or other means into soils, usually cohesive types. Relatively undisturbed samples are recovered.

D. Soil Investigation and Sampling by Auger Borings

(AASHTO* Designation: T203-82)

This method consists of augering a hole and removing representative soil samples from the auger flight or bucket at 5-foot intervals or with each change in the substrata. Relatively disturbed samples are obtained and its use is therefore limited to situations where it is satisfactory to determine approximate subsurface profile.

E. Diamond Core Drilling for Site Investigation

(AASHTO* Designation: T225-83)

This method consists of advancing a hole in bedrock or other hard strata by rotating downward a single tube or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings. Normally, a 3-inch outside diameter by 2-inch inside diameter coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and laboratory. Cores are stored in partitioned boxes and the length of recovered material is expressed as a percentage of the actual distance penetrated.

* American Association of State Highway and Transportation Officials, Washington D.C.

APPENDIX C

EXPLORATORY LOCATION PLAN
(Drawing No. 1-04-132.B1)

EXPLORATORY LOCATION PLAN AT PROPOSED STRUCTURE
(Drawing No. 1-04-132.B2)

SUBSURFACE PROFILE A-A`
(Drawing No. 1-04-132.D3)

SUBSURFACE PROFILE B-B`
(Drawing No. 1-04-132.D4)

SUBSURFACE PROFILE C-C`
(Drawing No. 1-04-132.D5)

SUBSURFACE PROFILE D-D`
(Drawing No. 1-04-132.D6)

LOCATION OF POTENTIAL KARSTIC FEATURES
(Drawing No. 1-04-132.B7)

C5X RailRoad

Rabbitsville Road

BEGIN PROJECT
STA 10+44.83 - LINE "A"

Refer to Drawing 1-04-132.B2
for Exploratory Location Plan
at Proposed Structure

RB-1 RB-2 RB-3 RB-4 RB-5 RB-6 RB-7 RB-8 RB-9 RB-10 RB-11 RB-12

Proposed Hamilton Boulevard

TV Tower Road

SR 37

North Meridian Road

END PROJECT
STA 106+51.43 - LINE "A"

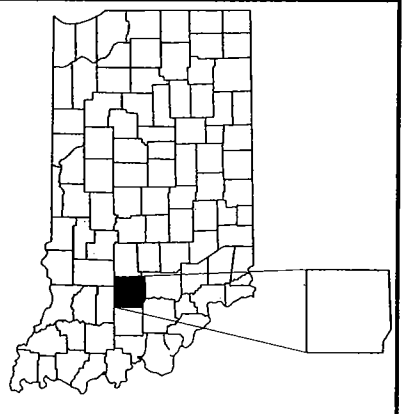
Mill Creek Road

Helmar Acres Lane

Rock Lick Branch

CR 850 S - (W Hancock Avenue)

VICINITY MAP
N.T.S.



Lawrence County, Indiana

LEGEND

RB-1	◔	Test Boring Location and Designation
S-1	◔	Test Sounding Location and Designation

NOTES

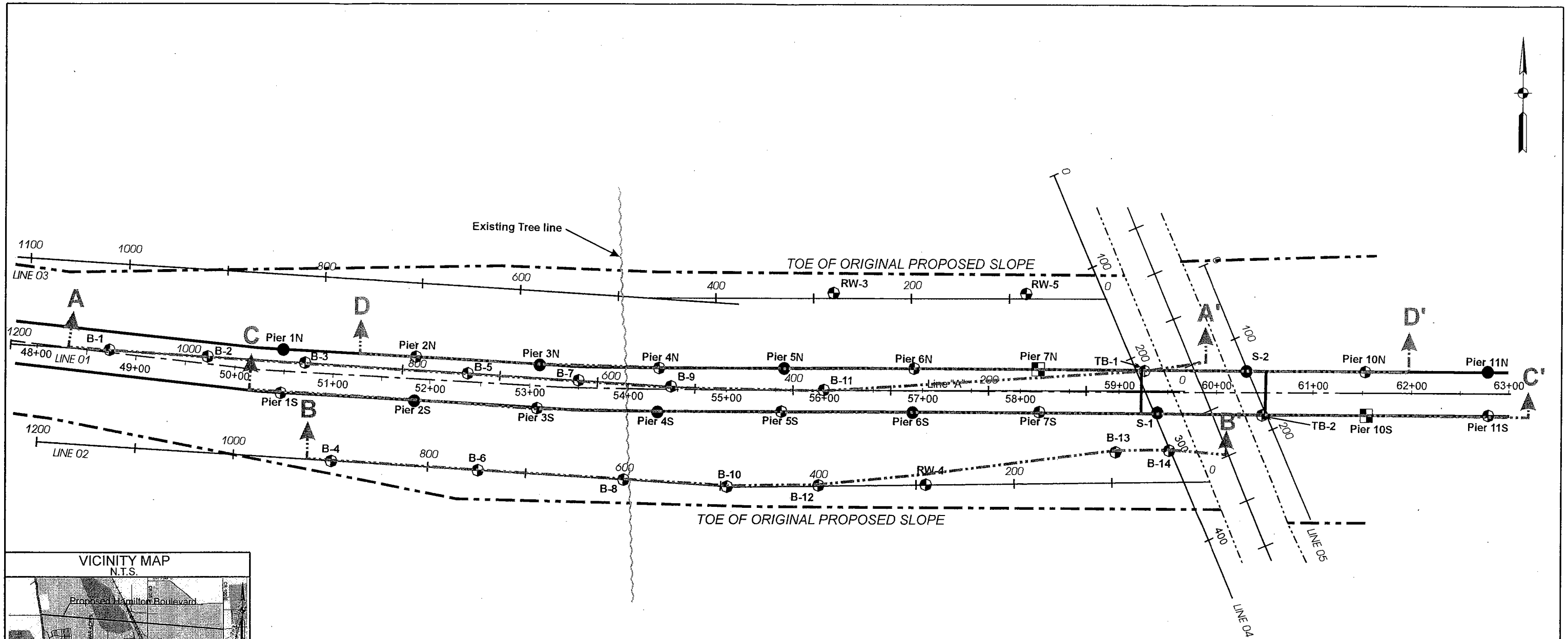
1. Base map generated using commercially-available software by DeLorme (Street Atlas USA ver. 7.0).
2. Refer to the Log of Test Boring (43) and Summary of Soundings in Appendix D for a description of the subsurface conditions encountered at the test boring/sounding locations.
3. Borings were located in the field by Earth Exploration, Inc.
4. Ground surface elevation at the test boring locations were interpolated to the nearest ½ ft based on topographic information shown on plans provided by Strand Associates, Inc.
5. Boring locations are approximate.

EXPLORATORY LOCATION PLAN

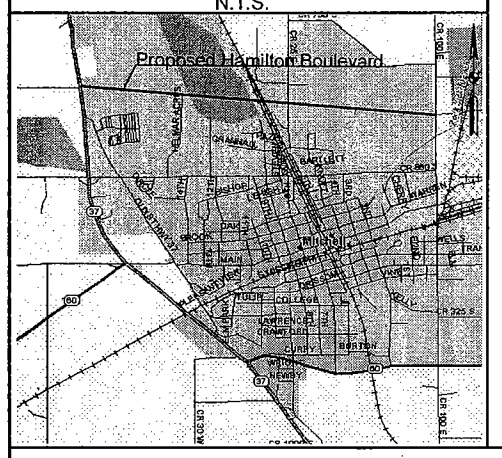
PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
LOCATION:	Mitchell, Lawrence County, Indiana
CLIENT:	Strand Associates, Inc.
DES NO.:	0200775
CLIENT PROJ NO.:	STP-6647 (002)
EEI PROJECT NO.:	1-04-132
SCALE:	1" = 600'

PROJECT ENGINEER:	CRB
APPROVED BY:	SJL
DRAWN BY:	JDR
DATE AND TIME:	10-12-05 14:25:21
DRAWING NUMBER:	1-04-132.B1

EARTH EXPLORATION, Inc.
7770 West New York Street
Indianapolis, IN 46214-2988
317-273-1690
(FAX) 317-273-2250



VICINITY MAP
N.T.S.



LEGEND

TB-10	Test Boring Location and Designation
S-1	Test Sounding Location and Designation
7N	Test Sounding w/Rock Core Location and Designation
A A'	Subsurface Profile
1200 1000	Seismic Profile Locations
	Toe of Original Proposed Slope

NOTES

1. Base map developed from plans provided by Strand Associates, Inc. on April 4, 2004.
2. Refer to the Log of Test Boring (43) and Summary of Sounding for a description of the subsurface conditions encountered at the test boring and sounding locations.
3. Refer to Drawing Nos. 1-04-132.D3, 1-04-132.D4, 1-04-132.D5 and 1-04-132.D6 for Subsurface Profiles A-A', B-B', C-C' and D-D' respectively.

EXPLORATORY LOCATION PLAN AT PROPOSED STRUCTURE

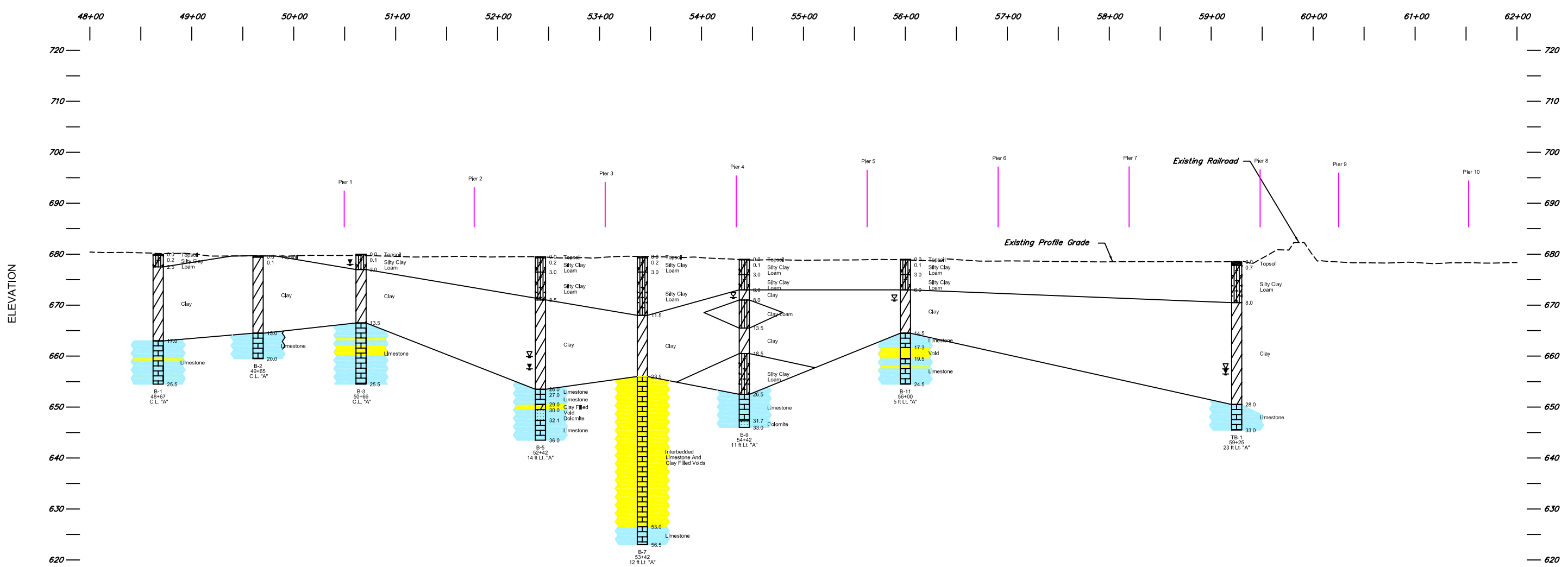
PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
DES NO.:	0200775
PROJECT NO.:	STP-6647 (002)
LOCATION:	Lawrence County, Indiana
CLIENT:	Strand Associates, Inc.
EEI PROJECT NO.:	1-04-132
SCALE:	1" = 100'

PROJECT GEOLOGIST:	MJH
APPROVED BY:	MJH
DRAWN BY:	JDR
DATE AND TIME:	1-13-05 8:03:21
DRAWING NUMBER:	1-04-132.B2

EARTH EXPLORATION, INC.
7770 West New York Street
Indianapolis, IN 46214-2988
317-273-1690
(FAX) 317-273-2250

WEST

EAST



SECTION A-A'

NOTES:

1. Base map developed from an electronic file provided by Strand Associates, Inc. on April 4, 2005.
2. Refer to the Log of Test Boring (43) and Summary of Sounding In Appendix D for a description of the subsurface conditions encountered at the test boring/sounding locations.
3. Subsurface information shown incorporates interpreted seismic features projected onto each section.
4. All stratigraphic contacts are inferred.
5. Refer to Drawing No. 1-04-132.B2 for section location.

LEGEND

Rock - (Limestone, Dolomite, Sandstone & Siltstone)

Void & Clay-filled void

PROJECT ENGINEER: CRB

DRAWN: JBF

APPROVED BY: SJL

APPROVED BY: SJL

SUBSURFACE PROFILE A-A'

Hamilton Boulevard from SR 37 to Meridian Road

Lawrence County, Indiana

7770 West New York Street
Indianapolis, Indiana 46214-2988
317-273-1690
FAX 317-273-2250

EARTH EXPLORATION

- Geotechnical Engineering
- Materials Engineering and Testing
- Exploratory Field Services

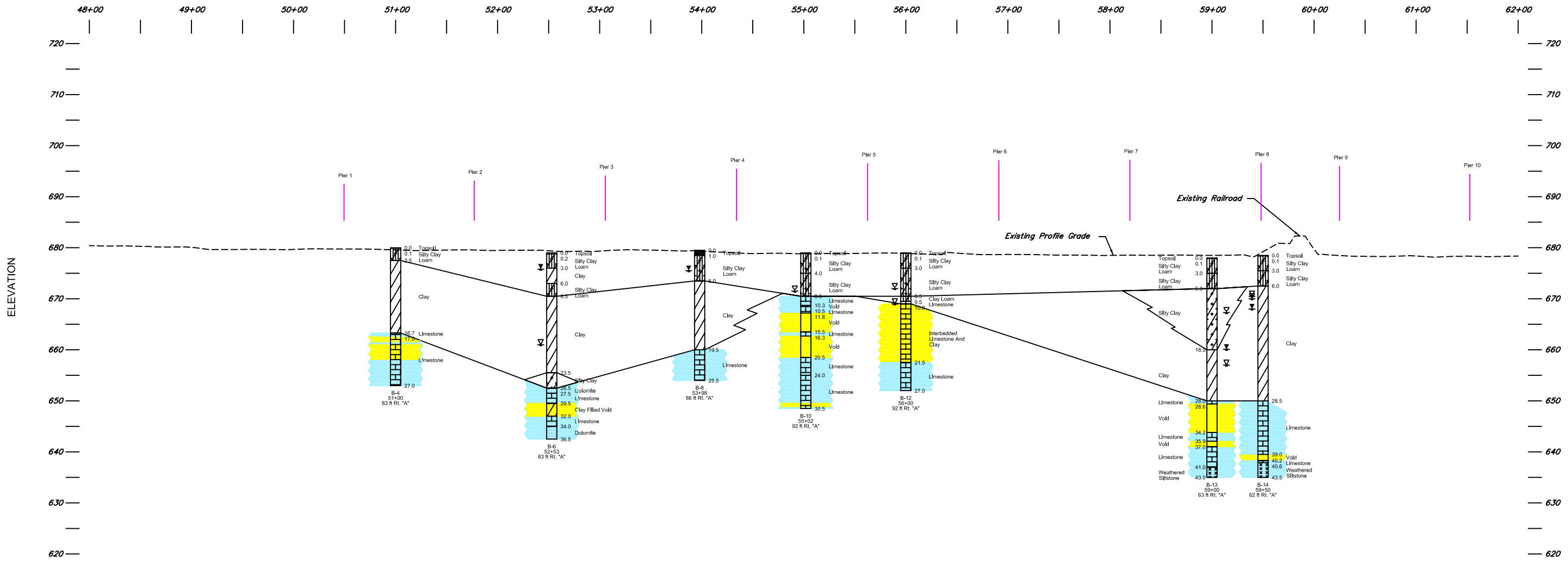
SCALE: 1" = 10' Vert.	CLIENT PROJ NO.: STP-6647 (002)
SCALE: 1" = 50' Horz.	EEI PROJECT NO.: 1-04-132
PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
LOCATION:	Lawrence County, Indiana
CLIENT:	Strand Associates
DES NO.:	

DRAWING NO.: 1-04-132.D3

DRAWING NO.: 1-04-132.D3 DATE: 10-31-05 TIME: 11:31:55

WEST

EAST



SECTION B-B'

TIME: 11:31:55
DATE: 10-31-05
DRAWING NO.: 1-04-132.D4

NOTES:

1. Base map developed from an electronic file provided by Strand Associates, Inc. on April 4, 2004.
2. Refer to the Log of Test Boring (43) and Summary of Sounding In Appendix D for a description of the subsurface conditions encountered at the test boring/sounding locations.
3. Subsurface information shown incorporates interpreted seismic features projected onto each section.
4. All stratigraphic contacts are inferred.
5. Refer to Drawing No. 1-04-132.B2 for section location.

LEGEND

Rock - (Limestone, Dolomite, Sandstone & Siltstone)

Void & Clay-filled void

PROJECT ENGINEER: CRB

DRAWN: JBF

APPROVED BY: SJL

APPROVED BY: SJL

SUBSURFACE PROFILE B-B'

Hamilton Boulevard from SR 37 to Meridian Road

Lawrence County, Indiana

7770 West New York Street
Indianapolis, Indiana 46214-2988
317-273-1690
FAX 317-273-2250

EARTH EXPLORATION

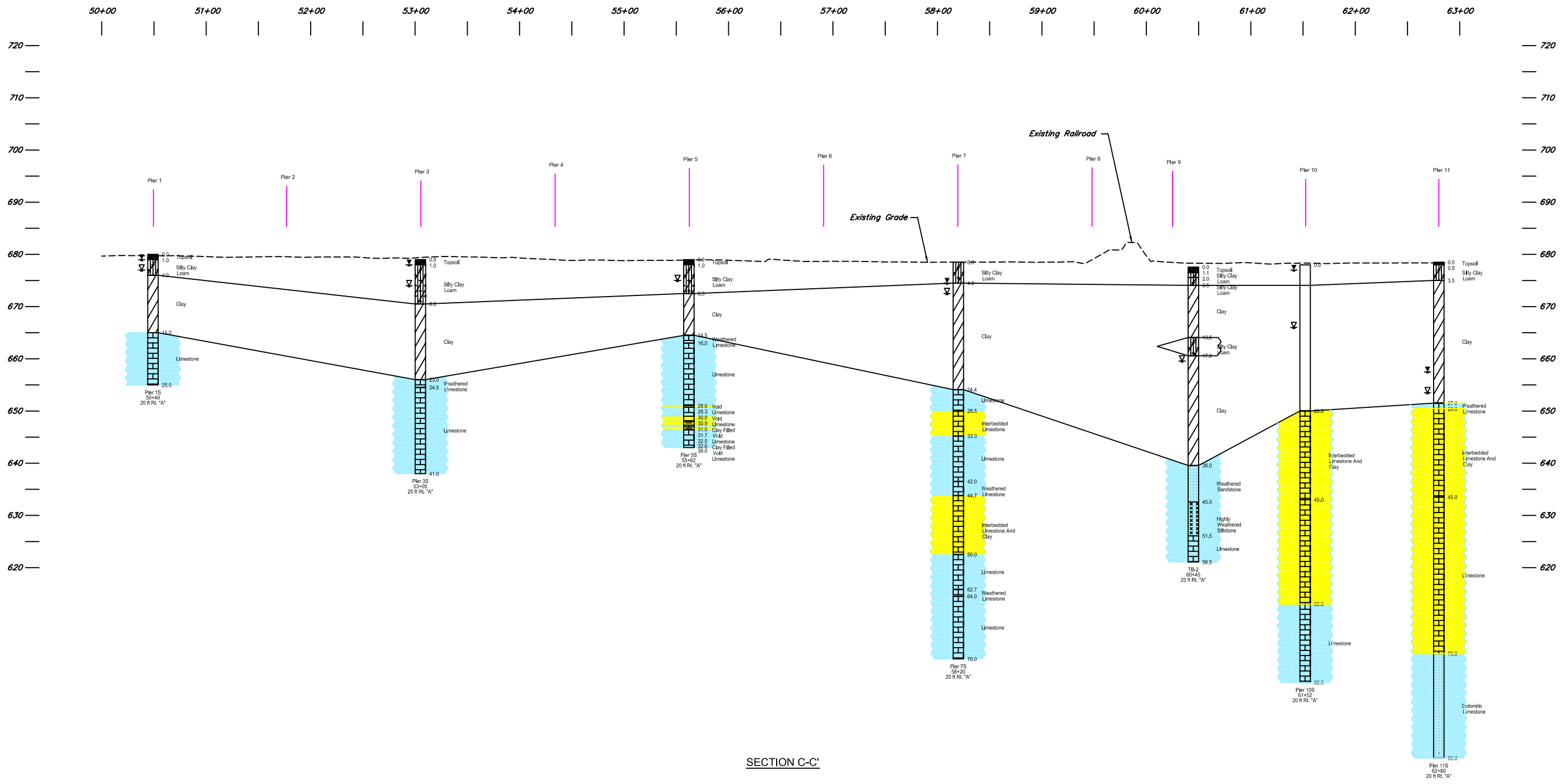
- Geotechnical Engineering
- Materials Engineering and Testing
- Exploratory Field Services

SCALE: 1" = 10' Vert.	CLIENT PROJ NO.: STP-6647 (002)
SCALE: 1" = 50' Horz.	EEI PROJECT NO.: 1-04-132
PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
LOCATION:	Lawrence County, Indiana
CLIENT:	Strand Associates
DES NO.:	

DRAWING NO.: 1-04-132.D4

WEST

EAST



SECTION C-C'

TIME: 12:38:35
DATE: 8-1-06
DRAWING NO.: 1-04-132.D5

NOTES:

1. Base map developed from an electronic file provided by Strand Associates, Inc. on April 4, 2004.
2. Refer to the Log of Test Boring (43) and Summary of Sounding In Appendix D for a description of the subsurface conditions encountered at the test boring/sounding locations.
3. Subsurface information shown incorporates interpreted seismic features projected onto each section.
4. All stratigraphic contacts are inferred.
5. Refer to Drawing No. 1-04-132.B2 for section location.

LEGEND	
Rock - (Limestone, Dolomite, Sandstone & Siltstone)	Void & Clay-filled void

PROJECT ENGINEER: CRB	DRAWN: JBF
APPROVED BY: SJL	APPROVED BY: SJL

SUBSURFACE PROFILE C-C'

Hamilton Boulevard from SR 37 to Meridian Road

Lawrence County, Indiana

7770 West New York Street
Indianapolis, Indiana 46214-2988
317-273-1690
FAX 317-273-2250

EARTH EXPLORATION

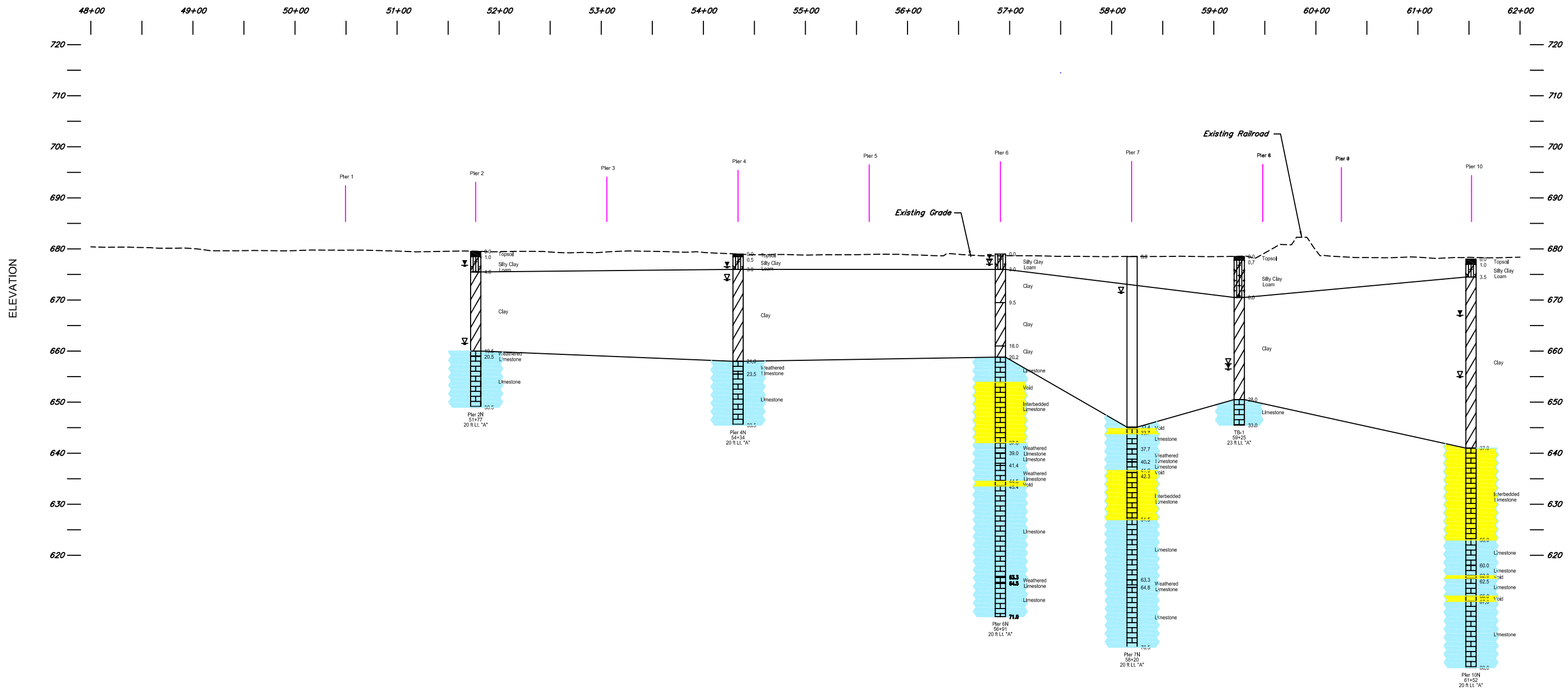
- Geotechnical Engineering
- Materials Engineering and Testing
- Exploratory Field Services

SCALE:1" = 10' Vert.	CLIENT PROJ NO.: STP-6647 (002)
SCALE:1" = 50' Horz.	EEI PROJECT NO.: 1-04-132
PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
LOCATION:	Lawrence County, Indiana
CLIENT:	Strand Associates
DES NO.:	0200775

DRAWING NO.: 1-04-132.D5

WEST

EAST



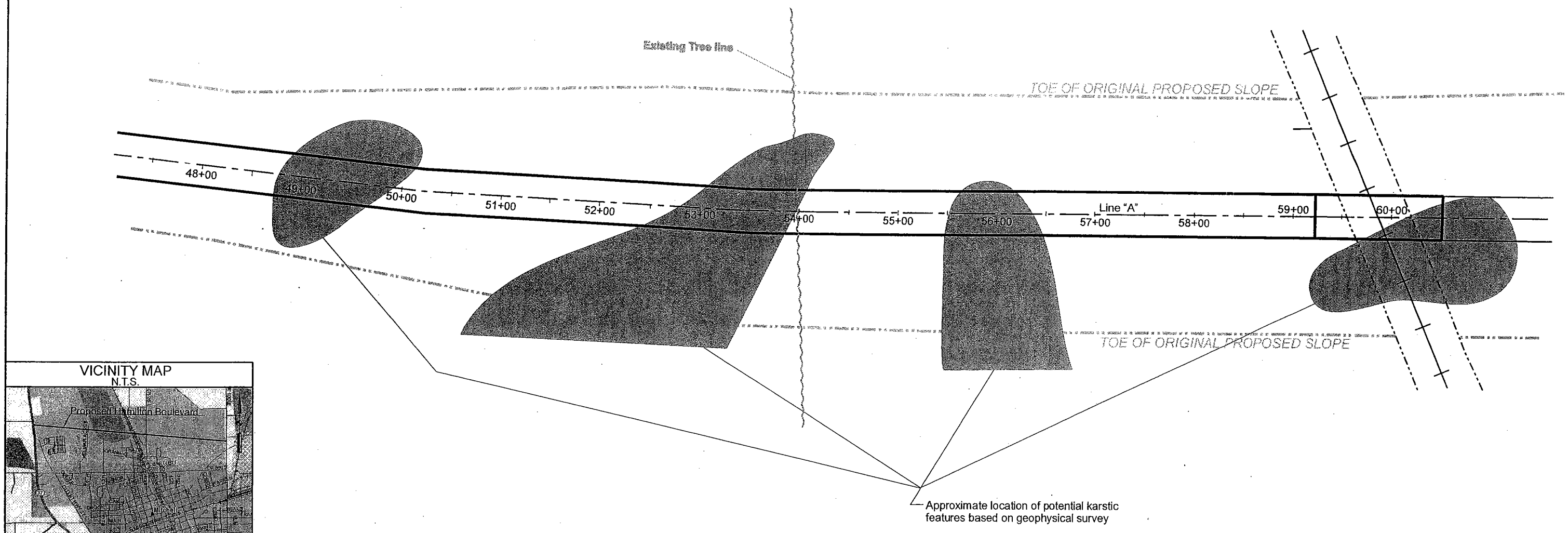
SECTION D-D'

NOTES:

1. Base map developed from an electronic file provided by Strand Associates, Inc. on April 4, 2004.
2. Refer to the Log of Test Boring (43) and Summary of Sounding In Appendix D for a description of the subsurface conditions encountered at the test boring/sounding locations.
3. Subsurface information shown incorporates interpreted seismic features projected onto each section.
4. All stratigraphic contacts are inferred.
5. Refer to Drawing No. 1-04-132.B2 for section location.

LEGEND		SUBSURFACE PROFILE D-D'	SCALE:1" = 10' Vert.	CLIENT PROJ NO.: STP-6647 (002)
Rock - (Limestone, Dolomite, Sandstone & Siltstone)	Void & Clay-filled void	Hamilton Boulevard from SR 37 to Meridian Road Lawrence County, Indiana	SCALE:1" = 50' Horz.	EEI PROJECT NO.: 1-04-132
			PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
PROJECT ENGINEER: CRB	DRAWN: JBF	7770 West New York Street Indianapolis, Indiana 46214-2988 317-273-1690 FAX 317-273-2250 EARTH EXPLORATION • Geotechnical Engineering • Materials Engineering and Testing • Exploratory Field Services	LOCATION:	Lawrence County, Indiana
			CLIENT:	Strand Associates
APPROVED BY: SJL	APPROVED BY: SJL		DES NO.:	
			DRAWING NO.:	1-04-132.D6

TIME: 12:36:35
DATE: 8-1-06
DRAWING NO.: 1-04-132.D6



VICINITY MAP
N.T.S.

LEGEND	NOTES
Interpreted karstic feature	1. Refer to Drawing Nos. 1-04-132.D3, 1-04-132.D4, 1-04-132.D5 and 1-04-132.D6 (i.e. Subsurface Profiles A-A', B-B', C-C' and D-D' respectively) for additional details within and adjacent to these features.

LOCATION OF POTENTIAL KARSTIC FEATURES

PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
DES NO.:	0200775
PROJECT NO.:	STP-6647 (002)
LOCATION:	Lawrence County, Indiana
CLIENT:	Strand Associates, Inc.
EEI PROJECT NO.:	1-04-132
SCALE:	1" = 100'

PROJECT GEOLOGIST:	MJH
APPROVED BY:	MJH
DRAWN BY:	JDR
DATE AND TIME:	1-13-05 8:03:21
DRAWING NUMBER:	1-04-132.B7

EARTH EXPLORATION
7770 West New York Street
Indianapolis, IN 46214-2988
317-273-1690
(FAX) 317-273-2250

APPENDIX D

LOG OF TEST BORING - GENERAL NOTES

LOG OF TEST BORING - ROAD BORINGS (13)

LOG OF TEST BORING - STRUCTURE BORINGS
(Including soundings where cores were taken) (13)

LOG OF TEST BORING - RETAINING WALL BORINGS (3)

LOG OF TEST BORING - EMBANKMENT BORINGS (14)

SUMMARY OF SOUNDINGS

LOG OF TEST BORING - GENERAL NOTES

DESCRIPTIVE SOIL CLASSIFICATION

GRAIN SIZE TERMINOLOGY

Soil Fraction		Particle Size	US Standard Sieve Size
Boulders		Larger than 75 mm	Larger than 3"
Gravel		2.00 to 75 mm	#10 to 75 mm
Sand:	Coarse	0.425 to 2.00 mm	#40 to #10
	Fine	0.075 to 0.425 mm	#200 to #40
Silt		0.002 to 0.075 mm	Smaller than #200
Clay		Smaller than 0.002 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

GENERAL TERMINOLOGY

Physical Characteristics
- Color, moisture, grain shape, fineness, etc.

Major Constituents
- Clay, silt, sand, gravel

Structure
- Laminated, varved, fibrous, stratified, cemented, fissured, etc.

Geologic Origin
- Glacial, alluvial, eolian, residual, etc.

RELATIVE PROPORTIONS OF COHESIONLESS SOILS

Term	Defining Range by % of Weight
Trace	1 - 10%
Little	11 - 20%
Some	21 - 35%
And	36 - 50%

ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	LOI
w/ trace organic matter	1 - 6%
w/ little organic matter	7 - 12%
w/ some organic matter	13 - 18%
Organic Soil (A-8)	19 - 30%
Peat (A-8)	More than 30%

RELATIVE DENSITY

Term	"N" Value
Very loose	0 - 5
Loose	6 - 10
Medium dense	11 - 30
Dense	31 - 50
Very Dense	51+

CONSISTENCY

Term	"N" Value
Very soft	0 - 3
Soft	4 - 5
Med stiff	6 - 10
Stiff	11 - 15
Very Stiff	16 - 30
Hard	31+

PLASTICITY

Term	Plastic Index
None to slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High/Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6-in. penetrations of the 2-in. split-barrel sampler. The sampler is driven with a 140-lb weight falling 30 in. and is seated to a depth of 6 in. before commencing the standard penetration test.

SYMBOLS

DRILLING AND SAMPLING

- AS - Auger Sample
- BS - Bag Sample
- C - Casing: Size 2½", NW; 4", HW
- COA - Clean-Out Auger
- CS - Continuous Sampling
- CW - Clear Water
- DC - Driven Casing
- DM - Drilling Mud
- FA - Flight Auger
- FT - Fish Tail
- HA - Hand Auger
- HSA - Hollow Stem Auger
- NR - No Recovery
- PMT - Borehole Pressuremeter Test
- PT - 3" O.D. Piston Tube Sample
- PTS - Peat Sample
- RB - Rock Bit
- RC - Rock Coring
- REC - Recovery
- RQD - Rock Quality Designation
- RS - Rock Sounding
- S - Soil Sounding
- SS - 2" O.D. Split-Barrel Sample
- 2ST - 2" O.D. Thin-Walled Tube Sample
- 3ST - 3" O.D. Thin-Walled Tube Sample
- VS - Vane Shear Test
- WPT - Water Pressure Test

LABORATORY TESTS

- qp - Penetrometer Reading, tsf
- qu - Unconfined Strength, tsf
- W - Moisture Content, %
- LL - Liquid Limit, %
- PL - Plastic Limit, %
- PI - Plasticity Index
- SL - Shrinkage Limit, %
- LOI - Loss on Ignition, %
- γ - Dry Unit Weight, pcf
- pH - Measure of Soil Alkalinity/Acidity

WATER LEVEL MEASUREMENT

- BF - Backfilled upon Completion
- NW - No Water Encountered

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

EARTH EXPLORATION Inc.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-1
Elevation 701.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 65° F	Driller	J.M.
Des. No.	0200775	Station	12+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						SAND AND GRAVEL, (fill)							
SS-1	X	45	3-8-8		700	**SILTY CLAY LOAM**, very stiff, moist, reddish brown, (fill), A-7-6, Lab No. 6168SL	1.5			18.0			
SS-2	X	100	3-6-6			**SAND**, medium dense, moist, gray, (fill; visual)							
				▽ 5									
SS-3	X	100	1-2-3		695	**SILTY CLAY LOAM**, soft to medium stiff, moist, brown to reddish brown below 8½', (residual soil), A-6, Lab No. 6167SL	1.0			20.8			
SS-4	X	100	2-3-4				2.25			19.1			
				10		End of Boring at 10 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	5½	NW	NW
To Cave-in		8½	8½

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

GENERAL NOTES

Start 5/3/04 End 5/3/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-2
Elevation 690.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 65° F	Driller	J.M.
Des. No.	0200775	Station	18+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (4 in.)							
SS-1	X	100	1-2-3			**SILTY CLAY LOAM**, soft to medium stiff, moist, brown to reddish brown below 3', A-6, Lab No. 6167SL	1.5			25.1			
SS-2	X	100	3-4-5				>4.5			19.0			
				5	685								
						SILTY CLAY LOAM, medium stiff, moist, reddish brown, (residual soil), A-6, Lab No. 6927SL							
SS-3	X	95	2-3-5				3.5			22.0			
						CLAY, medium stiff, moist, reddish brown, (residual soil), A-7-6, Lab No. 6166SL							
SS-4	X	80	7-10-12			**SILTY CLAY LOAM**, very stiff, moist, reddish brown, with limestone fragments (residual soil), A-7-6, Lab No. 6168SL	2.75			17.6			
				10	680								
						End of Boring at 10 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		8	8

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

GENERAL NOTES

Start 5/3/04 End 5/3/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-3
Elevation 686.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 65° F	Driller	J.M.
Des. No.	0200775	Station	23+60	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					685	**TOPSOIL**, (4 in.)							
SS-1	X	100	2-3-6			**SILTY CLAY LOAM**, medium stiff to stiff, moist, reddish brown and gray, A-6, Lab No. 6927SL	2.25			24.1			
SS-2	X	100	3-5-6	5			1.75			19.6			
					680	**SILTY CLAY LOAM**, stiff, moist, mottled dark gray and brown, A-6, Lab No. 6167SL							
SS-3	X	100	3-6-9				>4.5			17.8			
SS-4	X	45	16-27-42	10		**SILTY CLAY LOAM**, hard, moist, reddish brown, with frequent limestone and rock fragments, (residual soil), A-7-6, Lab No. 6168SL	---			---			
					675	**CLAY**, stiff, moist, reddish brown, with trace limestone fragments (residual soil), A-7-6, Lab No. 6166SL							
SS-5	X	70	3-5-6	15			2.25			40.4			
						End of Boring at 15 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		12½	12½

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

GENERAL NOTES

Start 5/3/04 End 5/3/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-4
Elevation 682.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Partly Sunny, 60° F	Driller	J.M.
Des. No.	0200775	Station	30+40	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (5 in.)							
SS-1		45	1-2-3			**SILTY CLAY LOAM**, soft, moist, brown and gray, with trace roots, A-6, Lab No. 6167SL	1.5			24.7			
					680	**SILTY CLAY LOAM**, soft to very stiff, moist, brown and gray, A-6, Lab No. 6927SL							
SS-2		100	3-7-19	5		**SILTY CLAY LOAM**, very stiff, moist, reddish brown, with frequent limestone fragments, (residual soil), A-7-6, Lab No. 6168SL	4.5			11.2			
SS-3		70	4-7-9		675		3.25			32.6			
SS-4		90	5-5-5	10		**CLAY**, very stiff to medium stiff, moist, reddish brown, (residual soil), A-7-6, Lab No. 6166SL	3.25			34.9			
					670	**WEATHERED LIMESTONE**							
SS-5		100	50/.2			End of Boring at 13.7 ft Auger refusal at 13.7 ft							

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	24 hrs After Drilling
To Water	12½	NW	4
To Cave-in		12	11½

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

GENERAL NOTES

Start 5/3/04 End 5/3/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-5
Elevation 684.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 65° F	Driller	J.M.
Des. No.	0200775	Station	37+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (4 in.)							
SS-1		70	3-4-4			**SILTY CLAY LOAM**, medium stiff, moist, light brown, A-6, Lab No. 6167SL	>4.5			21.5			
SS-2		100	3-4-5	5	680	**SILTY CLAY LOAM**, medium stiff, moist, brown and gray, A-6, Lab No. 6927SL	1.5			24.6			
SS-3		50	5-15-12			**SILTY CLAY LOAM**, very stiff, moist, reddish brown, with frequent limestone fragments, (residual soil), A-7-6, Lab No. 6168SL	---			---			
SS-4		70	3-5-5	10	675	**CLAY**, medium stiff to stiff, moist, reddish brown to brown below 14', with occasional limestone fragments (residual soil), A-7-6, Lab No. 6166SL	1.75			34.9			
SS-5		100	3-5-6	15	670		1.0			32.3			
						End of Boring at 15 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	14	NW	2½
To Cave-in		12½	12

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

GENERAL NOTES

Start 5/3/04 End 5/3/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-6
Elevation 683.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 65° F	Driller	J.M.
Des. No.	0200775	Station	45+50	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (4 in.)							
SS-1	X	100	1-2-3			**SILTY CLAY LOAM**, soft, moist, light brown, with trace roots, A-6, Lab No. 6167SL	1.5			24.2			
					680								
SS-2	X	100	3-5-7	5			4.0			19.7			
						SILTY CLAY LOAM, stiff to medium stiff, moist, brown to reddish brown and brown below 5½', (residual soil), A-6, Lab No. 6927SL							
SS-3	X	100	3-5-7				>4.5			24.2			
					675								
SS-4	X	100	3-4-5	10			3.0			24.7			
						End of Boring at 10 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	NW	2
To Cave-in		7½	7

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

GENERAL NOTES

Start 5/3/04 End 5/3/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-7
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 84° F	Driller	J.M.
Des. No.	0200775	Station	69+13	Offset	8 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (5 in.)							
SS-1		45	1-2-4			**SILTY CLAY LOAM**, medium stiff, moist, light brown, with trace roots, A-6, Lab No. 6167SL	2.5			26.4			
					675								
SS-2		100	4-4-4	5		**SILTY CLAY LOAM**, medium stiff to stiff, moist, brown and gray, A-6, Lab No. 6927SL	2.5			21.2			
SS-3		100	4-6-8				4.5			18.4			
					670								
SS-4		45	11-10-14	10		**CLAY LOAM with Some Gravel**, very stiff, moist, reddish brown, with frequent limestone fragments (visual; residual soil)	---			---			
					665								
SS-5		100	3-4-6	15		**CLAY**, medium stiff to hard, moist, reddish brown to brown below 19', with limestone fragments (residual soil), A-7-6(84), Lab No. 6166SL	3.5			38.9	104	27	77
					660								
SS-6		45	3-8-50/.2	20			1.5			35.5			
					655								
SS-7		60	17-38-50/.1				---			---			
						End of Boring at 24.6 ft							

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		18	18

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

GENERAL NOTES

Start 5/6/04 End 5/6/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **RB-8**
Elevation **675.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **1**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 84° F	Driller	J.M.
Des. No.	0200775	Station	76+25	Offset	21 ft Rt. "A"	Inspector	---

No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					675	**TOPSOIL**, (6 in.)							
SS-1	X	70	3-3-5			**SILTY CLAY LOAM**, medium stiff, moist, light brown, A-6(18), Lab No. 6167SL	2.75			20.9	37	18	19
SS-2	X	100	3-6-8	5	670	**SILTY CLAY LOAM**, stiff, moist, brown, A-6, Lab No. 6927SL	4.25			19.1			
SS-3	X	45	6-9-7			**SILTY CLAY LOAM**, very stiff, moist, reddish brown, with frequent limestone fragments (residual soil), A-7-6, Lab No. 6168SL	2.5			27.8			
SS-4	X	80	3-6-8	10	665	**CLAY**, stiff, moist, brown and gray, with limestone fragments, (residual soil), A-7-6, Lab No. 6166SL	2.25			26.5			
SS-5	X	100	6-7-7	15	660	**CLAY**, stiff to medium stiff, moist, reddish brown, with limestone fragments (residual soil), A-7-6, Lab No. 6166SL	3.75			37.3			
SS-6	X	100	3-5-5	20	655		2.0			27.0			
SS-7	X	45	4-7-7	25			1.75			34.5			
						End of Boring at 25 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ 24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		21	21

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

GENERAL NOTES

Start **5/6/04** End **5/6/04** Rig **D120 ATV**
Drilling Method **3¼" I.D. HSA**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface.**

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-9
Elevation 674.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 82° F	Driller	J.M.
Des. No.	0200775	Station	83+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (6 in.)							
SS-1	X	70	3-5-6			**SILTY CLAY LOAM**, stiff, moist, light brown, A-6, Lab No. 6167SL	3.5			19.3			
SS-2	X	100	3-5-8		670		3.75			18.6			
				5		**SILTY CLAY LOAM**, stiff, moist, brown, A-6, Lab No. 6927SL							
SS-3	X	100	3-5-7				1.75			22.1			
						End of Boring at 7.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		4½	4½

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

GENERAL NOTES

Start 5/6/04 End 5/6/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-10
Elevation 668.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 82° F	Driller	J.M.
Des. No.	0200775	Station	91+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (6 in.)							
SS-1	X	45	2-4-8			**SILTY CLAY LOAM**, stiff, moist, brown, A-6, Lab No. 6167SL	---			21.0			
					665								
SS-2	X	100	4-6-9	5			4.0			19.0			
						SILTY CLAY LOAM, stiff, moist, brown, A-6, Lab No. 6927SL							
SS-3	X	70	3-6-8				3.5			18.8			
					660								
SS-4	X	100	4-5-7	10			4.25			18.1			
						End of Boring at 10 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		8	8

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

GENERAL NOTES

Start 5/6/04 End 5/6/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-11
Elevation 656.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 75° F	Driller	J.M.
Des. No.	0200775	Station	97+50	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (6 in.)							
SS-1	X	45	1-2-2		655		2.25			23.0			
SS-2	X	70	1-2-3				1.25			21.0			
				5		**SILTY CLAY LOAM**, soft to very soft, moist, dark brown, with trace organic matter and large root matter (fill), A-6, Lab No. 6167SL							
SS-3	X	80	1-1-2		650		0.25			39.6			
SS-4	X	70	1-2-2				1.0			21.2			
				10									
SS-5	X	80	3-3-6		645	**SILTY CLAY LOAM**, medium stiff, moist, brown, A-6, Lab No. 6167SL	1.5			46.4			
SS-6	X	90	2-3-4				1.75			33.7			
				15									
					640	**CLAY**, medium stiff to very stiff, moist, reddish brown, with slightly weathered limestone layer near 18' (residual soil), A-7-6, Lab No. 6166SL							
SS-7	X	55	21-20-10				---			---			
				20									
					635								
SS-8	X	65	1-1-2			**SILTY CLAY LOAM**, very soft to very stiiff, moist, brown, with frequent weathered limestone fragments, (residual soil), A-7-6(22), Lab No. 6168SL	1.0			24.7	43	15	28
				25									
					630								
SS-9	X	50	48-13-5				---			---			
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	20	11	7
To Cave-in		31	25

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

GENERAL NOTES

Start 5/5/04 End 5/5/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **RB-11**
Elevation **656.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 75° F	Driller	J.M.
Des. No.	0200775	Station	97+50	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					625	**SILTY CLAY LOAM**, very soft to very stiiff, moist, brown, with frequent weathered limestone fragments, (residual soil), A-7-6(22), Lab No. 6168SL							
SS-10	X	50	8-3-50/.2				0.25			25.8			
						End of Boring at 34.7 ft							
						Auger refusal at 34.7 ft							

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

EARTH EXPLORATION Inc.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **RB-12**
Elevation **664.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **1**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 75° F	Driller	J.M.
Des. No.	0200775	Station	104+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (5 in.)							
SS-1	X	100	2-4-7			**SILTY CLAY LOAM**, stiff, moist, brown and gray, A-6, Lab No. 6927SL	2.5			22.3			
SS-2	X	100	4-6-9	5	660	**CLAY**, stiff to very stiff, moist, reddish brown, with occasional limestone fragments (residual soil), A-7-6, Lab No. 6166SL	>4.5			26.8			
SS-3	X	100	4-7-12				4.25			31.1			
SS-4	X	100	2-3-9	10	655		4.25			30.6			
						End of Boring at 10 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	NW	NW
To Cave-in		8	7½

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

GENERAL NOTES

Start **5/5/04** End **5/5/04** Rig **D120 ATV**
Drilling Method **3¼" I.D. HSA**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface.**

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RB-13
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (12 in.)							
SS-1	X	45	2-2-2		675		1.75			25.2			
SS-2	X	80	2-2-4	5		**SILTY CLAY LOAM**, soft to medium stiff, moist, brown and gray, A-6, Lab No. 6927SL	1.25			22.3			
SS-3	X	65	2-3-4				1.5			21.3			
SS-4	X	90	3-3-8	10	670	**CLAY**, stiff, moist, gray, with limestone fragments, (residual soil), A-7-6, Lab No. 6166SL	1.5			21.2			
SS-5	X	45	6-6-8	15	665		---			23.0			
SS-6	X	85	4-6-6	20	660	**CLAY**, stiff to very soft, moist, reddish brown, with frequent limestone fragments (residual soil), A-7-6, Lab No. 6166SL	2.5			29.6			
SS-7	X	90	4-3-4	25	655		1.25			40.8			
SS-8	X	45	1-0-1	30	650		---			---			

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	NW	NW	BF
To Cave-in		23	

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

GENERAL NOTES

Start 5/11/04 End 5/11/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

EARTH EXPLORATION Inc

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

Boring No. **RB-13**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+00	Offset	C.L. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
SS-9	X	80	3-3-5		645	**CLAY**, stiff to very soft, moist, reddish brown, with frequent limestone fragments (residual soil), A-7-6, Lab No. 6166SL	1.0			26.2			
				35		**WEATHERED SANDSTONE**, brown, (visual)							
						End of Boring at 37 ft							
						Auger refusal at 37 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. TB-1
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	59+25	Offset	23 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (8 in.)							
SS-1		80	2-2-3		675	**SILTY CLAY LOAM**, soft to stiff, moist, brown and gray, with trace roots, A-6(10), Lab No. 6927SL	1.5			26.5			
SS-2		90	3-4-5	5			1.75			19.7			
SS-3		85	5-6-6				2.5			21.6			
SS-4		80	3-4-5		670		2.0			21.8			
				10									
SS-5		80	3-9-5		665		2.25			21.2			
				15		**CLAY**, stiff to very soft, moist, brown and gray to reddish brown below 13', with occasional limestone fragments (residual soil), A-7-6, Lab No. 6166SL							
SS-6		70	2-4-7		660		2.5			29.8			
				20									
SS-7		45	1-0-1		655		---			---			
				25									
					650								
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	21	22	BF
To Cave-in		25½	

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

GENERAL NOTES

Start 5/10/04 End 5/10/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **TB-1**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	**STP-6647 (002)**	Struct. No.	---	Weather	**Sunny 80° F**	Driller	**J.M.**
Des. No.	**0200775**	Station	**59+25**	Offset	**23 ft Lt. "A"**	Inspector	---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES						
No.	Type	Rec %	Blow Counts	Depth ft / Elev		q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-1		85	RQD=37%	645	**LIMESTONE**, low bedding plane angles, very hard to moderately hard, fine grained, gray to brown and gray below 30.5', with vertical fractures from 29.4' - 30', highly fractured from 30.5' to 31.5' and mud seam from 32' to 32.3'							
					End of Boring at 33 ft							
					Auger refusal at 28 ft Bag sample (BS-1) obtained from 1 to 3 ft in offset boring TB-1A. LL = 30%, PL = 19%, PI = 11%							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. TB-2
Elevation 678.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 72° F	Driller	J.M.
Des. No.	0200775	Station	60+45	Offset	25 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (13 in.)							
SS-1		55	1-2-3		675	**SILTY CLAY LOAM**, soft, moist, brown, with trace roots, A-6, Lab No. 6167SL	0.75			29.3			
						SILTY CLAY LOAM, soft, moist, brown and gray, A-6, Lab No. 6927SL							
SS-2		100	3-4-6	5			3.0			22.9			
SS-3		100	2-3-5		670		2.5			24.3			
SS-4		100	2-3-3	10		**CLAY**, medium stiff, moist, brown and gray, A-7-6, Lab No. 6166SL	1.75	1.15	102.5	23.1			
					665								
SS-5		100	1-2-3	15		**SILTY CLAY LOAM**, soft, moist, brown, A-6, Lab No. 6927SL	1.25			26.7			
					660								
SS-6		100	2-3-4	20			1.75			21.4			
					655	**CLAY**, medium stiff to very soft, moist, reddish brown to reddish brown and tan below 33½', with occasional limestone fragments (residual soil), A-7-6, Lab No. 6166SL							
SS-7		50	3-4-6	25			1.75			22.1			
					650								
SS-8		45	1-2-3	30			0.75			37.3			

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	24 hrs After Drilling
To Water	18	NW	NW
To Cave-in		16½	11½

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

GENERAL NOTES

Start 5/4/04 End 5/4/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **TB-2**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 72° F	Driller	J.M.
Des. No.	0200775	Station	60+45	Offset	25 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					645								
SS-9		70	1-1-1	35		**CLAY**, medium stiff to very soft, moist, reddish brown to reddish brown and tan below 33½', with occasional limestone fragments (residual soil), A-7-6, Lab No. 6166SL	---			36.2			
					640								
SS-10		45	33-13-6	40									
					635	**WEATHERED SANDSTONE**, soft, brown, with occasional clay seams							
SS-11		100	13-36-20	45									
					630	**HIGHLY WEATHERED SILTSTONE**, soft, light brown							
SS-12		100	17-29-31	50									
					625								
RC-1		90	RQD=28%	55		**LIMESTONE**, low bedding plane angles, very hard to hard, fine grained, gray, with clay seam at 52' - 52.2', weathered from 52.3' - 52.5', vuggy from 53.5' - 54.5', highly fractured from 54.5' - 55'							
						End of Boring at 56.5 ft Auger refusal at 51.5 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 1S
Elevation 680.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	50+49	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0		**TOPSOIL**, (12 in.)							
SS-1		55	1-1-2			**SILTY CLAY LOAM**, very soft to soft, moist, gray and brown, A-7-6, Lab No. 6168SL	0.75			28.1			
SS-2		65	2-2-2	5	675		1.25			29.3			
SS-3		45	2-3-3				2.0			25.4			
SS-4		100	3-3-5	10	670	**CLAY**, soft to hard, moist, brown and gray, with occasional boulders below 13', A-7-6, Lab No. 6166SL	3.25			22.7			
SS-5		45	3-36-50	15	665		1.0			24.7			
RC-1		100	RQD=70%			**LIMESTONE**, low bedding planes, hard to very hard, fine grained, gray, with trace chert below 21½', vertical fracture near 17.5' to 17.8'							
RC-2		100	RQD=65%	20	660								
				25	655	End of Boring at 25 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	3	1*	BF
To Cave-in		11	

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

GENERAL NOTES

Start 6/6/06 End 6/6/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 2N
Elevation 679.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	51+77	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (12 in.)							
SS-1		100	2-2-3			**SILTY CLAY LOAM**, soft, moist, gray and brown, A-7-6, Lab No. 6168SL	1.0			30.9			
SS-2		100	2-2-2	5	675		1.25			27.6			
SS-3		100	2-3-3				2.5			23.5			
SS-4		90	3-4-14	10	670		2.0			25.9			
						CLAY, very soft to hard, moist, brown and gray to reddish brown and gray, with chert and limestone fragments below 10', A-7-6, Lab No. 6166SL							
SS-5		55	5-6-6	15	665		1.0			24.5			
SS-6		45	0-0-50	20	660		<0.25			46.2			
						WEATHERED LIMESTONE, soft, moist, gray							
RC-1		100	RQD=38%	25	655	**LIMESTONE**, low bedding planes, moderately hard to hard, fine grained, brown and gray to gray below 22.5', slightly weathered to 22.5', with vertical fractures near 22.2' to 2.4' and 23.9' to 24.3', trace vugs near 21.8'							
RC-2		100	RQD=93%	30	650								
						End of Boring at 30.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	18	2½*	BF
To Cave-in		16½	

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

GENERAL NOTES

Start 5/31/06 End 6/1/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 3S
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	53+05	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0		**TOPSOIL**, (12 in.)							
SS-1		45	1-1-2				0.5			31.1			
SS-2		45	2-3-4		675	**SILTY CLAY LOAM**, very soft to medium stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	2.0			20.4			
SS-3		45	3-3-4	5			2.0			21.7			
SS-4		90	4-4-12		670		1.75			23.3			
SS-5		45	4-7-7	10	665	**CLAY**, very stiff to very soft, moist, brown and gray to reddish brown below 12' to gray and brown below 18½', A-7-6, Lab No. 6166SL	1.0			28.3			
SS-6		35	0-1-1	15	660		<0.25			32.8			
SS-7		50	7-50/.4	20	655	**WEATHERED LIMESTONE**, soft to moderately hard, gray							
RC-1		100	RQD=100%	25		**LIMESTONE**, low bedding planes, very hard to hard, fine grained, gray, with bands of weathered limestone near 32.2' to 32.4' and 38.6' to 39', vertical fracture from near 39.1' to 39.4' and 40' to 40.8'							
RC-2		100	RQD=88%	30	650								

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	5	1*	BF
To Cave-in		12	

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

GENERAL NOTES

Start 5/25/06 End 5/25/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 3S**
Elevation **679.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	**STP-6647 (002)**	Struct. No.	---	Weather	**Sunny 80° F**	Driller	**J.M.**
Des. No.	**0200775**	Station	**53+05**	Offset	**20 ft Rt. "A"**	Inspector	**---**

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-3		100	RQD=55%	35	645	**LIMESTONE**, low bedding planes, very hard to hard, fine grained, gray, with bands of weathered limestone near 32.2' to 32.4' and 38.6' to 39', vertical fracture from near 39.1' to 39.4' and 40' to 40.8'							
RC-4		100	RQD=54%	40	640								
						End of Boring at 41 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 4N
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	J.M.
Des. No.	0200775	Station	54+34	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (6 in.)							
SS-1		55	0-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-7-6, Lab No. 6168SL	0.25			36.1			
SS-2		45	3-3-3	5	675		1.5			23.4			
SS-3		100	3-3-5				<0.25			22.5			
SS-4		55	3-3-4	10	670		1.5			28.9			
						CLAY, medium stiff to stiff, moist, brown and gray to reddish brown below 12', with chert near 19', A-7-6, Lab No. 6166SL							
SS-5		65	3-5-6	15	665		2.5			35.2			
SS-6		45	3-3-4	20	660		0.75			32.4			
						WEATHERED LIMESTONE, moderately hard, gray							
RC-1		100	RQD=80%	25	655	**LIMESTONE**, low bedding planes, very hard to hard, fine grained, gray, with vertical fracture near 31' to 31.5', weathered and moderately hard from near 33' to 33.5'							
RC-2		100	RQD=85%	30	650								

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	5	2½*	BF
To Cave-in		21½	

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

GENERAL NOTES

Start 5/23/06 End 5/24/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 4N**
Elevation **679.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	**STP-6647 (002)**	Struct. No.	---	Weather	**Sunny 70° F**	Driller	**J.M.**
Des. No.	**0200775**	Station	**54+34**	Offset	**20 ft Lt. "A"**	Inspector	---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES						
No.	Type	Rec %	Blow Counts	Depth ft / Elev		q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					LIMESTONE, low bedding planes, very hard to hard, fine grained, gray, with vertical fracture near 31' to 31.5', weathered and moderately hard from near 33' to 33.5'							
RC-3		100	RQD=60%									
				645	End of Boring at 33.5 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 5S
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	J.M.
Des. No.	0200775	Station	55+62	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (12 in.)							
SS-1		45	1-2-1				0.75			35.7			
						SILTY CLAY LOAM, very soft, moist, brown and gray, A-7-6, Lab No. 6168SL							
SS-2		50	1-1-2	▽ 5	675		0.25			38.6			
SS-3		55	0-2-2				1.5			27.5			
SS-4		100	2-4-5	10	670		2.25			26.3			
						CLAY, soft to hard, moist, brown and gray, A-7-6, Lab No. 6166SL							
SS-5		45	4-8-24	15	665		2.0			27.0			
						WEATHERED LIMESTONE, soft to moderately hard, gray and brown							
RC-1		100	RQD=39%	20	660								
RC-2		100	RQD=48%	25	655	**LIMESTONE**, low bedding planes, very hard to hard, fine grained, gray							
RC-3		73	RQD=30%	30	650								
						VOID							
						LIMESTONE, low bedding planes, very hard to hard, fine grained, gray							

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	4	1½*	BF
To Cave-in		9	

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

GENERAL NOTES

Start 5/19/06 End 5/19/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 5S**
Elevation **679.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	J.M.
Des. No.	0200775	Station	55+62	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						VOID							
RC-4		60	RQD=35%		645	**LIMESTONE**, low bedding planes, very hard to hard, fine grained, gray							
						CLAY FILLED VOID							
						LIMESTONE, low bedding planes, very hard to hard, fine grained, gray							
				35		**CLAY FILLED VOID**							
						LIMESTONE, low bedding planes, very hard to hard, fine grained, gray, with vertical fracture from 35' to 36'							
						End of Boring at 36 ft							

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

LOG OF TEST BORING

EARTH EXPLORATION Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

Boring No.: **Pier 6N**
Elevation: **679.0**
Datum: **USC & GS**
EEI Proj. No.: **1-04-132**
Sheet: **1** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Rainy 55° F	Driller	C.N.
Des. No.	0200775	Station	56+91	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
SS-1		80	1-0-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-7-6, Lab No. 6168SL	0.25			32.3			
SS-2		90	1-3-4		675		2.0			23.3			
				5									
SS-3		100	2-3-4			**CLAY**, medium stiff to very stiff, moist, brown and gray, A-7-6, Lab No. 6166SL	2.0			23.5			
SS-4		80	2-5-13		670		1.5			26.0			
				10									
SS-5		80	3-5-6		665	**CLAY**, very stiff to stiff, moist, reddish brown, with chert fragments near 9½' to 10', A-7-6, Lab No. 6166SL	3.25			26.2			
				15									
SS-6		90	1-2-2		660	**CLAY**, soft, moist, brown and gray, A-7-6, Lab No. 6166SL	0.75			40.3			
				20									
RC-1		46	RQD=0%			**LIMESTONE**, low bedding planes, very hard, fine grained, gray							
RC-2		45	RQD=40%		655								
				25		**VOID**							
RC-3		38	RQD=28%										
						INTERBEDDED LIMESTONE, low bedding planes, very hard, fine grained, gray							
RC-4		25	RQD=0%		650								
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	2	1*	BF
To Cave-in		12	

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

GENERAL NOTES

Start **5/11/06** End **5/15/06** Rig **CME 45C**
Drilling Method **3¼" I.D. HSA ATV**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.**

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 6N**
Elevation **679.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Rainy 55° F	Driller	C.N.
Des. No.	0200775	Station	56+91	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-5		80	RQD=30%	35	645	**INTERBEDDED LIMESTONE**, low bedding planes, very hard, fine grained, gray							
RC-6		80	RQD=45%	40	640	**VOID** **WEATHERED LIMESTONE**, low bedding planes, soft to moderately hard, fine grained, yellowish gray **LIMESTONE**, low bedding planes, hard, fine grained, gray, with band of weathered limestone near 39.5' to 39.7'							
RC-7		66	RQD=60%	45	635	**WEATHERED LIMESTONE**, low bedding planes, soft to moderately hard, fine grained, yellowish gray **VOID**							
RC-8		90	RQD=55%	50	630	**LIMESTONE**, low bedding planes, hard to moderately hard, fine to medium grained, gray, vuggy, with occasional small voids and vertical fractures from near 56' to 61'							
RC-9		60	RQD=33%	55	625								
RC-10		65	RQD=30%	60	620								
RC-11		98	RQD=65%										

Continued Next Page

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

LOG OF TEST BORING

Project **Hamilton Blvd from SR 37 to Meridian Road**
Location **Mitchell, Lawrence County, Indiana**
Client **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 6N**
Elevation **679.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **3** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Rainy 55° F	Driller	C.N.
Des. No.	0200775	Station	56+91	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES						
No.	Type	Rec %	Blow Counts	Depth ft / Elev		q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				615 / 65	**WEATHERED LIMESTONE**, low bedding planes, soft to moderately hard, fine grained, yellowish gray							
RC-12		95	RQD=50%	610 / 70	**LIMESTONE**, low bedding planes, hard, fine to medium grained, brownish gray, with vertical fractures from near 68' to 70'							
					End of Boring at 71 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 7S
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 3

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather		Driller	C.N.
Des. No.	0200775	Station	58+20	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
SS-1		100	0-1-1			**SILTY CLAY LOAM**, very soft to medium stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	1.0			28.5			
SS-2		100	1-2-4		675		1.25			22.9			
SS-3		100	2-3-5	5			2.75			24.4			
SS-4		100	2-5-7		670		2.25			26.1			
SS-5		100	2-5-5	10	665	**CLAY**, medium stiff to hard, moist, brown and gray to dark brown below 9' to reddish brown below 11', with chert fragments near 14', A-7-6, Lab No. 6166SL	1.5			39.4			
SS-6		100	2-4-4	15	660		1.75			30.4			
SS-7		50	4-50	20	655		<0.25			48.2			
RC-1		92	RQD=100%	25		**LIMESTONE**, low bedding planes, very hard to hard, fine grained, gray							
RC-2		44	RQD=58%	30	650								

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	6	4*	BF
To Cave-in		9	

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

GENERAL NOTES

Start 5/3/06 End 5/4/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 7S**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather		Driller	C.N.
Des. No.	0200775	Station	58+20	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft / Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					INTERBEDDED LIMESTONE, low bedding planes, very soft to moderately hard, fine to medium grained, reddish brown and gray, with clay seams and voids							
RC-3		60	RQD=7%	645 / 35	**LIMESTONE**, low bedding planes, hard to moderately hard, fine grained, gray, slightly weathered, fractured and broken from near 34.3' to 38', vertical fracture from near 41' to 41.5'							
RC-4		60	RQD=38%	640 / 40								
					WEATHERED LIMESTONE, low bedding planes, very soft, fine grained, yellowish gray							
RC-5		50	RQD=20%	635 / 45								
					INTERBEDDED LIMESTONE and CLAY, low bedding planes, moderately hard to hard, gray with frequent voids throughout							
RC-6		100	RQD=0%	630 / 50								
				625 / 55								
RC-7		100	RQD=47%	620 / 60	**LIMESTONE**, low bedding planes, moderately hard to hard, fine to medium grained, gray, vuggy							
RC-8		100	RQD=33%	615	**WEATHERED LIMESTONE**, low bedding							

Continued Next Page

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

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 7S**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **3** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather		Driller	C.N.
Des. No.	0200775	Station	58+20	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				65		planes, soft, fine grained, yellowish gray							
RC-9		100	RQD=38%	610		**LIMESTONE**, low bedding planes, hard, fine to medium grained, gray, with few vugs to near 66'							
				70									
RC-10		87	RQD=58%	605									
				75									
						End of Boring at 76 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 7N
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 3

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 68° F	Driller	C.N.
Des. No.	0200775	Station	58+20	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES						
No.	Type	Rec %	Blow Counts	Depth ft / Elev		q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				675								
				5								
				▽								
				670								
				10								
				665								
				15	**Blank drilled to top of rock**							
				660								
				20								
				655								
				25								
				650								
				30								

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	7	4½*	BF
To Cave-in		8	

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

GENERAL NOTES

Start 5/8/06 End 5/9/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 7N
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 2 of 3

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 68° F	Driller	C.N.
Des. No.	0200775	Station	58+20	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						Blank drilled to top of rock							
RC-1		81	RQD=38%	35	645	**LIMESTONE**, hard, gray **VOID** **LIMESTONE**, low bedding planes, hard, fine grained, gray, weathered from near 33.7' to 34'							
RC-2		100	RQD=60%	40	640	**WEATHERED LIMESTONE**, low bedding planes, moderately hard to soft, fine grained, gray and brown **LIMESTONE**, low bedding planes, hard to moderately hard, fine grained, gray, fractured and broken, occasional clay seams **VOID**							
RC-3		25	RQD=0%	45	635	**INTERBEDDED LIMESTONE**, low bedding planes, soft, fine grained, brownish gray							
RC-4		35	RQD=0%	50	630								
RC-5		70	RQD=45%	55	625	**LIMESTONE**, low bedding planes, hard, fine grained, gray to brown below 58' to gray below 60.5', trace vugs from near 51.6' to 51.8', 55.8' to 56.7' and 61.5' to 62'							
RC-6		100	RQD=52%	60	620								
					615	Continued Next Page							

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

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 7N**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **3** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 68° F	Driller	C.N.
Des. No.	0200775	Station	58+20	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-7		75	RQD=15%	65		**WEATHERED LIMESTONE**, low bedding planes, soft to moderately hard, fine grained, yellowish brown							
RC-8		88	RQD=31%	610 / 70		**LIMESTONE**, low bedding planes, hard to moderately hard, fine grained, gray to brown below 65.5' to gray below 67.8', vuggy, with weathered band near 68' to 68.3', fractured and broken below 71.5'							
RC-9		95	RQD=70%	605 / 75									
						End of Boring at 76.5 ft							

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

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 10N**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+52	Offset	20 ft Lt. "A"	Inspector	---

No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (12 in.)							
SS-1	X	55	2-1-2		675	**SILTY CLAY LOAM**, soft, moist, gray and brown, A-7-6, Lab No. 6168SL	1.0			28.6			
SS-2	X	100	3-4-5	5			3.0			19.4			
SS-3	X	90	4-5-5		670		2.25			22.3			
SS-4	X	65	3-4-5	10			1.75			18.4			
					665								
SS-5	X	100	3-4-10	15			1.0			23.6			
					660	**CLAY**, stiff to very soft, moist, gray to reddish brown below 12', A-7-6, Lab No. 6166SL							
SS-6	X	55	5-4-5	20			2.25			36.7			
					655								
SS-7	X	45	4-4-4	25			1.0			29.8			
					650								
SS-8	X	45	0-0-1	30			---			---			

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	23	11*	BF
To Cave-in		17	

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

GENERAL NOTES

Start **6/8/06** End **6/8/06** Rig **CME 45C**
Drilling Method **3¼" I.D. HSA** **Skid**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.**

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 10N**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+52	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					645								
SS-9	X	55	0-0-1	35		**CLAY**, stiff to very soft, moist, gray to reddish brown below 12', A-7-6, Lab No. 6166SL	<0.25			43.5			
RC-1		10	RQD=0%	40	640								
RC-2		10	RQD=7%		635								
RC-3		10	RQD=7%	45	630	**INTERBEDDED LIMESTONE**, low bedding planes, very soft to hard, fine grained, gray							
RC-4		10	RQD=0%	50	625								
RC-5		50	RQD=23%	55	620	**LIMESTONE**, low bedding planes, hard, fine to medium grained, gray, with some voids and vertical fractures							
RC-6		73	RQD=52%	60	615	**LIMESTONE**, low bedding planes, hard to soft, fine grained, gray and brownish gray **VOID**							

Continued Next Page

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

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No.: **Pier 10N**
Elevation: **678.0**
Datum: **USC & GS**
EEI Proj. No.: **1-04-132**
Sheet: **3** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+52	Offset	20 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft / Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				65	**LIMESTONE**, low bedding planes, hard to soft, fine grained, gray and brownish gray							
					VOID							
RC-7		75	RQD=38%	610								
				70								
RC-8		100	RQD=55%	605	**LIMESTONE**, low bedding planes, hard to soft, fine grained, gray and brownish gray, with occasional shale partings near 71.7' to 73', weathered near 75.5' to 76.5'							
				75								
RC-9		100	RQD=45%	600								
				80	End of Boring at 80 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 10S
Elevation 678.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 3

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+52	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
SS-1		55	2-1-2										
SS-2		100	3-4-5	5	675								
SS-3		90	4-5-5										
SS-4		65	3-4-5	10	670								
SS-5		100	3-4-10	15	665	**Blank drilled to top of rock**							
SS-6		55	5-4-5	20	660								
SS-7		45	4-4-4	25	655								
RC-1		29	RQD=0%	30	650	**INTERBEDDED LIMESTONE and CLAY**, low bedding planes, moderately hard to hard, gray to brownish gray							
RC-2		45	RQD=27%	35	645								

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	12	1*	BF
To Cave-in		7½	

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

GENERAL NOTES

Start 6/8/06 End 6/9/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 10S**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+52	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-3		52	RQD=9%	40	640								
RC-4		20	RQD=0%	45	635								
RC-5		33	RQD=23%	50	630	**INTERBEDDED LIMESTONE and CLAY**, low bedding planes, moderately hard to hard, gray to brownish gray							
RC-6		17	RQD=7%	55	625								
RC-7		80	RQD=14%	60	620								
RC-8		60	RQD=7%	65	615								
RC-9		95	RQD=32%	70	610	**LIMESTONE**, low bedding planes, hard to soft, fine grained, gray and brownish gray, vertical fractures near 67.5' to 67.7' and 78.5' to 79', weathered from near 68' to 70' and 72' to 72.6'							
RC-10		87	RQD=62%		605								

Continued Next Page

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

LOG OF TEST BORING

Project **Hamilton Blvd from SR 37 to Meridian Road**
Location **Mitchell, Lawrence County, Indiana**
Client **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 10S**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **3** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	61+52	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES						
No.	Type	Rec %	Blow Counts	Depth ft / Elev		q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				75								
RC-11		93	RQD=70%	600	**LIMESTONE**, low bedding planes, hard to soft, fine grained, gray and brownish gray, vertical fractures near 67.5' to 67.7' and 78.5' to 79', weathered from near 68' to 70' and 72' to 72.6'							
				80	End of Boring at 80 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. Pier 11S
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 3

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	62+80	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (6 in.)							
SS-1		65	1-2-2		675	**SILTY CLAY LOAM**, soft, moist, gray and brown, A-6, Lab No. 6167SL	0.5			27.8			
SS-2		55	2-5-6	5			2.75			21.0			
SS-3		80	6-7-7		670		2.5			21.0			
SS-4		100	5-10-5	10			2.25			22.7			
SS-5		65	3-4-7		665	**CLAY**, stiff to very soft, moist, brown and gray to reddish brown below 12', with trace limestone fragments, A-7-6, Lab No. 6166SL	1.75			28.4			
SS-6		55	8-7-6	20	660		2.75			33.0			
SS-7		45	0-0-2	25	655		0.25			36.6			
					650	**WEATHERED LIMESTONE**, soft, gray							
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	25	21	BF
To Cave-in		36	

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

GENERAL NOTES

Start 6/13/06 End 6/13/06 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 11S**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	62+80	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-1		60	RQD=12%										
RC-2		100	RQD=14%		645								
RC-3		88	RQD=51%	35									
RC-4		90	RQD=16%	40	640								
RC-5		93	RQD=32%	45	635	**INTERBEDDED LIMESTONE and CLAY**, low bedding planes, moderately hard to hard, fine grained, gray to brownish gray, less clay from 65' to 75'							
RC-6		45	RQD=18%	50	630								
RC-7		20	RQD=0%	55	625								
RC-8		57	RQD=36%	60	620								
					615								

Continued Next Page

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

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **Pier 11S**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **3** of **3**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	62+80	Offset	20 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				65									
RC-9		82	RQD=33%		610	**INTERBEDDED LIMESTONE and CLAY**, low bedding planes, moderately hard to hard, fine grained, gray to brownish gray, less clay from 65' to 75'							
				70									
RC-10		95	RQD=18%		605								
				75									
RC-11		47	RQD=18%		600	**LIMESTONE**, low bedding planes, hard to moderately hard, fine grained, gray to brownish gray, occasional partings and bands of shale from 75' to 85'							
				80									
RC-12		57	RQD=26%		595								
				85									
RC-13		100	RQD=33%		590	**DOLOMITIC LIMESTONE**, low bedding planes, moderately hard, fine grained, gray, with shale seam from near 87.2' to 87.8'							
				90									
RC-14		100	RQD=80%		585								
				95		End of Boring at 95 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RW-3
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	56+00	Offset	100 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
SS-1		45	1-1-2			**SILTY CLAY LOAM**, very soft, moist, brown, with trace roots, A-6, Lab No. 6167SL	1.5			23.9			
SS-2		100	1-2-4	5	675		2.25			23.1			
SS-3		100	2-3-5			**CLAY**, medium stiff, moist, mottled brown and gray to gray below 7', with occasional limestone fragments, A-7-6, Lab No. 6166SL	2.0			26.4			
SS-4		100	2-3-6	10	670		2.0			27.2			
SS-5		45	5-10-29	15	665	**CLAY**, hard to medium stiff, moist, reddish brown, with limestone fragments (residual soil), A-7-6, Lab No. 6166SL	2.25			36.6			
SS-6		45	3-4-5	20	660		---			38.5			
SS-7		100	50/.2				---			---			
						End of Boring at 23.7 ft Auger refusal at 23.7 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	22	NW	BF
To Cave-in		22	

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

GENERAL NOTES

Start 5/7/04 End 5/7/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **RW-4**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 85° F	Driller	J.M.
Des. No.	0200775	Station	57+00	Offset	100 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
SS-1		55	1-1-1		675	**SILTY CLAY LOAM**, very soft, moist, brown and gray, with roots, A-6, Lab No. 6167SL	---			27.3			
SS-2		100	2-5-7	5			3.0			21.3			
SS-3		100	2-4-5				2.0			23.1			
SS-4		100	2-3-6		670	**CLAY**, stiff to medium stiff, moist, mottled brown and gray to gray below 8½', with limestone fragments below 8½', (residual soil), A-7-6, Lab No. 6166SL	1.5			17.6			
SS-5		100	2-3-4	10	665		1.5			38.9			
SS-6		100	2-3-4	15	660	**CLAY**, medium stiff, moist, reddish brown, (residual soil), A-7-6, Lab No. 6166SL	2.25			28.5			
SS-7		100	1-1-1	20	655		---			58.6			
SS-8		45	11-5-3	25	650	**SILTY CLAY LOAM**, very soft to medium stiff, wet, reddish brown, with limestone fragments (residual soil), A-7-6, Lab No. 6168SL	0.25			39.3			
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	24 hrs After Drilling
To Water	23	13	8
To Cave-in		29½	8½

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

GENERAL NOTES

Start **5/6/04** End **5/6/04** Rig **D120 ATV**
Drilling Method **3¼" I.D. HSA**
Remarks **Backfilled with auger cuttings and bentonite chip plug near surface.**

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **RW-4**
Elevation **678.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	**STP-6647 (002)**	Struct. No.	**---**	Weather	**Sunny 85° F**	Driller	**J.M.**
Des. No.	**0200775**	Station	**57+00**	Offset	**100 ft Rt. "A"**	Inspector	**---**

SAMPLE					DESCRIPTION/CLASSIFICATION and REMARKS	SOIL PROPERTIES						
No.	Type	Rec %	Blow Counts	Depth ft / Elev		q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					SILTY CLAY LOAM, very soft to medium stiff, wet, reddish brown, with limestone fragments (residual soil), A-7-6, Lab No. 6168SL							
				645	End of Boring at 32.5 ft Auger refusal at 32.5 ft							

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

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. RW-5
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 80° F	Driller	J.M.
Des. No.	0200775	Station	58+00	Offset	100 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						SILTY CLAY LOAM, very soft, moist, brown, A-6, Lab No. 6167SL							
SS-1		45	1-1-2				---			---			
SS-2		95	2-2-4		675		1.5			25.5			
				5		**SILTY CLAY LOAM**, medium stiff, moist, brown and gray, A-6, Lab No. 6927SL							
SS-3		100	3-5-5				2.0			23.7			
SS-4		100	2-3-4		670	**CLAY**, medium stiff, moist, brown and gray, with trace limestone fragments, (residual soil), A-7-6, Lab No. 6166SL	2.25			23.6			
				10									
SS-5		100	3-8-11		665		3.0	2.60	87.7	34.0			
				15		**CLAY**, medium stiff to hard, moist, reddish brown to brown below 18', with frequent limestone fragments (residual soil), A-7-6, Lab No. 6166SL							
SS-6		45	3-3-3		660		2.0			18.6			
				20									
SS-7		50	50/.3		655		---			35.5			
				25		End of Boring at 25 ft Auger refusal at 25 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	8	19½	10
To Cave-in		21	12

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

GENERAL NOTES

Start 5/7/04 End 5/7/04 Rig D120 ATV
Drilling Method 3¼" I.D. HSA
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-1
Elevation 680.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Station	48+67	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	C.L. "A"	Temp.	60° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (2 in.)							
SS-1		50	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, with trace roots, A-6, Lab No. 6927SL	<0.25			28.4			
SS-2		85	3-3-4	5	675		3.0			23.7			
SS-3		100	3-4-5				2.5			22.5			
SS-4		100	5-5-6	10	670	**CLAY**, medium stiff to stiff, moist, brown and gray, with trace limestone fragments below 13', (residual soil), A-7-6, Lab No. 6166SL	2.5			23.6			
SS-5		100	6-4-4	15	665		1.0			40.9			
RC-1		89	RQD=100%	20	660	**LIMESTONE**, very low bedding planes, very fine grained, gray							
RC-2		80	RQD=54%			**CLAY FILLED VOID**							
						LIMESTONE, very low bedding planes, very fine grained, gray, vertically fractured at 24' and 25'							
				25	655	**CLAY FILLED VOID**							
						LIMESTONE, very low bedding planes, very fine grained, gray, vertically fractured at 24' and 25'							
						End of Boring at 25.5 ft							
						Auger refusal at 17 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	NW	*	BF
To Cave-in		15	

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

GENERAL NOTES

Start 5/5/05 End 5/5/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

EARTH EXPLORATION Inc.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-2**
Elevation **679.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **1**

Proj. No.	STP-6647 (002)	Station	49+65	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	C.L. "A"	Temp.	60° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1		10	1-1-1				1.25			32.4			
SS-2		100	2-2-3		675		2.5			25.0			
				5									
SS-3		100	3-3-4			**CLAY**, very soft to stiff, moist, brown to brown and gray, with limestone fragments below 13', (residual soil), A-7-6, Lab No. 6166SL	3.75	4.37	104.1	22.7			
SS-4		100	4-5-6		670		2.5			30.3			
				10									
SS-5		100	35-50/.1				<0.25			28.0			
					665								
				15									
RC-1		100	RQD=82%			**LIMESTONE**, very low bedding planes, very hard, very fine grained, gray, with vertical fracture from 19.6' to 20'							
					660								
				20		End of Boring at 20 ft Auger refusal at 15 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	surface	*	½
To Cave-in		12	9

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

GENERAL NOTES

Start **5/4/05** End **5/4/05** Rig **CME 45C**
Drilling Method **3¼" I.D. HSA** **Skid**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.**

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-3
Elevation 680.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Station	50+66	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	C.L. "A"	Temp.	60° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1		55	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, with trace roots, A-6, Lab No. 6927SL	0.25			32.7			
SS-2		85	5-3-5	5	675		2.5			22.6			
SS-3		100	4-4-4			**CLAY**, medium stiff to stiff, moist, brown and gray to reddish brown below 9', with limestone fragments below 9', (residual soil), A-7-6, Lab No. 6166SL	2.0			23.1			
SS-4		100	8-8-9	10	670		4.5			26.5			
RC-1		100	RQD=100%	15	665	**LIMESTONE**, low bedding planes, very hard, very fine grained, gray, with clay seam from 17' to 18', highly fractured from 22.8' to 23.5'							
RC-2		48	RQD=13%			**VOID** **LIMESTONE**, low bedding planes, very hard, very fine grained, gray, with clay seam from 17' to 18', highly fractured from 22.8' to 23.5' **VOID**							
RC-3		93	RQD=65%	20 25	660 655	**LIMESTONE**, low bedding planes, very hard, very fine grained, gray, with clay seam from 17' to 18', highly fractured from 22.8' to 23.5'							
						End of Boring at 25.5 ft Auger refusal at 14.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	NW	*	BF
To Cave-in		12	

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

GENERAL NOTES

Start 5/4/05 End 5/4/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-4
Elevation 680.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	51+00	Offset	83 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1		45	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-6, Lab No. 6167SL	0.75			29.6			
SS-2		85	2-3-3	5	675		2.25			24.2			
SS-3		100	2-5-3				1.5			23.3			
SS-4		100	3-4-4	10	670	**CLAY**, medium stiff, moist, brown and gray to reddish brown below 10', with limestone fragments below 10', (residual soil), A-7-6, Lab No. 6166SL	2.0	2.33	104.3	22.0			
SS-5		45	5-4-5	15	665		---			---			
						LIMESTONE, (visual)							
RC-1		22	RQD=18%	20	660	**LIMESTONE**, low bedding planes, hard, very fine grained, gray, vertically fractured from 25.8' to 26' and 26.5' to 27' **VOID** **LIMESTONE**, low bedding planes, hard, very fine grained, gray, vertically fractured from 25.8' to 26' and 26.5' to 27'							
						VOID							
RC-2		100	RQD=37%	25	655	**LIMESTONE**, low bedding planes, hard, very fine grained, gray, vertically fractured from 25.8' to 26' and 26.5' to 27'							
						End of Boring at 27 ft Auger refusal at 17 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	surface	*	surface
To Cave-in		13½	9

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

GENERAL NOTES

Start 5/6/05 End 5/6/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-5
Elevation 679.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	52+42	Offset	14 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (2 in.)							
SS-1		85	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-6, Lab No. 6167SL	0.25			31.2			
SS-2		100	3-4-4	5	675	**SILTY CLAY LOAM**, medium stiff to very stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	2.5			21.5			
SS-3		100	4-6-17				1.5			20.1			
SS-4		100	5-3-20	10	670		2.5			23.0			
SS-5		100	3-5-7	15	665	**CLAY**, very stiff to very soft, moist, reddish brown, with occasional limestone fragments, (residual soil), A-7-6, Lab No. 6166SL	3.5	3.44	83.3	37.5			
SS-6		45	6-3-4	20	660		---			---			
SS-7		65	0-0-0	25	655		<0.25			33.1			
						LIMESTONE, (visual)							
RC-1		75	RQD=65%	30	650	**LIMESTONE**, low bedding planes, very hard, very fine grained, gray to brown below 28½' **CLAY FILLED VOID**							

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	19½	*	BF
To Cave-in		25	

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

GENERAL NOTES

Start 5/3/05 End 5/3/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-5**
Elevation **679.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	52+42	Offset	14 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						DOLOMITE, low bedding planes, moderately hard to hard, fine grained, brown							
RC-2		97	RQD=80%	35	645	**LIMESTONE**, low bedding planes, very hard, fine grained, gray, with clay seam near 36.3' and moderately weathered from 33' to 33.4'							
						End of Boring at 36 ft Auger refusal at 27 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-6
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	52+53	Offset	83 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (2 in.)							
SS-1		85	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-6, Lab No. 6167SL	0.5			29.2			
SS-2		100	2-3-4	675 / 5		**CLAY**, medium stiff, moist, brown and gray, A-7-6, Lab No. 6166SL	2.5			24.4			
SS-3		100	4-4-3			**SILTY CLAY LOAM**, medium stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	2.5			23.0			
SS-4		100	4-5-6	670 / 10			2.25			23.2			
SS-5		100	3-3-3	665 / 15		**CLAY**, stiff to medium stiff, moist, brown and gray to reddish brown below 13½', occasional limestone fragments (residual soil), A-7-6, Lab No. 6166SL	0.5			26.0			
SS-6		100	3-5-4	660 / 20			1.25			32.3			
SS-7		100	1-2-3	655 / 25		**SILTY CLAY**, soft, moist, reddish brown, with limestone fragments below 25½' (residual soil; visual)	0.25			29.3			
RC-1		83	RQD=70%	650 / 30		**DOLOMITE**, moderate bedding planes, soft, fine grained, brown, highly weathered, vertically fractured **LIMESTONE**, low bedding planes, hard, fine grained, gray, moderately fractured							

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	18	*	BF
To Cave-in		22½	

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

GENERAL NOTES

Start 5/9/05 End 5/9/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA Skid
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-6**
Elevation **679.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	52+53	Offset	83 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						CLAY, with limestone fragments, red to brown (void)							
RC-2		90	RQD=45%		645	**LIMESTONE**, low bedding planes, very hard to moderately hard, fine grained, gray, with highly weathered zone from 32.3' to 32.8'							
				35		**DOLOMITE**, low bedding planes, moderately hard, fine grained, brown, with silt seam at 35.3', vertically fractured near 36.1' to 36.5'							
						End of Boring at 36.5 ft Auger refusal at 27 ft							

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

LOG OF TEST BORING

EARTH EXPLORATION Inc

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-7**
Elevation **679.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	53+42	Offset	12 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (2 in.)							
SS-1		100	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-6, Lab No. 6167SL	0.25			29.9			
SS-2		85	2-3-4	5	675		1.25			20.5			
SS-3		100	4-5-6			**SILTY CLAY LOAM**, medium stiff to stiff, moist, brown and gray, A-6, Lab No. 6927SL	1.5			21.2			
SS-4		100	3-4-4	10	670		1.25			21.6			
SS-5		100	3-5-6	15	665	**CLAY**, stiff, moist, brown to reddish brown, (residual soil), A-7-6, Lab No. 6166SL	1.0			34.9			
SS-6		100	6-6-6	20	660		2.0			27.8			
RC-1		42	RQD=22%	25	655	**INTERBEDDED LIMESTONE AND CLAY**, low bedding planes, moderately hard to very hard, gray, with frequent voids throughout							
RC-2		40	RQD=8%	30	650								

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	*	surface
To Cave-in		15	6

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

GENERAL NOTES

Start **4/22/05** End **4/22/05** Rig **CME 45C**
Drilling Method **3¼" I.D. HSA** **ATV**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.**

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-7**
Elevation **679.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	53+42	Offset	12 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-3		33	RQD=23%	35	645								
RC-4		5	RQD=0%	40	640	**INTERBEDDED LIMESTONE AND CLAY**, low bedding planes, moderately hard to very hard, gray, with frequent voids throughout							
RC-5		23	RQD=0%	45	635								
RC-6		17	RQD=0%	50	630								
RC-7		68	RQD=30%	55	625	**LIMESTONE**, low to moderate bedding planes, moderately hard to hard, fine to medium grained, gray, highly weathered, with some vugginess near 55.6'							
						End of Boring at 56.5 ft Auger refusal at 23.5 ft							

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

LOG OF TEST BORING

EARTH EXPLORATION Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

Boring No. **B-8**
Elevation **679.5**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **1**

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	53+98	Offset	86 ft Rt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (12 in.)							
SS-1		45	1-1-1			**SILTY CLAY LOAM**, very soft to stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	3.5			23.4			
SS-2		100	4-6-6	5	675		3.5			21.8			
SS-3		100	4-5-6				2.0	2.35	104.0	22.4			
SS-4		45	6-7-10	10	670		3.5			33.0			
SS-5		100	7-7-7	15	665	**CLAY**, stiff to very stiff, moist, brown and gray to reddish brown below 8', with trace limestone fragments (residual soil), A-7-6, Lab No. 6166SL	1.0			38.2			
SS-6		100	50/.3		660		1.0			21.7			
RC-1		100	RQD=58%	20									
RC-1		97	RQD=48%	25	655	**LIMESTONE**, low bedding planes, very hard, fine grained, gray, vertically fractured from 22' to 22.6' and from 24.1' to 24.7'							
						End of Boring at 25.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	surface	*	surface
To Cave-in		16½	9½

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

GENERAL NOTES

Start **4/21/05** End **4/21/05** Rig **CME 45C**
Drilling Method **3¼" I.D. HSA** **ATV**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.**

LOG OF TEST BORING

EARTH EXPLORATION Inc

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-9
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Struct. No.	---	Weather	Sunny 70° F	Driller	S.P.
Des. No.	0200775	Station	54+42	Offset	11 ft Lt. "A"	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1		55	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-6, Lab No. 6927SL	0.25			34.8			
SS-2		100	4-4-5	5	675	**SILTY CLAY LOAM**, medium stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	2.75			23.0			
SS-3		100	4-2-3			**CLAY**, soft, moist, brown and gray, A-7-6, Lab No. 6166SL	1.75			25.0			
SS-4		100	7-9-8	10	670	**CLAY LOAM**, very stiff, moist, brown, with sandstone fragments (visual)	2.0			25.9			
SS-5		85	4-6-8	15	665	**CLAY**, stiff, moist, reddish brown, (residual soil), A-7-6, Lab No. 6166SL	1.5			36.3			
SS-6		100	5-2-3	20	660	**SILTY CLAY LOAM**, soft, moist, brown, with frequent limestone fragments (residual soil), A-7-6, Lab No. 6168SL	0.5			28.0			
SS-7		100	43-29-3	25	655		---			17.6			
RC-1		100	RQD=100%										
RC-2		100	RQD=100%	30	650	**LIMESTONE**, very low bedding plane angles, very hard, very fine grained, brown							
						DOLOMITE, low bedding plane angles, hard, very fine grained, brown							
						End of Boring at 33 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	*	7½
To Cave-in		21½	18

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

GENERAL NOTES

Start 4/21/05 End 4/21/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-10
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Station	55+02	Weather	Partly Cloudy	Driller	S.P.
Struct. No.	---	Offset	92 ft Rt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1	X	45	1-1-1			**SILTY CLAY LOAM**, very soft to medium stiff, moist, brown and gray, A-6, Lab No. 6927SL	0.25			34.5			
SS-2	X	100	4-4-4	675	5		1.0			24.1			
SS-3	X	100	5-6-7			**SILTY CLAY LOAM**, medium stiff to stiff, moist, brown and gray, A-7-6, Lab No. 6168SL	2.0			22.0			
~~SS-4~~	~~X~~	~~50~~	~~50/.3~~	670		**LIMESTONE**, moderate bedding planes, hard, fine grained, brown and gray, vuggy	---			~~22.5~~			
RC-1		83	RQD=41%		10	**VOID**							
RC-2		23	RQD=0%	665	15	**LIMESTONE**, low bedding planes, hard, fine grained, gray, with clay seams **VOID**							
RC-3		13	RQD=0%	660	20	**LIMESTONE**, low bedding planes, hard, fine grained, gray **VOID**							
RC-4		23	RQD=0%	655	25	**LIMESTONE**, low bedding planes, very hard, fine grained, gray, with vertical fractures at 21' to 21.2' and 21.8' to 22.2'							
RC-5		100	RQD=75%	650	30	**LIMESTONE**, low to moderate bedding planes, hard, fine grained, gray, with clay seam from 29.4' to 30.2', highly weathered from 30.2' to 30.5'							
						End of Boring at 30.5 ft Shelby tubes (ST-1 and ST-2) obtained from 1 to 3 ft and 3 to 5 ft respectively. 1.3 to 1.7 ft: γ_d = 87.3 pcf, %m = 31.1 2.3 to 2.7 ft: γ_d = 85.6 pcf, %m = 35.3 3.1 to 3.5 ft: γ_d = 87.9 pcf, %m = 31.1 3.7 to 4.0 ft: γ_d = 89.6 pcf, %m = 31.8							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	surface	*	7½
To Cave-in		8	8

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

GENERAL NOTES

Start 4/19/05 End 4/19/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-11
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Station	56+00	Weather	Partly Cloudy	Driller	S.P.
Struct. No.	---	Offset	5 ft Lt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1		45	1-2-2			**SILTY CLAY LOAM**, soft, moist, brown and gray, A-6, Lab No. 6927SL	1.0			32.0			
SS-2		100	2-4-7		675	**SILTY CLAY LOAM**, stiff, moist, dark brown and gray, A-7-6, Lab No. 6168SL	2.5			23.2			
				5									
SS-3		100	9-9-11				2.0			25.2			
SS-4		100	6-7-10		670	**CLAY**, very stiff, moist, brown and gray to reddish brown below 8½', with occasional limestone floaters (residual soil), A-7-6, Lab No. 6166SL	3.75			38.6			
				10									
SS-5		100	4-11-50		665		2.75			31.7			
				15		**LIMESTONE**, low bedding planes, moderately hard, fine grained, gray, moderately weathered							
RC-1		61	RQD=35%		660	**VOID**							
				20		**LIMESTONE**, low bedding planes, hard, fine grained, gray							
						CLAY FILLED VOID							
RC-2		100	RQD=63%		655	**LIMESTONE**, low bedding planes, hard, fine grained, gray							
						End of Boring at 24.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	NW	*	8
To Cave-in		12	12

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

GENERAL NOTES

Start 4/18/05 End 4/18/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

EARTH EXPLORATION Inc
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-12
Elevation 679.0
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 1

Proj. No.	STP-6647 (002)	Station	56+00	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	92 ft Rt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1	X	95	1-1-1			**SILTY CLAY LOAM**, very soft, moist, brown and gray, A-6, Lab No. 6167SL	0.25			29.5			
SS-2	X	100	3-3-4		675		1.5	1.56	103.0	22.6			
				5		**SILTY CLAY LOAM**, medium stiff to very stiff, moist, brown and gray, A-6, Lab No. 6927SL							
SS-3	X	100	4-6-10				3.0			23.9			
~~SS-4~~	~~X~~	~~50~~	~~50/.2~~		670	**CLAY LOAM**, with limestone fragments (visual)	---			---			
RC-1		33	RQD=0%	10		**LIMESTONE**, moderate bedding planes, hard, fine grained, gray with some vugginess, vertically fractured							
RC-2		13	RQD=0%		665	**INTERBEDDED LIMESTONE AND CLAY**, low to moderate bedding planes, very hard, fine grained, gray, with frequent voids throughout							
				15									
RC-3		15	RQD=0%		660								
				20									
RC-4		100	RQD=82%		655	**LIMESTONE**, low to moderate bedding planes, very hard, fine grained, gray							
				25									
						End of Boring at 27 ft							

Shelby tube (ST-1) obtained from 1 to 3 ft.
1.5 to 1.8 ft: γ_d = 90.1 pcf, %m = 30.7
2.2 to 2.5 ft: γ_d = 93.3 pcf, %m = 29.1

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	10	*	7
To Cave-in		8	8

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

GENERAL NOTES

Start 4/19/05 End 4/19/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-13**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **1** of **2**

Proj. No.	STP-6647 (002)	Station	59+00	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	63 ft Rt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1	X	100	2-2-2		675	**SILTY CLAY LOAM**, soft, moist, brown and gray, A-6, Lab No. 6167SL	0.5			27.7			
SS-2	X	100	3-4-5	5		**SILTY CLAY LOAM**, medium stiff, moist, brown, A-7-6, Lab No. 6168SL	3.0			21.3			
SS-3	X	100	4-5-6		670		1.75			23.1			
SS-4	X	85	4-5-10	10			2.25	2.37	102.0	24.3			
					665	**SILTY CLAY**, stiff to very stiff, moist, brown and gray, (visual)							
SS-5	X	100	6-9-10	15			2.5			20.9			
					660								
SS-6	X	100	4-10-11	20			2.25			39.5			
					655	**CLAY**, very stiff, moist, reddish brown, with limestone fragments, A-7-6, Lab No. 6166SL							
SS-7	X	85	8-4-50/.5	25			0.25			46.2			
					650	**LIMESTONE**, low bedding planes, hard, very fine grained, gray							
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ 24 hrs After Drilling
To Water	21	*	10½
To Cave-in		24½	21½

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

GENERAL NOTES

Start **4/15/05** End **4/18/05** Rig **CME 45C**
Drilling Method **3¼" I.D. HSA** **ATV**
Remarks: **Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.**

LOG OF TEST BORING

Project: **Hamilton Blvd from SR 37 to Meridian Road**
Location: **Mitchell, Lawrence County, Indiana**
Client: **Strand Associates, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **B-13**
Elevation **678.0**
Datum **USC & GS**
EEI Proj. No. **1-04-132**
Sheet **2** of **2**

Proj. No.	STP-6647 (002)	Station	59+00	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	63 ft Rt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-1		11	RQD=0%			**VOID**							
					645								
RC-2		44	RQD=8%	35		**LIMESTONE**, low bedding planes, hard to moderatley hard, very fine grained, gray with clay seam from 34.4' to 34.8'							
						VOID							
					640								
RC-3		100	RQD=12%	40		**LIMESTONE**, low to moderate bedding planes, hard to soft, fine grained, gray and brown, with frequent weathered siltstone beds and seams							
						WEATHERED SILTSTONE, moderate bedding planes, soft to moderately hard, very fine grained, brown, with limestone banding and inclusions							
					635								
						End of Boring at 43 ft							

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

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-14
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 1 of 2

Proj. No.	STP-6647 (002)	Station	59+50	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	62 ft Rt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
						TOPSOIL, (1 in.)							
SS-1		85	2-2-2			**SILTY CLAY LOAM**, soft, moist, brown and gray, A-6, Lab No. 6927SL	0.5			28.6			
					675								
SS-2		100	3-4-5	5		**SILTY CLAY LOAM**, medium stiff, moist, brown, A-7-6, Lab No. 6168SL	2.5			24.4			
SS-3		100	4-5-8				1.25	1.93	106.3	20.7			
					670								
SS-4		100	1-5-6	10			3.0			20.3			
					665								
SS-5		100	23-12-8	15			2.75			27.4			
						CLAY, medium stiff to very stiff, moist, brown and gray to reddish brown below 13', with occasional limestone fragments below 13', A-7-6, Lab No. 6166SL							
					660								
SS-6		100	3-3-4	20			2.0			39.7			
					655								
SS-7		45	32-16-4	25			---			---			
					650								
				30									

Continued Next Page

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	24 hrs After Drilling
To Water	8	*	8½
To Cave-in		24½	13

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

GENERAL NOTES

Start 4/11/05 End 4/15/05 Rig CME 45C
Drilling Method 3¼" I.D. HSA ATV
Remarks: Backfilled with auger cuttings and bentonite chip plug near surface. *Water introduced during rock coring.

EARTH EXPLORATION Inc

LOG OF TEST BORING

Project: Hamilton Blvd from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. B-14
Elevation 678.5
Datum USC & GS
EEI Proj. No. 1-04-132
Sheet 2 of 2

Proj. No.	STP-6647 (002)	Station	59+50	Weather	Sunny	Driller	S.P.
Struct. No.	---	Offset	62 ft Rt. "A"	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	Blow Counts	Depth ft	Elev	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
RC-1		100	RQD=15%										
					645								
RC-2		40	RQD=25%	35		**LIMESTONE**, low to moderate bedding planes, moderately hard to hard, fine grained, brown and gray with interbedded weathered siltstone layers at 29.2' to 30', 31.9' to 33', 33.8' to 35' and 38.5' to 38.9' and vertical weathering at 30' to 31.5'							
					640								
						VOID							
RC-3		60	RQD=28%	40		**LIMESTONE**, low bedding planes, moderately hard, fine grained, brown and gray							
						WEATHERED SILTSTONE, moderate bedding planes, soft to moderately hard, very fine grained, brown							
						End of Boring at 43 ft							

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

SUMMARY OF SOUNDINGS

Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Project No.: STP-6647(002)
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132
Date: May 11, 2004
Method: ATV-Mounted Auger and Hand Auger

Sounding No.	Station	Offset Line	Approx. Ground Surface Elevation	Depth Int.(ft)	Description - All Classifications are visual
S-1	59+45	24 ft Rt. "A"	678.0	0.0 - 1.0	**Topsoil**
				1.0 - 11.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				11.0 - 24.0	**Clay,** stiff, moist, brown to reddish brown
				24.0 - 26.0	**Clay,** soft, moist, reddish brown
				26.0 →	**Refusal**
S-2	60+30	23 ft Lt. "A"	679.0	0.0 - 1.0	**Topsoil**
				1.0 - 31.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				31.0 - 35.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				35.0 - 40.0	**Weathered Rock**
				40.0 →	**Refusal**
S-3	69+13	50 ft Rt. "A"	679.0	0.0 - 1.0	**Topsoil**
				1.0 - 15.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				15.0 - 30.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				30.0 →	**Refusal**
S-4	76+25	71 ft Rt. "A"	674.0	0.0 - 1.0	**Topsoil**
				1.0 - 15.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				15.0 - 28.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				28.0 →	**Refusal**
S-5	76+25	96 ft Rt. "A"	674.0	0.0 - 1.0	**Topsoil**
				1.0 - 16.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				16.0 - 28.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				28.0 →	**Refusal**
S-6	76+25	121 ft Rt. "A"	674.5	0.0 - 1.0	**Topsoil**
				1.0 - 16.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				16.0 - 30.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				30.0 →	**Refusal**
S-7	80+75	22 ft Lt. "A"	672.5	0.0 - 1.0	**Topsoil**
				1.0 - 8.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				8.0 - 26.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				26.0 →	**Refusal**

SUMMARY OF SOUNDINGS

Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Project No.: STP-6647(002)
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132
Date: May 11, 2004
Method: ATV-Mounted Auger and Hand Auger

Sounding No.	Station	Offset Line	Approx. Ground Surface Elevation	Depth Int.(ft)	Description - All Classifications are visual
S-8	80+75	62 ft Lt. "A"	671.0	0.0 - 1.5	**Topsoil**
				1.0 - 6.0	**Silty Clay Loam,** med. stiff, moist, brown and gray
				6.0 - 28.5	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				28.5 →	**Refusal**
S-9	80+75	102 ft Lt. "A"	670.0	0.0 - 0.5	**Topsoil**
				0.5 - 5.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown
				5.0 - 10.0	**Silty Clay Loam,** stiff, moist, brown, with uncontrolled fill (including wood) and debris
				10.0 - 33.0	**Silty Clay Loam,** med. stiff, moist, brown, with occasional limestone fragments
				33.0 →	**Refusal**
S-10	97+50	40 ft Lt. "A"	656.0	0.0 - 0.5	**Topsoil**
				0.5 - 8.0	**Silty Clay Loam,** stiff, moist, brown (fill)
				8.0 - 15.0	**Silty Clay Loam,** stiff, moist, brown, with uncontrolled fill (including wood), and debris
				15.0 - 33.0	**Silty Clay Loam,** med. stiff, moist, brown, with occasional limestone fragments
				33.0 →	**Refusal**
S-11	97+50	20 ft Lt. "A"	656.0	0.0 - 0.5	**Topsoil**
				0.5 - 18.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				18.0 - 34.0	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				34.0 →	**Refusal**
S-12	97+50	20 ft Rt. "A"	656.5	0.0 - 0.5	**Topsoil**
				0.5 - 20.0	**Silty Clay Loam,** med. stiff to stiff, moist, brown and gray
				20.0 - 34.5	**Clay,** stiff, moist, reddish brown, with occasional limestone fragments
				34.5 →	**Refusal**
Pier 1N	50+49	20 ft Lt. "A"	680.0	0.0 - 1.0	**Topsoil**
				0.5 - 15.0	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				15.0 →	**Refusal**
Pier 2S	51+77	20 ft Rt. "A"	679.5	0.0 - 1.0	**Topsoil**
				0.5 - 17.5	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				17.5 →	**Refusal**

SUMMARY OF SOUNDINGS

Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Project No.: STP-6647(002)
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132
Date: May 11, 2004
Method: ATV-Mounted Auger and Hand Auger

Sounding No.	Station	Offset Line	Approx. Ground Surface Elevation	Depth Int.(ft)	Description - All Classifications are visual
Pier 3N	53+05	20 ft Lt. "A"	679.0	0.0 - 1.0	**Topsoil**
				0.5 - 22.0	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				22.0 →	**Refusal**
Pier 4S	54+34	20 ft Rt. "A"	679.0	0.0 - 1.0	**Topsoil**
				0.5 - 20.5	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				20.5 →	**Refusal**
Pier 5N	55+62	20 ft Lt. "A"	679.0	0.0 - 1.0	**Topsoil**
				0.5 - 16.0	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				16.0 →	**Refusal**
Pier 6S	56+91	20 ft Rt. "A"	679.0	0.0 - 1.0	**Topsoil**
				0.5 - 22.0	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				22.0 →	**Refusal**
Pier 11N	62+80	20 ft Lt. "A"	678.5	0.0 - 0.5	**Topsoil**
				0.5 - 28.0	**Silty Clay Loam and Clay,** med. stiff to stiff, moist, brown and reddish brown, with occasional limestone fragments
				28.0 →	**Refusal**
HAS-1	48+30	CL "A"	680.5	0.0 - 0.4	**Topsoil,** (wet)
				0.4 - 3.5	**Silty Clay Loam,** soft, wet, brown
				3.5 - 4.5	**Silty Clay Loam,** stiff, moist, brown

APPENDIX E

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

SUMMARY OF CLASSIFICATION TEST RESULTS

GRAIN SIZE DISTRIBUTION CURVE (4)

UNCONFINED COMPRESSION TEST (9)

MOISTURE-DENSITY RELATIONS

SUMMARY OF CBR TEST RESULTS

CALIFORNIA BEARING RATIO

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

Project No.: STP-6647(002)
Des. Nos.: 0200775
Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132

Laboratory Number	Test Boring No.	Sample Number	Sample Depth Interval, ft	Moisture Content, %	pH
6171SL	RB-1	SS-1	1.0 - 2.5	18.0	
6171SL		SS-3	6.0 - 7.5	20.8	
6171SL		SS-4	8.5 - 10.0	19.1	
6171SL	RB-2	SS-1	1.0 - 2.5	25.1	
6171SL		SS-2	3.5 - 5.0	19.0	
6171SL		SS-3	6.0 - 7.5	22.0	
6171SL		SS-4	8.5 - 10.0	17.6	
6171SL	RB-3	SS-1	1.0 - 2.5	24.1	
6171SL		SS-2	3.5 - 5.0	19.6	
6171SL		SS-3	6.0 - 7.5	17.8	
6171SL		SS-5	13.5 - 15.0	40.0	
6171SL	RB-4	SS-1	1.0 - 2.5	24.7	
6171SL		SS-2	3.5 - 5.0	11.2	
6171SL		SS-3	6.0 - 7.5	32.6	
6171SL		SS-4	8.5 - 10.0	34.9	
6171SL	RB-5	SS-1	1.0 - 2.5	21.5	
6171SL		SS-2	3.5 - 5.0	24.6	
6171SL		SS-4	8.5 - 10.0	34.9	
6171SL		SS-5	13.5 - 15.0	32.3	
6171SL	RB-6	SS-1	1.0 - 2.5	24.2	
6171SL		SS-2	3.5 - 5.0	19.7	
6171SL		SS-3	6.0 - 7.5	24.2	
6171SL		SS-4	8.5 - 10.0	24.7	
6171SL	RB-7	SS-1	1.0 - 2.5	26.4	
6171SL		SS-2	3.5 - 5.0	21.2	
6171SL		SS-3	6.0 - 7.5	18.4	
6166SL		SS-5	13.5 - 15.0	38.9	6.4
6171SL		SS-6	18.5- 20.0	35.5	
6167SL	RB-8	SS-1	1.0 - 2.5	20.9	6.3
6171SL		SS-2	3.5 - 5.0	19.1	
6171SL		SS-3	6.0 - 7.5	27.8	
6171SL		SS-4	8.5 - 10.0	26.5	
6171SL		SS-5	13.5 - 15.0	37.3	
6171SL		SS-6	18.5 - 20.0	27.0	
6171SL		SS-7	23.5 - 25.0	34.5	

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

Project No.: STP-6647(002)
Des. Nos.: 0200775
Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132

6171SL	RB-9	SS-1	1.0 - 2.5	19.3	
6171SL		SS-2	3.5 - 5.0	18.6	
6171SL		SS-3	6.0 - 7.5	22.1	
6171SL	RB-10	SS-1	1.0 - 2.5	21.0	
6171SL		SS-2	3.5 - 5.0	19.0	
6171SL		SS-3	6.0 - 7.5	18.8	
6171SL		SS-4	8.5 - 10.0	18.1	
6171SL	RB-11	SS-1	1.0 - 2.5	23.0	
6171SL		SS-2	3.5 - 5.0	21.0	
6171SL		SS-3	6.0 - 7.5	39.6	
6171SL		SS-4	8.5 - 10.0	21.2	
6171SL		SS-5	11.0 - 12.5	46.4	
6171SL		SS-6	13.5 - 15.0	33.7	
6168SL		SS-8	23.5 - 25.0	24.7	7.5
6171SL		SS-10	33.5 - 35.0	25.8	
6171SL	RB-12	SS-1	1.0 - 2.5	22.3	
6171SL		SS-2	3.5 - 5.0	26.8	
6171SL		SS-3	6.0 - 7.5	31.1	
6171SL		SS-4	8.5 - 10.0	30.6	
6171SL	RB-13	SS-1	1.0 - 2.5	25.2	
6171SL		SS-2	3.5 - 5.0	22.3	
6171SL		SS-3	6.0 - 7.5	21.3	
6171SL		SS-4	8.5 - 10.0	21.2	
6171SL		SS-5	13.5 - 15.0	23.0	
6171SL		SS-6	18.5 - 20.0	29.6	
6171SL		SS-7	23.5 - 25.0	40.8	
6171SL		SS-9	33.5 - 35.0	26.2	
6927SL	TB-1A	BS-1	1.0 - 3.0	--	6.2
6171SL	TB-1	SS-1	1.0 - 2.5	26.5	
6171SL		SS-2	3.5 - 5.0	19.7	
6171SL		SS-3	6.0 - 7.5	21.6	
6171SL		SS-4	8.5 - 10.0	21.8	
6171SL		SS-5	13.5 - 15.0	21.2	
6171SL		SS-6	18.5 - 20.0	29.8	
6171SL	TB-2	SS-1	1.0 - 2.5	29.3	
6171SL		SS-2	3.5 - 5.0	22.9	
6171SL		SS-3	6.0 - 7.5	24.3	
6171SL		SS-4	8.5 - 10.0	23.1	

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

Project No.: STP-6647(002)
Des. Nos.: 0200775
Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132

6171SL	TB-2 (cont.)	SS-5	13.5 - 15.0	26.7	
6171SL		SS-6	18.5 - 20.0	21.4	
6171SL		SS-7	23.5 - 25.0	22.1	
6171SL		SS-8	28.5 - 30.0	37.3	
6171SL		SS-9	33.5 - 35.0	36.2	
6171SL	RW-3	SS-1	1.0 - 2.5	23.9	
6171SL		SS-2	3.5 - 5.0	23.1	
6171SL		SS-3	6.0 - 7.5	26.4	
6171SL		SS-4	8.5 - 10.0	27.2	
6171SL		SS-5	13.5 - 15.0	36.6	
6171SL		SS-6	18.5 - 20.0	38.5	
6171SL	RW-4	SS-1	1.0 - 2.5	27.3	
6171SL		SS-2	3.5 - 5.0	21.3	
6171SL		SS-3	6.0 - 7.5	23.1	
6171SL		SS-4	8.5 - 10.0	17.6	
6171SL		SS-5	13.5 - 15.0	38.9	
6171SL		SS-6	18.5 - 20.0	28.5	
6171SL		SS-7	23.5 - 25.0	58.6	
6171SL		SS-8	28.5 - 30.0	39.3	
6171SL	RW-5	SS-2	3.5 - 5.0	25.5	
6171SL		SS-3	6.0 - 7.5	23.7	
6171SL		SS-4	8.5 - 10.0	23.6	
6171SL		SS-5	13.5 - 15.0	34.0	
6171SL		SS-6	18.5 - 20.0	18.6	
6171SL		SS-7	23.5 - 25.0	35.5	
6171SL	B-1	SS-1	1.0 - 2.5	28.4	
6171SL		SS-2	3.5 - 5.0	23.7	
6171SL		SS-3	6.0 - 7.5	22.5	
6171SL		SS-4	8.5 - 10.0	23.6	
6171SL		SS-5	13.5 - 15.0	40.9	
6171SL	B-2	SS-1	1.0 - 2.5	32.4	
6171SL		SS-2	3.5 - 5.0	25.0	
6171SL		SS-3	6.0 - 7.5	22.7	
6171SL		SS-4	8.5 - 10.0	30.3	
6171SL		SS-5	13.5 - 15.0	28.0	
6171SL	B-3	SS-1	1.0 - 2.5	32.7	
6171SL		SS-2	3.5 - 5.0	22.6	
6171SL		SS-3	6.0 - 7.5	23.1	
6171SL		SS-4	8.5 - 10.0	26.5	

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

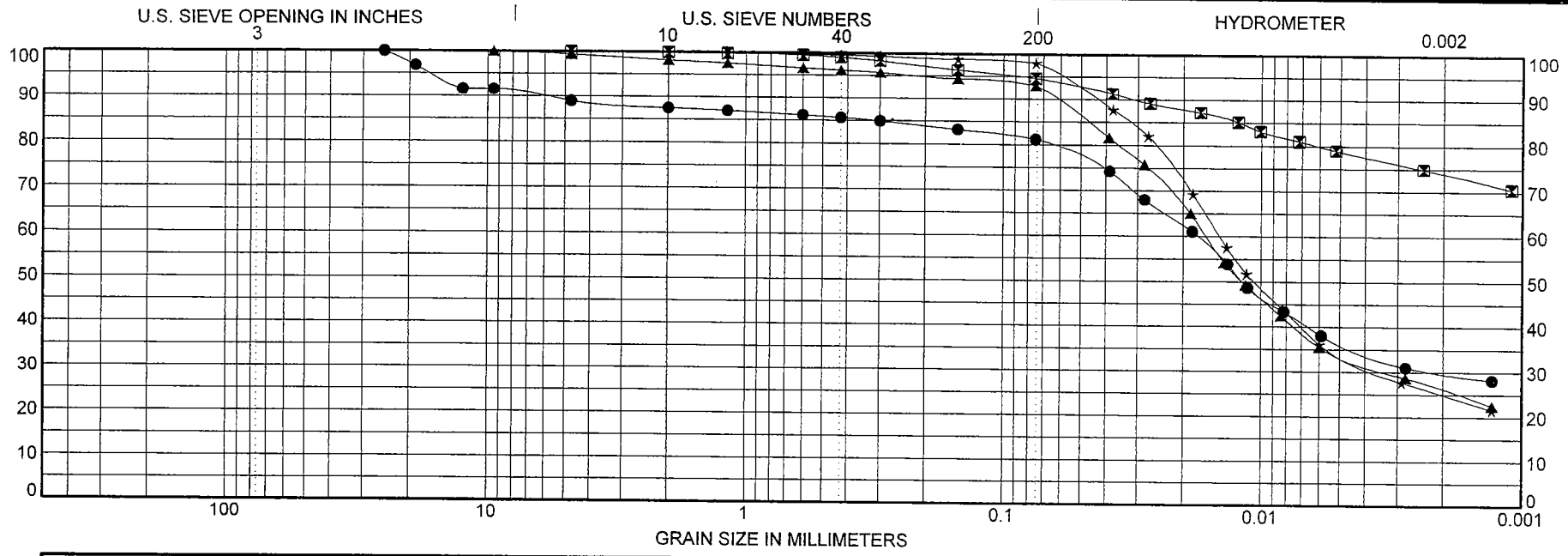
Project No.: STP-6647(002)
Des. Nos.: 0200775
Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132

6171SL	B-4	SS-1	1.0 - 2.5	29.6	
6171SL		SS-2	3.5 - 5.0	24.2	
6171SL		SS-3	6.0 - 7.5	23.3	
6171SL		SS-4	8.5 - 10.0	22.0	
6171SL	B-5	SS-1	1.0 - 2.5	31.2	
6171SL		SS-2	3.5 - 5.0	21.5	
6171SL		SS-3	6.0 - 7.5	20.1	
6171SL		SS-4	8.5 - 10.0	23.0	
6171SL		SS-5	13.5 - 15.0	37.5	
6171SL		SS-7	23.5 - 25.0	33.1	
6171SL	B-6	SS-1	1.0 - 2.5	29.2	
6171SL		SS-2	3.5 - 5.0	24.4	
6171SL		SS-3	6.0 - 7.5	23.0	
6171SL		SS-4	8.5 - 10.0	23.2	
6171SL		SS-5	13.5 - 15.0	26.0	
6171SL		SS-6	18.5 - 20.0	32.3	
6171SL		SS-7	23.5 - 25.0	29.3	
6171SL	B-7	SS-1	1.0 - 2.5	29.9	
6171SL		SS-2	3.5 - 5.0	20.5	
6171SL		SS-3	6.0 - 7.5	21.2	
6171SL		SS-4	8.5 - 10.0	21.6	
6171SL		SS-5	13.5 - 15.0	34.9	
6171SL		SS-6	18.5 - 20.0	27.8	
6171SL	B-8	SS-1	1.0 - 2.5	23.4	
6171SL		SS-2	3.5 - 5.0	21.8	
6171SL		SS-3	6.0 - 7.5	22.4	
6171SL		SS-4	8.5 - 10.0	33.0	
6171SL		SS-5	13.5 - 15.0	38.2	
6171SL		SS-6	18.5 - 20.0	21.7	
6171SL	B-9	SS-1	1.0 - 2.5	34.8	
6171SL		SS-2	3.5 - 5.0	23.0	
6171SL		SS-3	6.0 - 7.5	25.0	
6171SL		SS-4	8.5 - 10.0	25.9	
6171SL		SS-5	13.5 - 15.0	36.3	
6171SL		SS-6	18.5 - 20.0	28.0	
6171SL		SS-7	23.5 - 25.0	17.6	

SUMMARY OF SPECIAL LABORATORY TEST RESULTS

Project No.: STP-6647(002)
Des. Nos.: 0200775
Project: Hamilton Boulevard from SR 37 to Meridian Road
Location: Mitchell, Lawrence County, Indiana
Client: Strand Associates, Inc.
EEI Project No.: 1-04-132

6171SL	B-10	SS-1	1.0 - 2.5	34.5	
6171SL		SS-2	3.5 - 5.0	24.1	
6171SL		SS-3	6.0 - 7.5	22.0	
6171SL		SS-4	8.5 - 10.0	22.5	
6171SL	B-11	SS-1	1.0 - 2.5	32.0	
6171SL		SS-2	3.5 - 5.0	23.2	
6171SL		SS-3	6.0 - 7.5	25.2	
6171SL		SS-4	8.5 - 10.0	38.6	
6171SL		SS-5	13.5 - 15.0	31.7	
6171SL	B-12	SS-1	1.0 - 2.5	29.5	
6171SL		SS-2	3.5 - 5.0	22.6	
6171SL		SS-3	6.0 - 7.5	23.9	
6171SL	B-13	SS-1	1.0 - 2.5	27.7	
6171SL		SS-2	3.5 - 5.0	21.3	
6171SL		SS-3	6.0 - 7.5	23.1	
6171SL		SS-4	8.5 - 10.0	24.3	
6171SL		SS-5	13.5 - 15.0	20.9	
6171SL		SS-6	18.5 - 20.0	39.5	
6171SL		SS-7	23.5 - 25.0	46.2	
6171SL	B-14	SS-1	1.0 - 2.5	28.6	
6171SL		SS-2	3.5 - 5.0	24.4	
6171SL		SS-3	6.0 - 7.5	20.7	
6171SL		SS-4	8.5 - 10.0	20.3	
6171SL		SS-5	13.5 - 15.0	27.4	
6171SL		SS-6	18.5 - 20.0	39.7	



BOULDERS	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Lab No.	Boring	Station/Offset/Line	Sample No.	Depth ft	Classification	% Passing			% Gravel	% Sand	% Silt	% Clay	% Coll.	LL	PL	PI	Opt. Moist.	ϒmax pcf	* CBR at	
							No.10	No.40	No.200											93%	97%
●	6168SL	RB-11	97+50 C.L. "A"	SS-8	23.5 - 25.0	SILTY CLAY LOAM A-7-6 (22)	87.5	85.6	81.1	12.5	6.4	51.3	29.8	27.6	43	15	28				
⊠	6166SL	RB-7	69+13 8 ft Rt. "A"	SS-5	13.5 - 15.0	CLAY A-7-6 (84)	99.9	99.1	94.6	0.1	5.3	20.7	73.9	70.0	104	27	77				
▲	6167SL	RB-8	76+25 21 ft Rt. "A"	SS-1	1.0 - 2.5	SILTY CLAY LOAM A-6 (18)	98.2	96.2	93.0	1.8	5.2	67.0	26.0	20.2	37	18	19				
★	6927SL	TB-1A	59+23 23 ft Lt. "A"	BS-1	1.0 - 3.0	SILTY CLAY LOAM A-6 (10)	99.8	99.5	98.1	0.2	1.7	73.2	24.9	20.0	30	19	11	17.7	107.3	3.5	7.1

EARTH EXPLORATION, Inc.

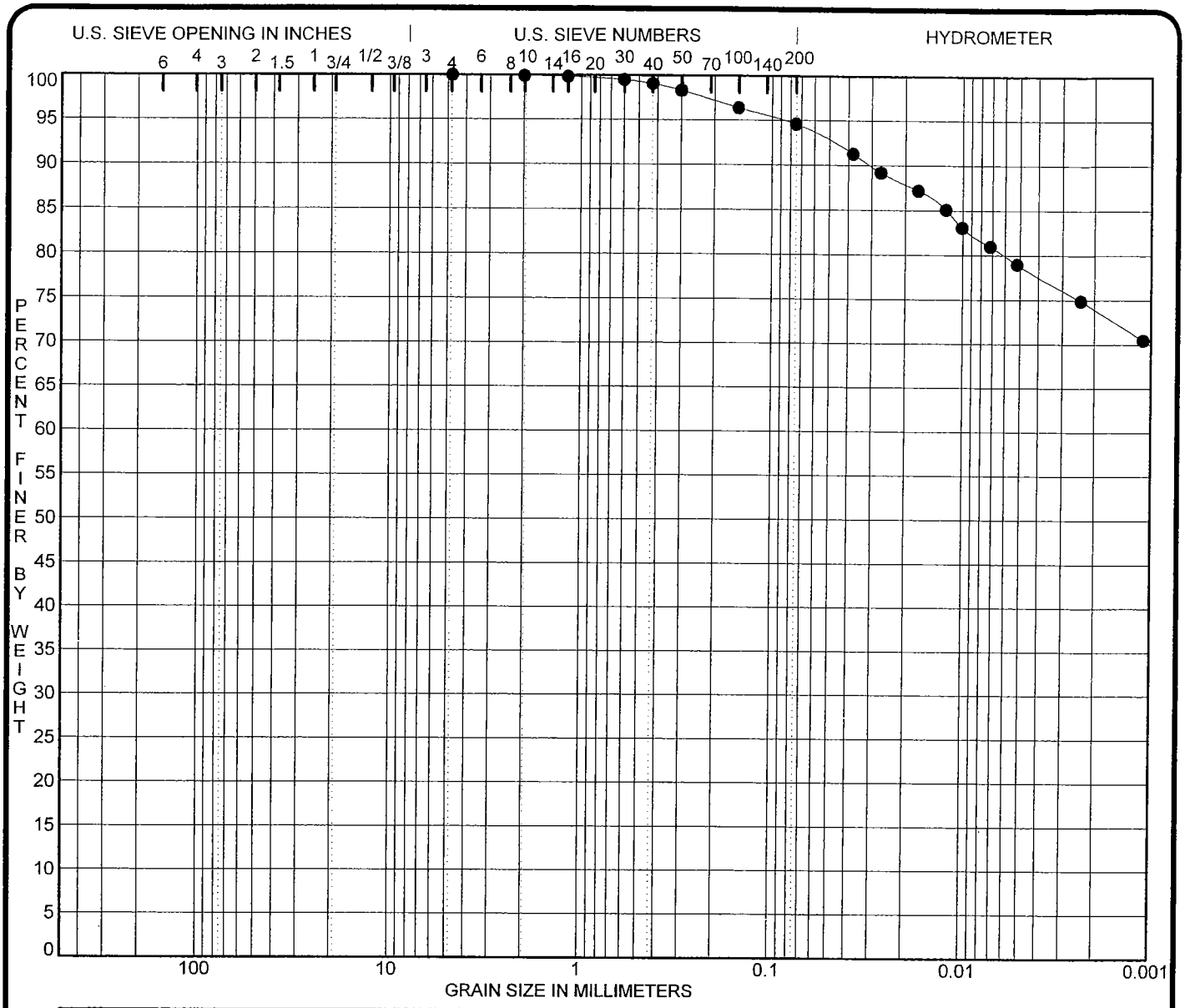
Project No. STP-6647 (002)
Structure No. ---
EEI Project No. 1-04-132

Project Location Hamilton Blvd from SR 37 to Meridian Road
Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

SUMMARY OF CLASSIFICATION TEST RESULTS

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

* See text for recommended values.



BOULDERS	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Sample Identification		Station / Offset / Line	Depth, ft.	Elevation, USCGS
●	RB-7	SS-5	69+13 8 ft Rt. "A"	13.5 - 15.0 ft.	665.0 -

Lab No.	Classification	pH	%Gravel	%Sand	%Silt	%Clay	MC%	LL	PL	PI
6166SL	CLAY A-7-6 (84)	6.4	0.1	5.3	20.7	73.9	38.9	104	27	77

Remarks:

EARTH EXPLORATION, Inc.

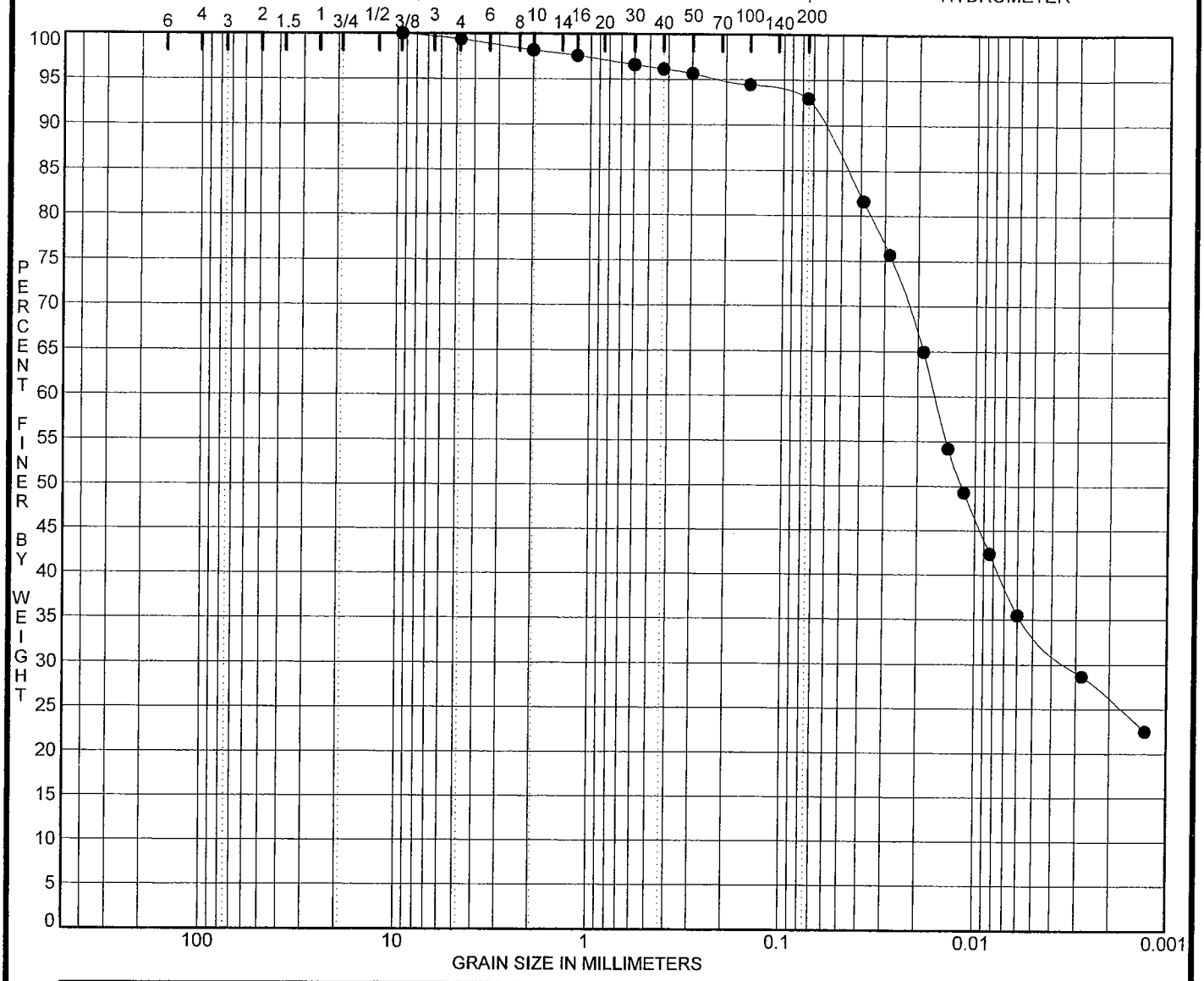
Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Mitchell, Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



BOULDERS	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Sample Identification		Station / Offset / Line	Depth, ft.	Elevation, USCGS
●	RB-8	SS-1	76+25 21 ft Rt. "A"	1.0 - 2.5 ft.	674.5 -

Lab No.	Classification	pH	%Gravel	%Sand	%Silt	%Clay	MC%	LL	PL	PI
6167SL	SILTY CLAY LOAM A-6 (18)	6.3	1.8	5.2	67.0	26.0	20.9	37	18	19

Remarks:

EARTH EXPLORATION, Inc.

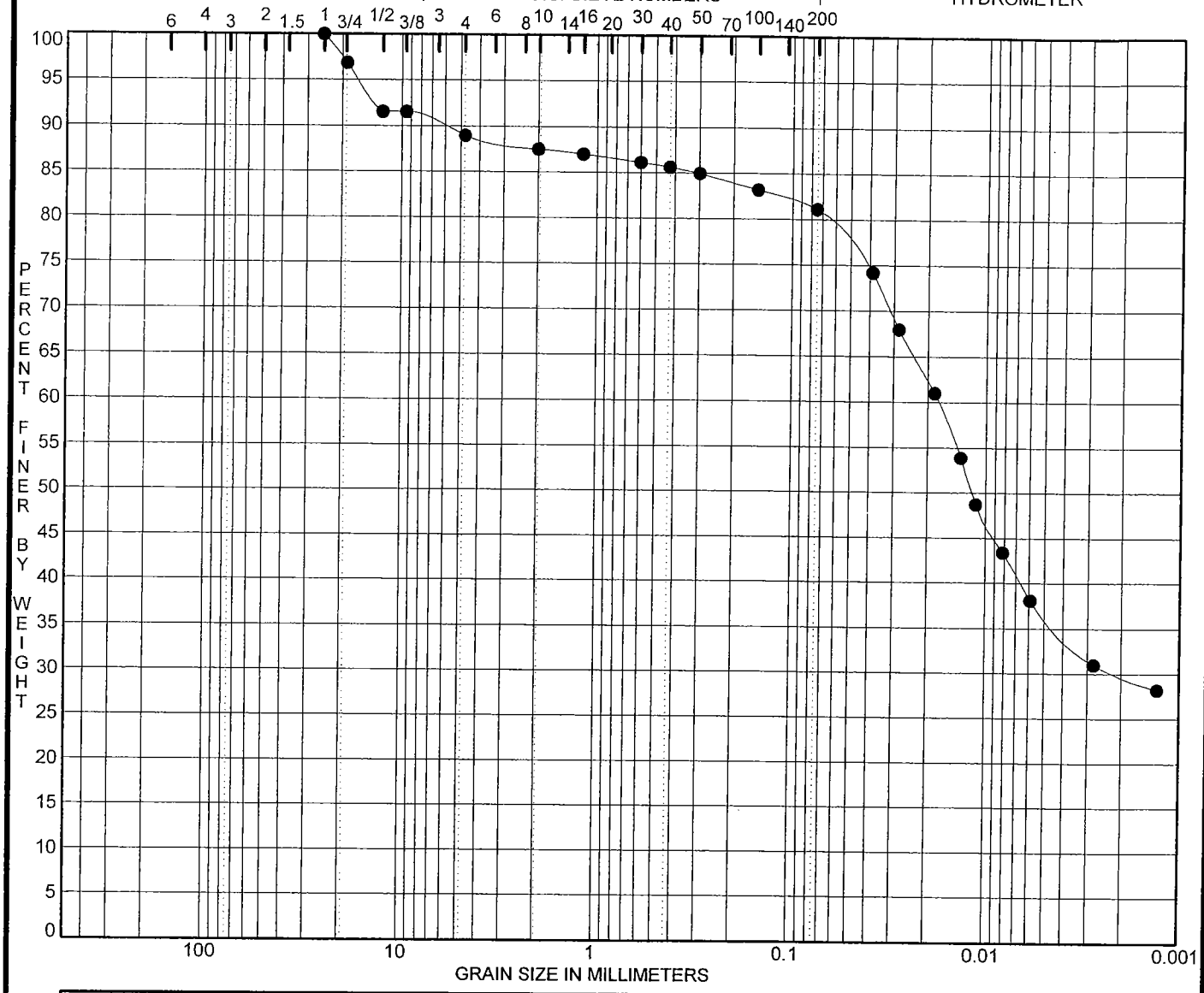
Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Mitchell, Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



BOULDERS	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Sample Identification	Station / Offset / Line	Depth, ft.	Elevation, USCGS
●	RB-11 SS-8	97+50 C.L. "A"	23.5 - 25.0 ft.	633.0 -

Lab No.	Classification	pH	%Gravel	%Sand	%Silt	%Clay	MC%	LL	PL	PI
6168SL	SILTY CLAY LOAM A-7-6 (22)	7.5	12.5	6.4	51.3	29.8	24.7	43	15	28

Remarks:

EARTH EXPLORATION Inc

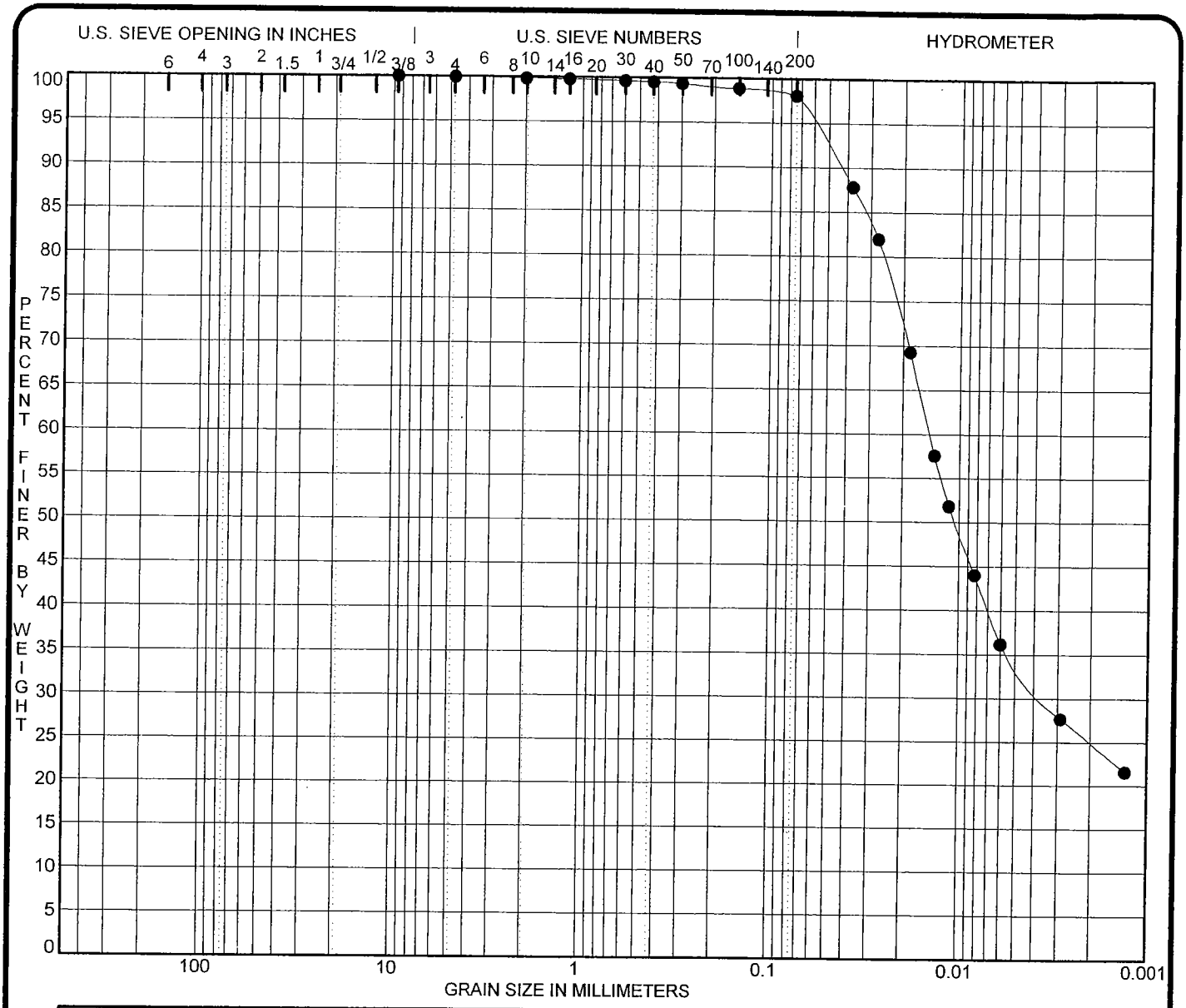
Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Mitchell, Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



BOULDERS	GRAVEL	SAND		SILT	CLAY
		coarse	fine		

	Sample Identification		Station / Offset / Line	Depth, ft.	Elevation, USCGS
●	TB-1A	BS-1	59+23 23 ft Lt. "A"	1.0 - 3.0 ft.	677.5 - 675.5

Lab No.	Classification	pH	%Gravel	%Sand	%Silt	%Clay	MC%	LL	PL	PI
6927SL	SILTY CLAY LOAM A-6 (10)	6.2	0.2	1.7	73.2	24.9	---	30	19	11

Remarks:

EARTH EXPLORATION Inc

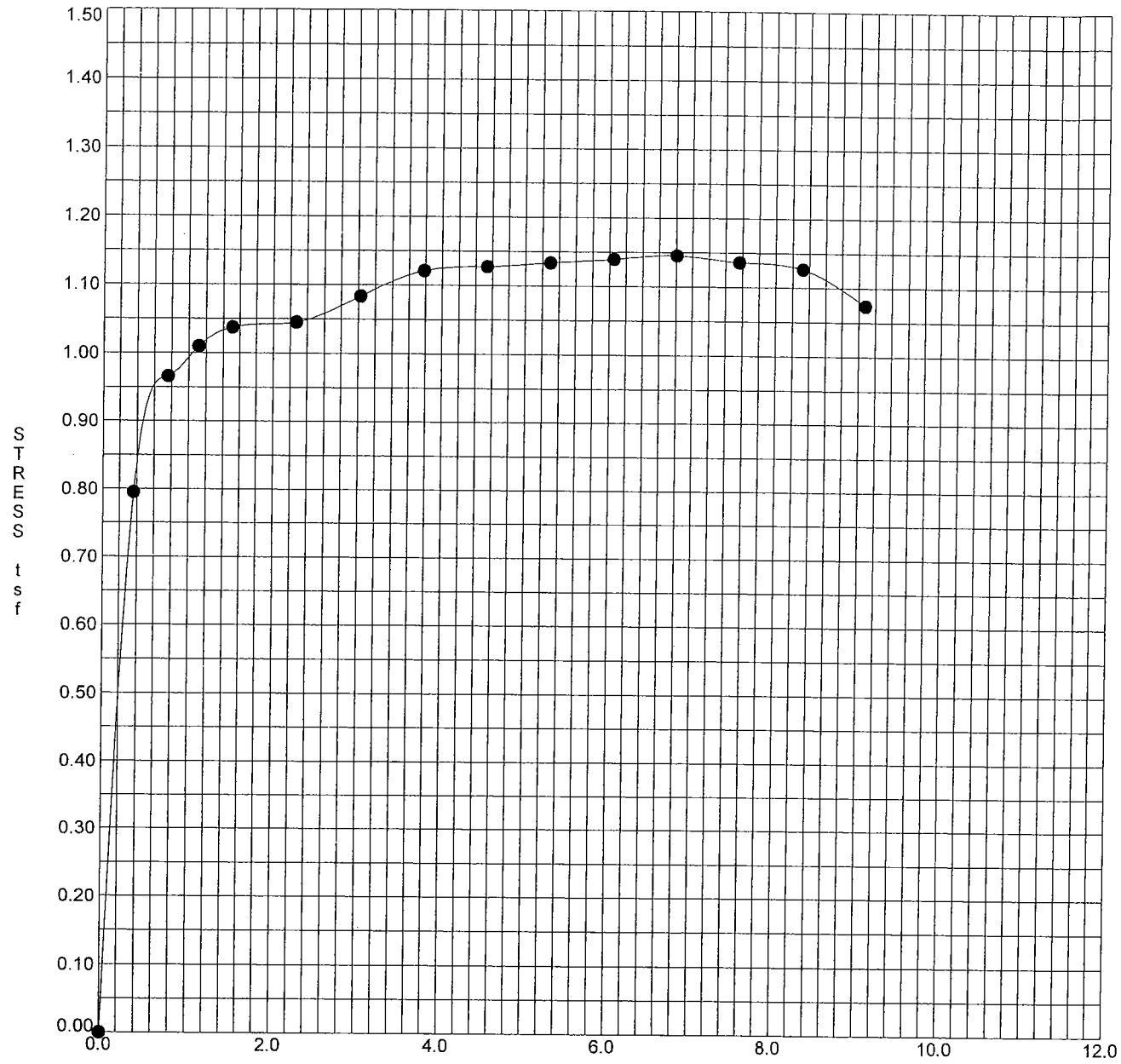
Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Mitchell, Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

GRAIN SIZE DISTRIBUTION CURVE

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



	Sample Identification	Station / Offset / Line	Depth, ft	Classification
●	TB-2 SS-4	60+45 25 ft Rt. "A"	8.5 - 10.0	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6170SL	70.5	34.1	23.1	126.2	102.5	94.2	1.15	6.8	1.5

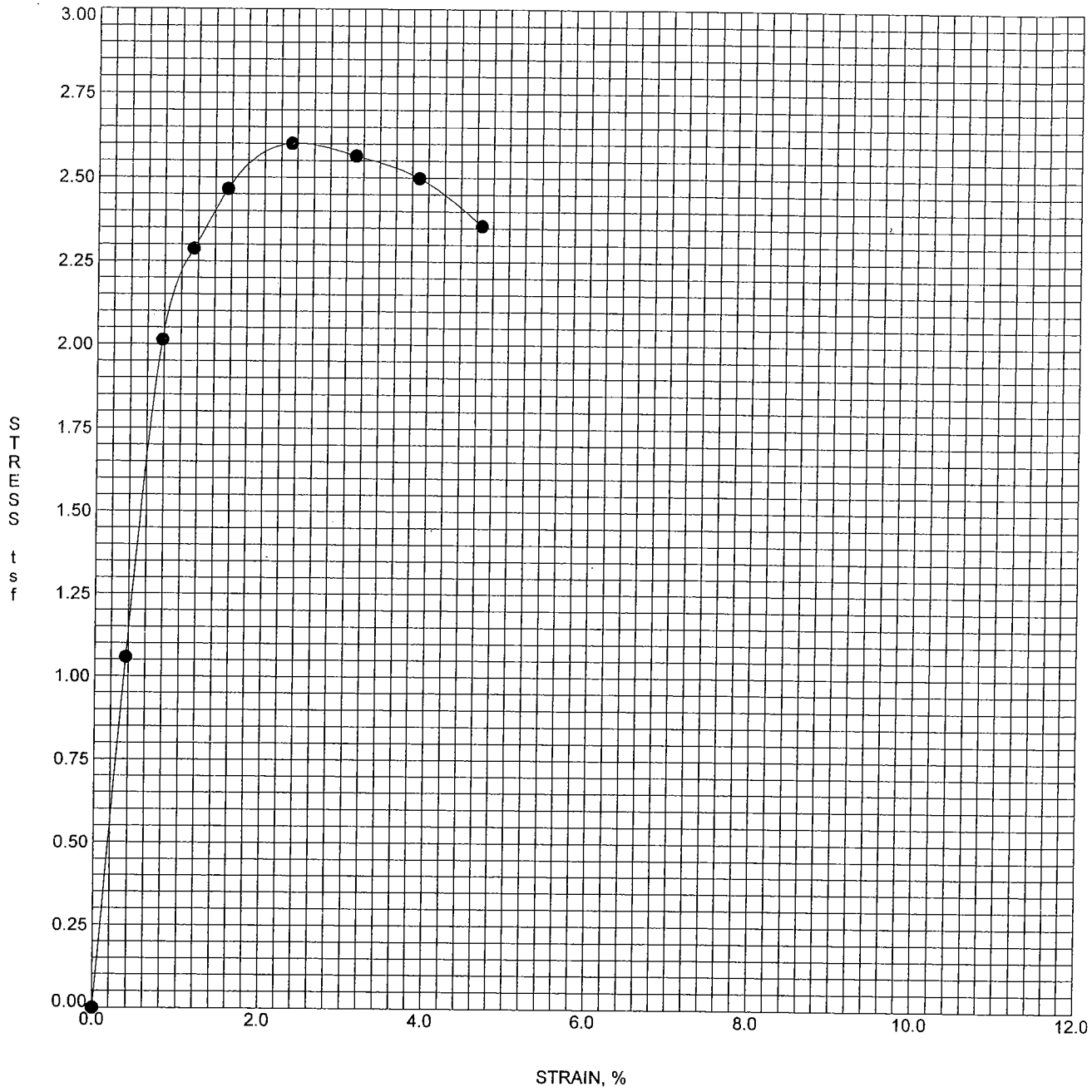
EARTH EXPLORATION Inc

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



Sample Identification	Station / Offset / Line	Depth, ft	Classification
● RW-5 SS-5	58+00 100 ft Lt. "A"	13.5 - 15.0	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6169SL	68.7	34.3	34.0	117.5	87.7	97.5	2.60	2.3	1.6

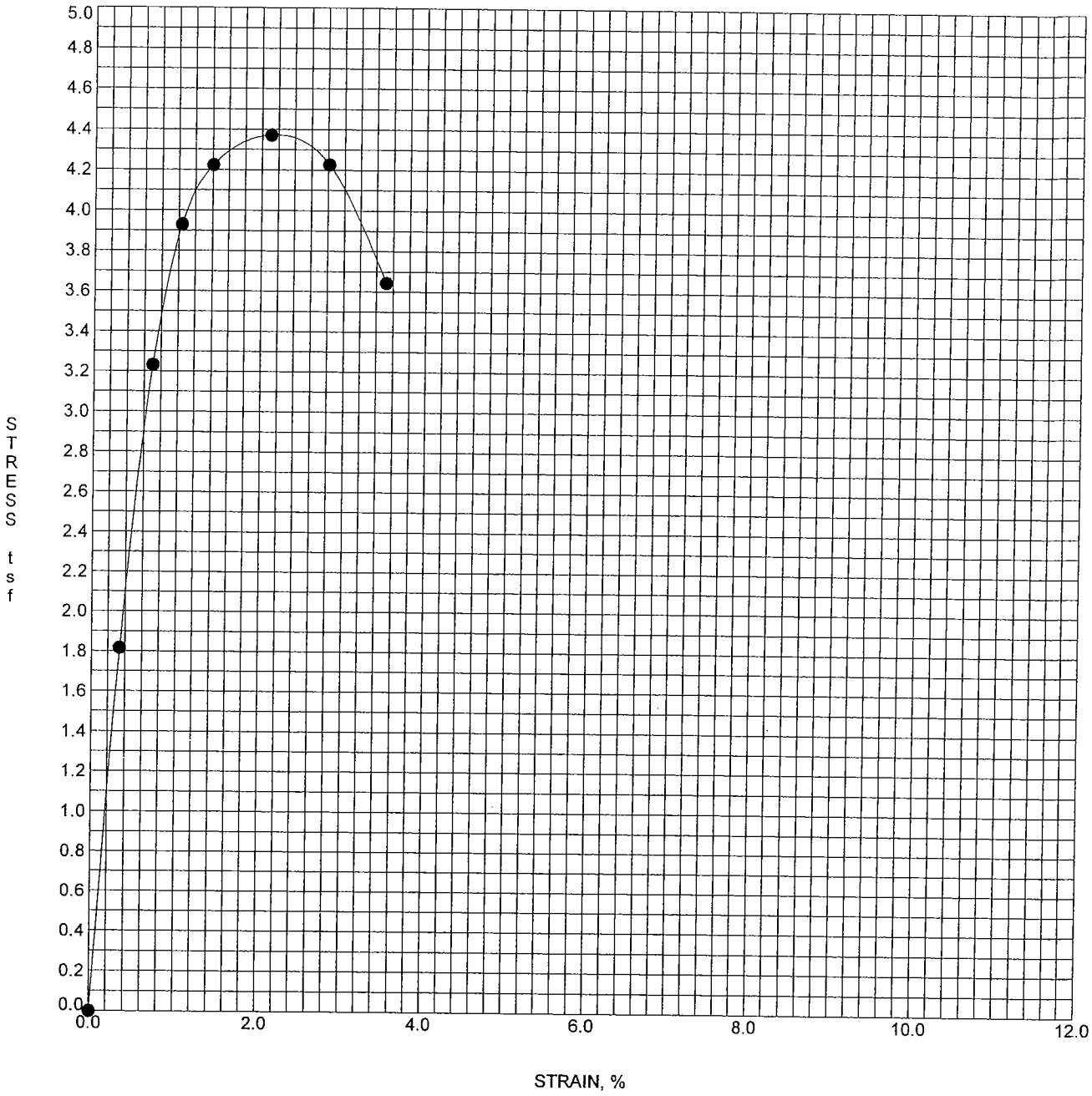
EARTH EXPLORATION Inc

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



Sample Identification	Station / Offset / Line	Depth, ft	Classification
● B-2 SS-3	49+65 C.L. "A"	6.0 - 7.5	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6928SL	75.8	37.8	22.7	127.7	104.1	97.8	4.37	2.1	1.4

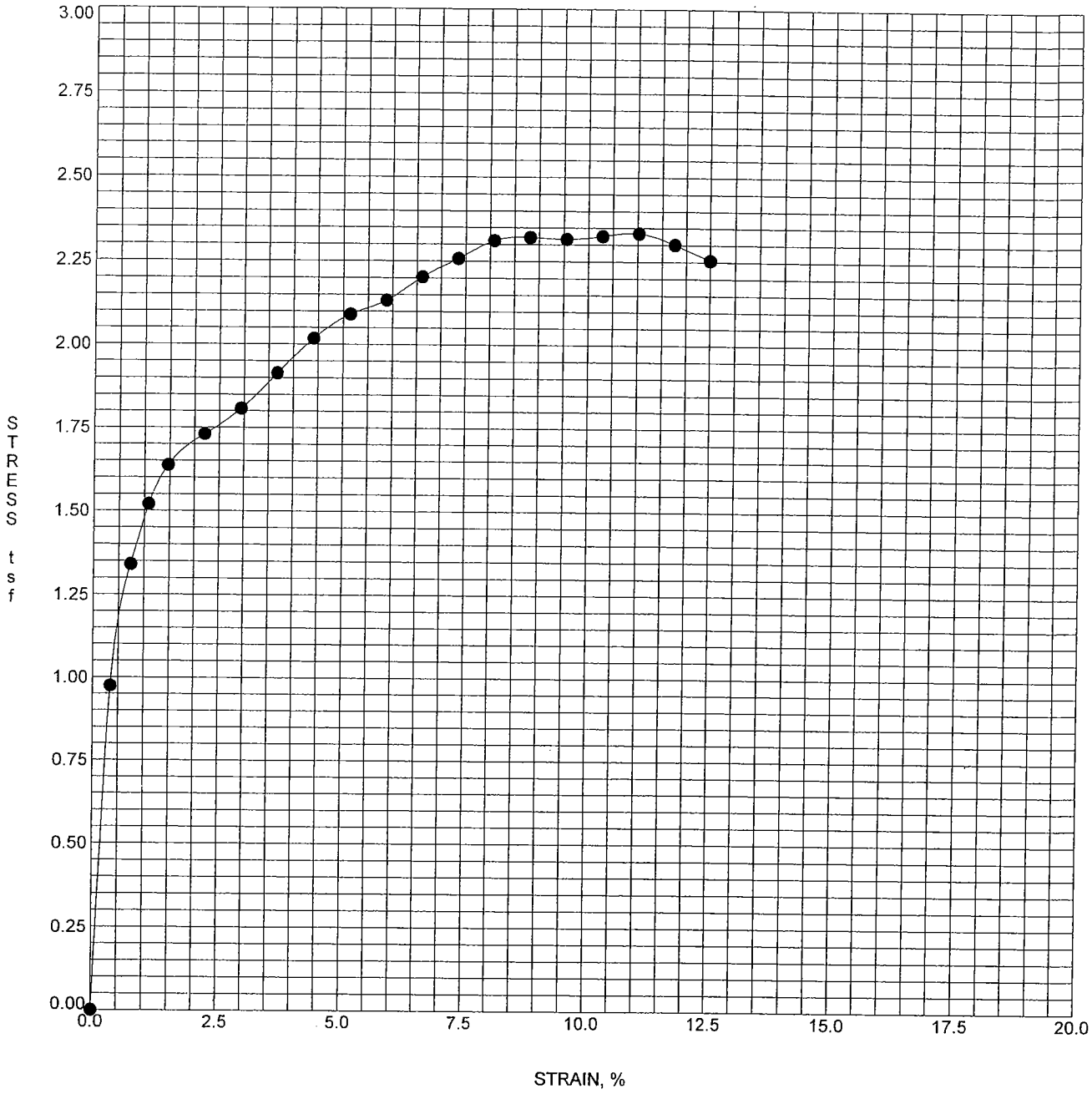
EARTH EXPLORATION Inc

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



	Sample Identification	Station / Offset / Line	Depth, ft	Classification
●	B-4 SS-4	51+00 83 ft Rt. "A"	8.5 - 10.0	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6929SL	72.6	34.6	22.0	127.3	104.3	95.3	2.33	11.0	1.5

EARTH EXPLORATION Inc

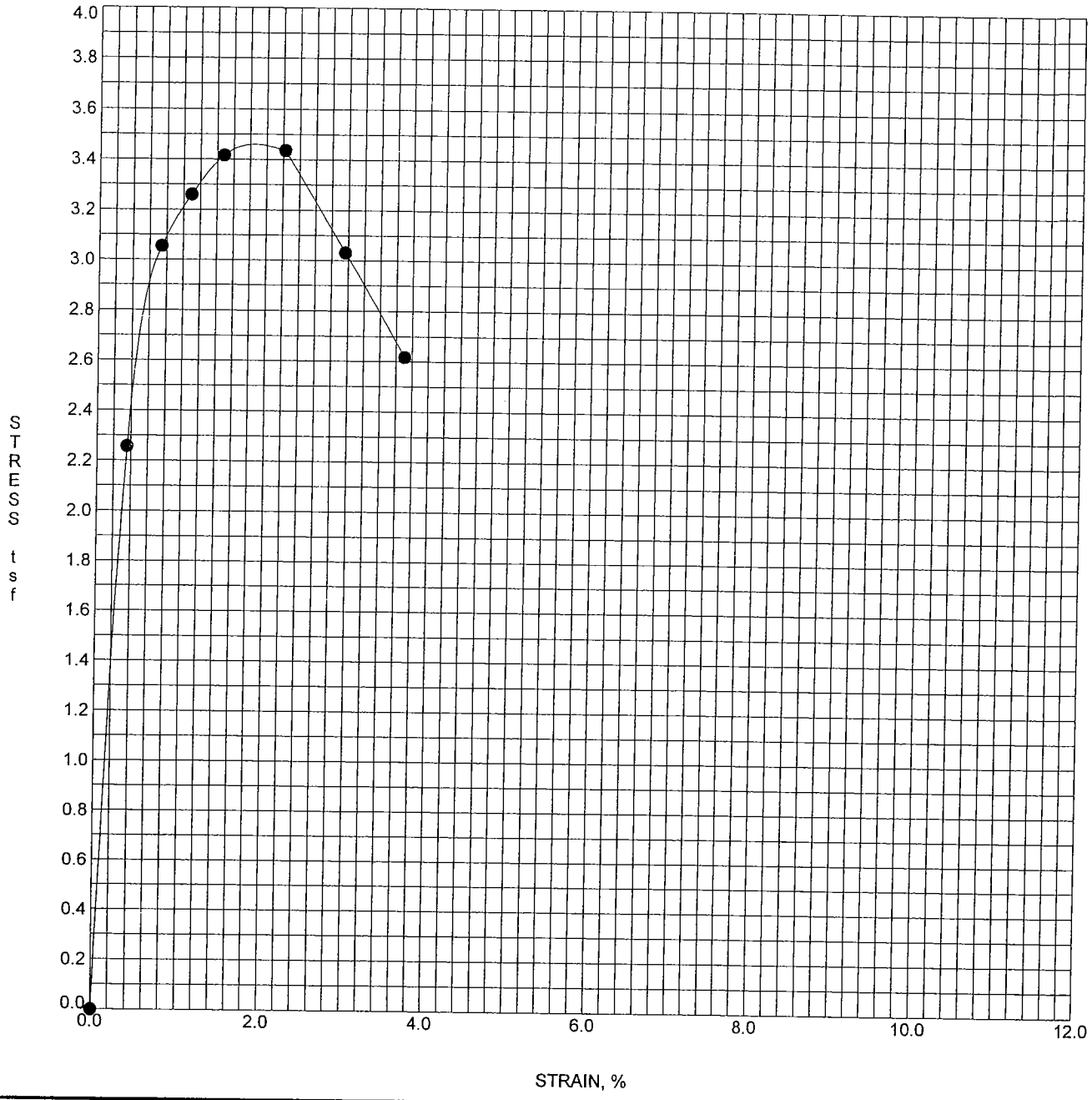
Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Mitchell, Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



Sample Identification	Station / Offset / Line	Depth, ft	Classification
● B-5 SS-5	52+42 14 ft Lt. "A"	13.5 - 15.0	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6930SL	72.0	34.5	37.5	114.5	83.3	98.3	3.44	2.2	1.5

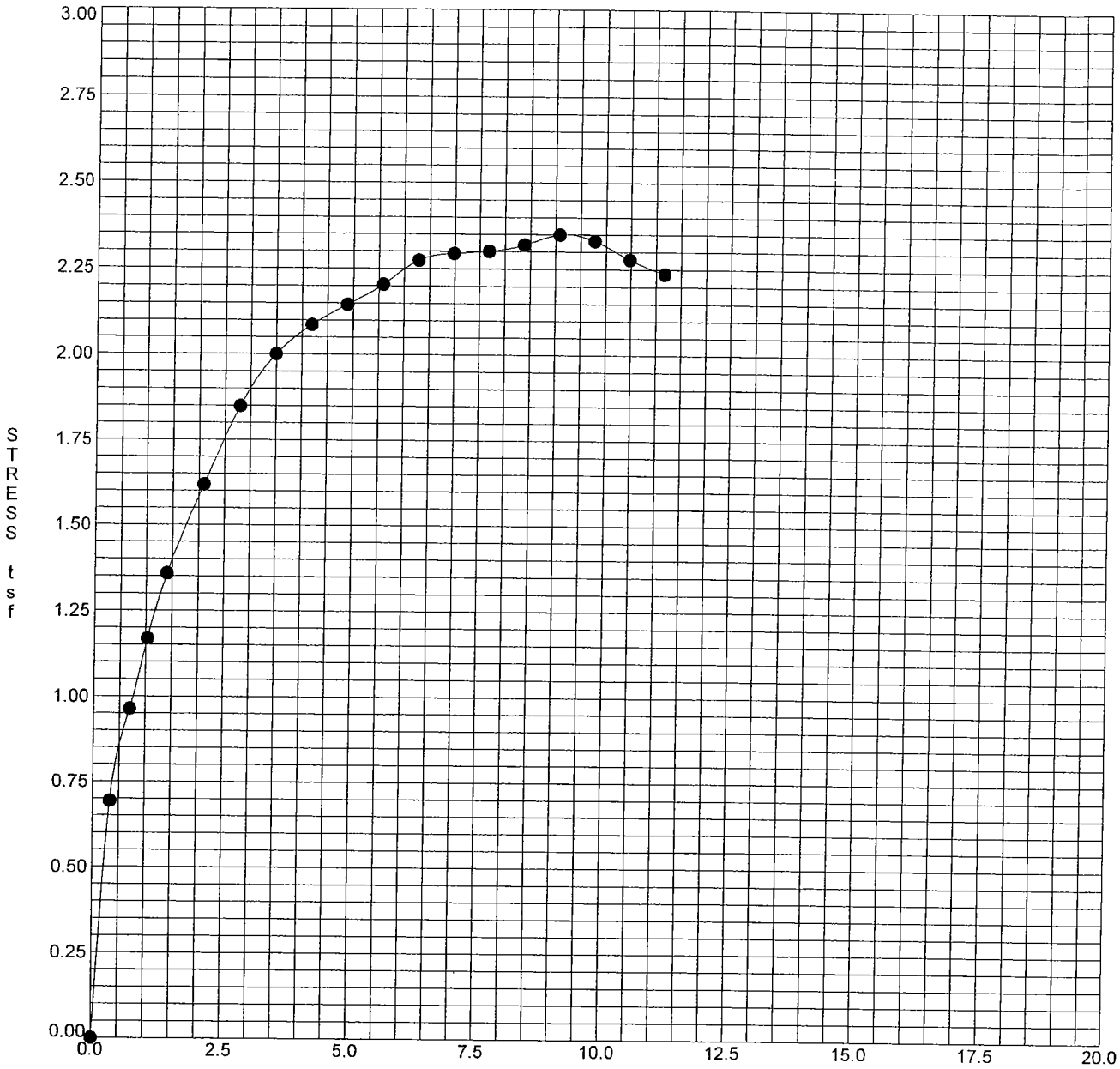
EARTH EXPLORATION, Inc.

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



	Sample Identification	Station / Offset / Line	Depth, ft	Classification
●	B-8 SS-3	53+98 86 ft Rt. "A"	6.0 - 7.5	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6931SL	76.4	37.7	22.4	127.4	104.0	96.5	2.35	9.1	1.4

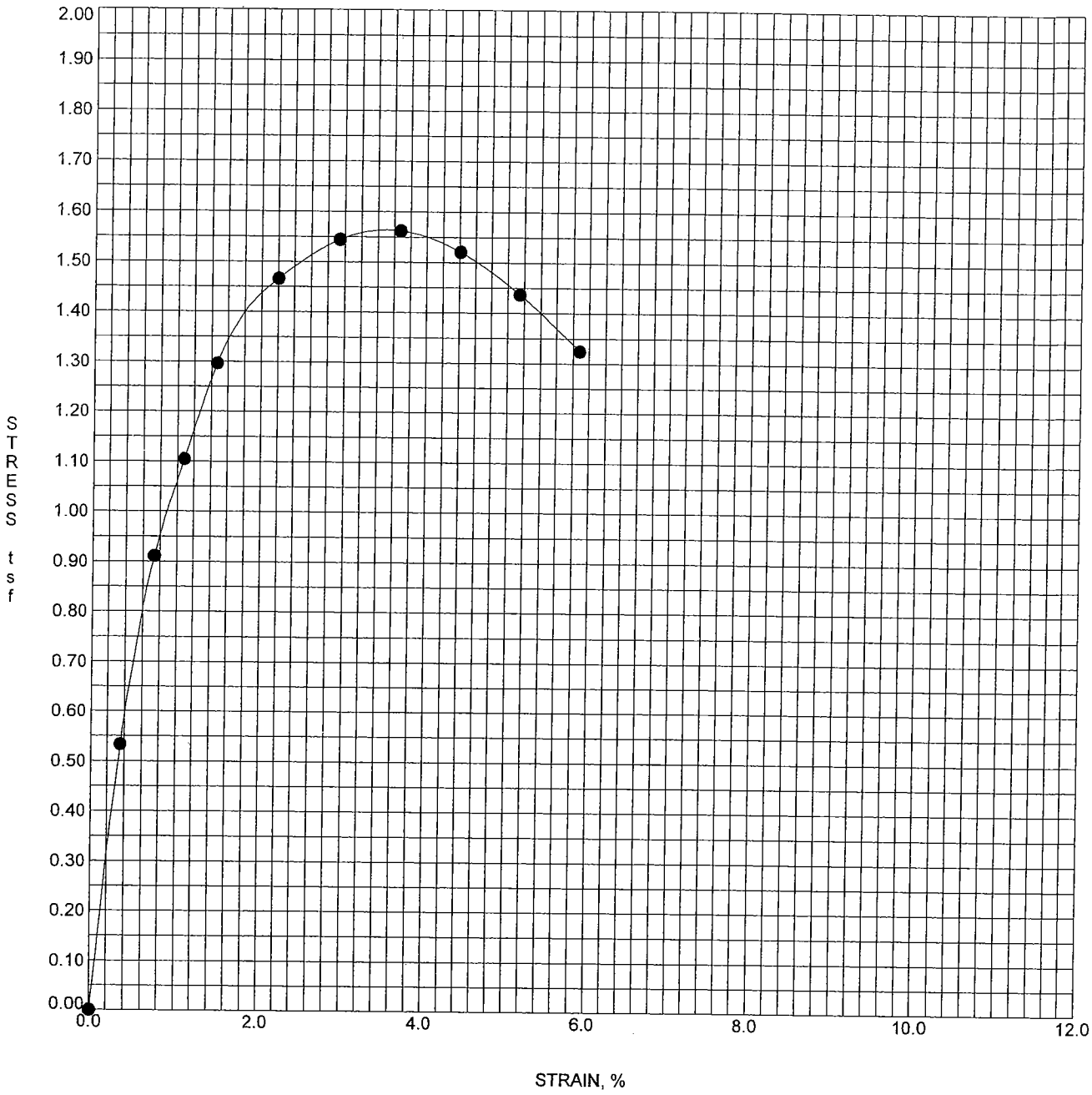
EARTH EXPLORATION, Inc.

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



	Sample Identification	Station / Offset / Line	Depth, ft	Classification
●	B-12 SS-2	56+00 92 ft Rt. "A"	3.5 - 5.0	SILTY CLAY LOAM

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6932SL	72.6	34.9	22.6	126.2	103.0	94.6	1.56	3.7	1.5

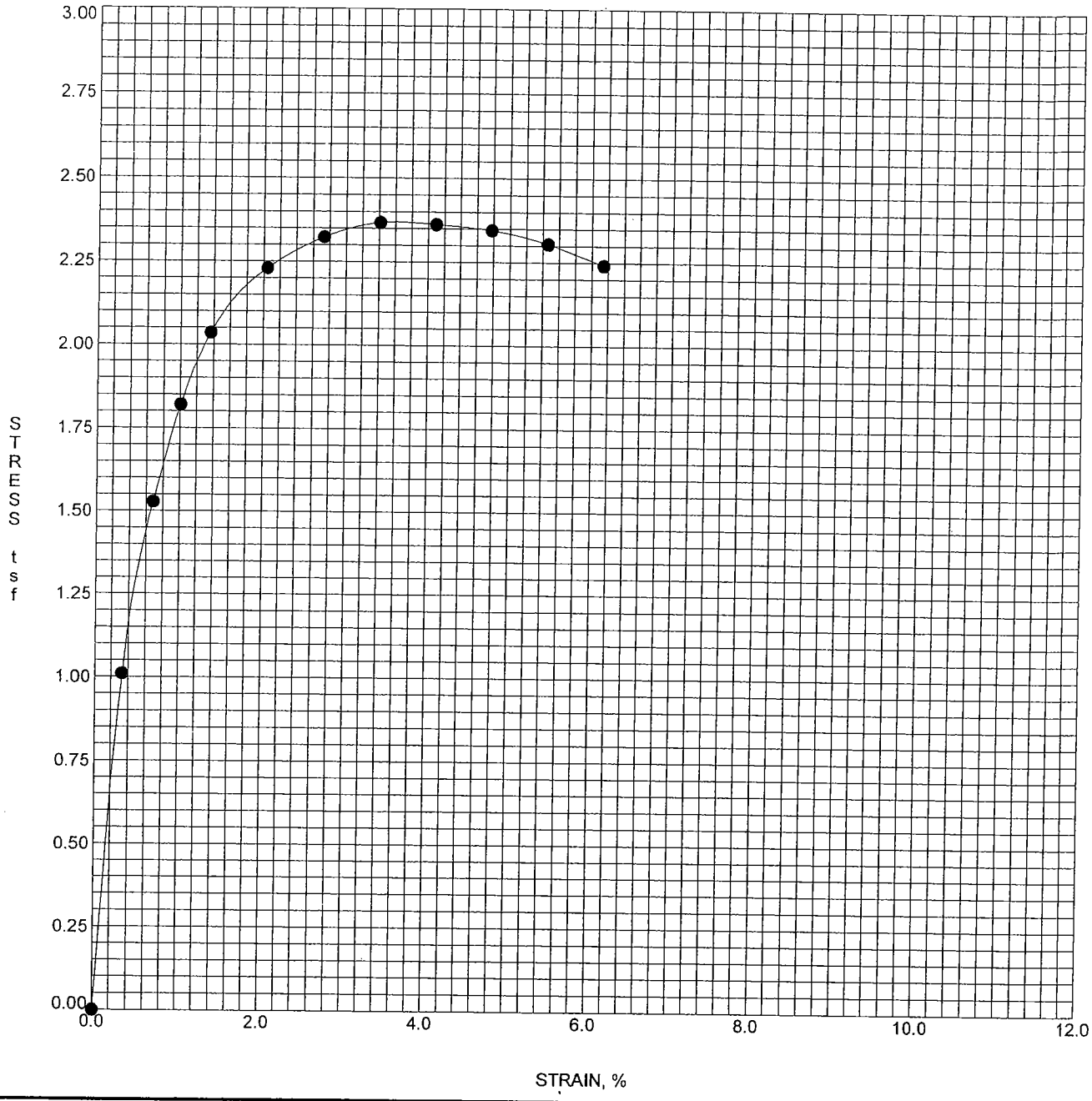
EARTH EXPLORATION Inc

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



	Sample Identification	Station / Offset / Line	Depth, ft	Classification
●	B-13 SS-4	59+00 63 ft Rt. "A"	8.5 - 10.0	SILTY CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6933SL	78.1	38.6	24.3	126.8	102.0	99.5	2.37	3.4	1.4

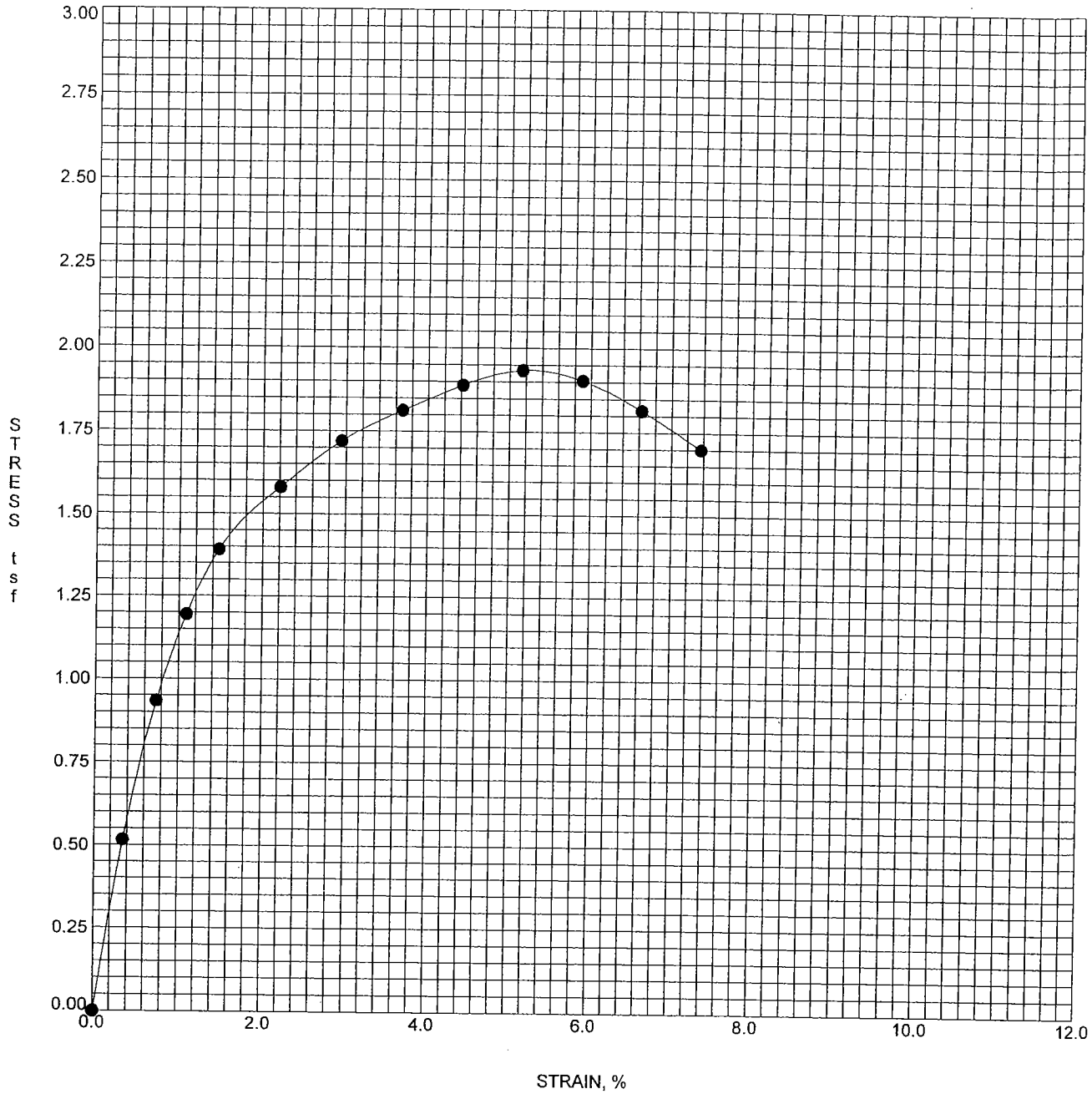
EARTH EXPLORATION, Inc.

Project No. STP-6647 (002)
Structure No. ---
EEI Proj. No. 1-04-132

Project Hamilton Blvd from SR 37 to Meridian Road
Location Mitchell, Lawrence County, Indiana
Client Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



	Sample Identification	Station / Offset / Line	Depth, ft	Classification
●	B-14 SS-3	59+50 62 ft Rt. "A"	6.0 - 7.5	CLAY

Lab No.	Sample Ht., mm	Sample Diam., mm	Initial M.C., %	Initial Wet Den, pcf	Initial Dry Den, pcf	Sat., %	Unc. Comp. Strength, tsf	Failure Strain, %	Rate of Strain to Failure, %
6934SL	72.4	34.4	20.7	128.3	106.3	94.3	1.93	5.2	1.5

EARTH EXPLORATION Inc

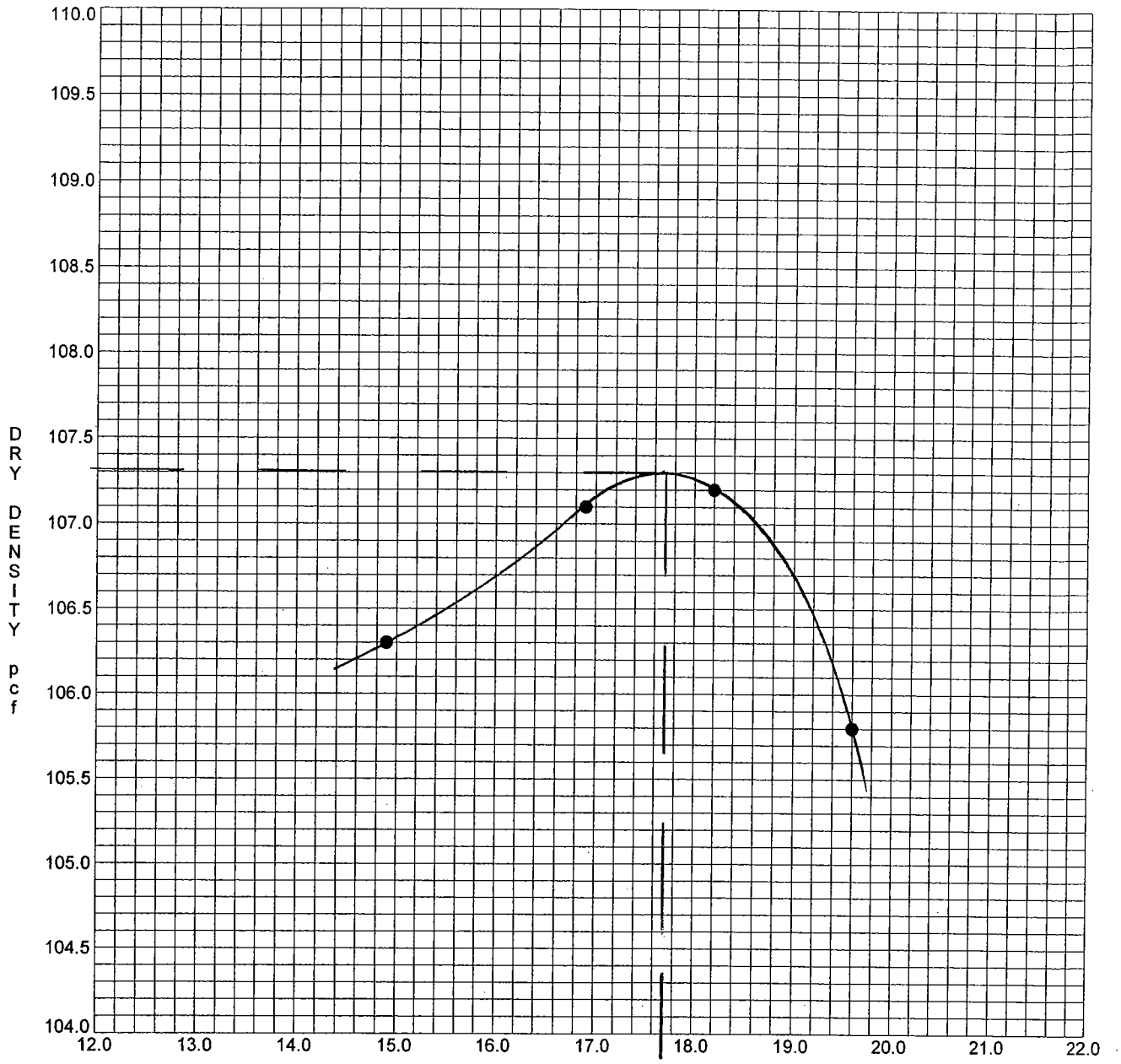
Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Mitchell, Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

UNCONFINED COMPRESSION TEST

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)



Sample Identification	Station / Offset / Line	Depth, ft.	Elevation, USC+GS
● TB-1A BS-1	59+23 23 ft Lt. "A"	1.0 - 3.0	677.5 - 675.5

Lab No.	Classification	As Received M.C., %	Optimum M.C., %	Maximum Dry Den., pcf	Test Method
6927SL	SILTY CLAY LOAM A-6 (10)	---	17.7	107.3	AASHTO T 99

EARTH EXPLORATION Inc

Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

MOISTURE - DENSITY RELATIONS

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

SUMMARY OF CBR TEST RESULTS

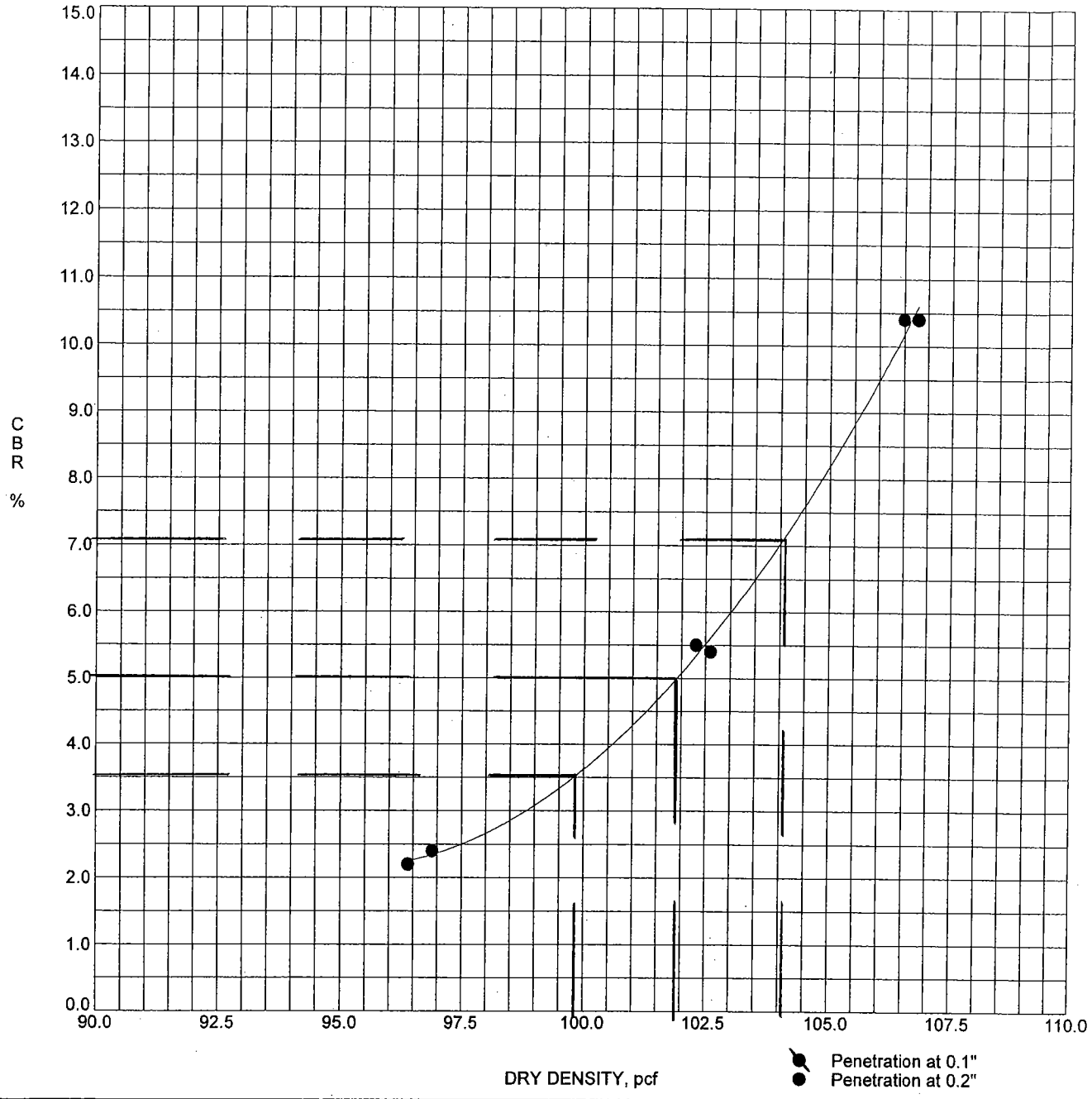
PROJECT:	Hamilton Boulevard from SR 37 to Meridian Road
LOCATION:	Lawrence County, Indiana
CLIENT:	Strand Associates, Inc.
EEI PROJECT NO.:	1-04-132
BORING NO.:	TB-1A
LOCATION:	59+23, 23' Lt. "A"
SAMPLE DEPTH, ft:	1.0 - 3.0
SOIL DESCRIPTION:	Silty Clay Loam, A-6(10)
MAXIMUM DRY DENSITY, pcf:	107.3
OPT. MOISTURE CONTENT, %:	17.7
SURCHARGE WEIGHT, lbs:	25.0

TEST DATA

Specimen No.	Blows/ Layer	Initial Dry Density, pcf	% Max. Dry Density	Avg. Water Content, %		Swell, %	CBR, % @ 0.1" Pen.	CBR, % @ 0.2" Pen.
				As Molded	After Soaking			
1	56	106.8	99.5	17.8	18.8	0.15	9.3	10.4
2	56	106.5	99.3	17.9	19.2	0.22	9.4	10.4
3	30	102.6	95.6	18.0	21.1	0.33	5.2	5.4
4	30	102.3	95.3	17.7	21.4	0.35	5.3	5.5
5	19	96.9	90.4	17.9	23.4	0.41	2.2	2.4
6	19	96.4	89.9	17.8	23.4	0.41	2.0	2.2

TEST RESULTS

Dry Density, pcf	Percent Maximum Dry Density	CBR, %
99.8	93.0	3.5
101.9	95.0	5.0
104.1	97.0	7.1



Sample Identification		Station / Offset / Line	Depth, ft.	Classification
TB-1A	BS-1	59+23 23 ft Lt. "A"	1.0 - 3.0	SILTY CLAY LOAM A-6 (10)

Lab No.	Maximum Wet Den, pcf	Maximum Dry Den, pcf	Optimum M.C., %	LL	PL	PI	CBR at 93%	CBR at 95%	CBR at 97%
6927SL	126.3	107.3	17.7	30	19	11	3.5	5.0	7.1

% Passing No. 10	% Passing No. 40	% Passing No. 200	%Gravel	%Sand	%Silt	%Clay
99.8	99.5	98.1	0.2	1.7	73.2	24.9

EARTH EXPLORATION Inc

Project No. STP-6647 (002) **Project** Hamilton Blvd from SR 37 to Meridian Road

Structure No. --- **Location** Lawrence County, Indiana

EEI Proj. No. 1-04-132 **Client** Strand Associates, Inc.

CALIFORNIA BEARING RATIO

Earth Exploration, Inc.
7770 West New York Street Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

APPENDIX F

PRELIMINARY ROCK SOCKET ANALYSIS FOR DRILLED SHAFT AT BRIDGE

PRELIMINARY LATERALLY LOADED PILE ANALYSIS

SPECIAL PROVISION FOR DRILLED SHAFT FOUNDATIONS

Project: Hamilton Boulevard				EARTH EXPLORATION, Inc.
EEI Proj. No.: 1-04-132	Date: 9/27/06	By: CRB	Rev. By: SJL	

Preliminary Rock Socket Analysis for Drilled Shaft at Bridge

DETERMINE REQUIRED ROCK SOCKET TO ADEQUATELY SUPPORT A LOAD OF 433.6 K (AS PROVIDED BY STRAND), i.e, MAXIMUM LOAD.

NEGLECT END BEARING FROM SHAFT AND ONLY CONSIDER SIDE SHEAR INTERACTION BETWEEN SHAFT AND ROCK. ASSUME A 3-FT DIAMETER SHAFT.

$f_c' = 3$ ksi , $q_u > f_c'$

FOR A SMOOTH ROCK SOCKET, DETERMINE THE SOCKET DEPTH

$$F_{MAX} = 0.65 p_a [f_c' / p_a]^{0.5} \quad : f_c' = 3 \text{ksi} = 432 \text{ksf}$$

$$p_a = 2.1$$

$$= 0.65 (2.1) [432 / 2.1]^{0.5} = 19.6 \text{ ksf}$$

$$R_T = R_B^{0} + R_S$$

$$(F_S) R_S = \pi B L F_{MAX}$$

USE F.S. 1.5

$$(1.5)(433.6) = \pi (3)(L)(19.6)$$

$$L = 3.5 \text{ Ft}$$

USE MINIMUM OF 5 Ft

DUE TO INCONSISTENCIES OF ROCK

Licensed to: CBradburn
Earth Exploration

LATERALLY LOADED PILE ANALYSIS PROGRAM LPILE plus
PC VERSION 3.0 (C) COPYRIGHT ENSOFT,INC. 1997
THE PROGRAM WAS COMPILED USING MICROSOFT FORTRAN COMPILER,
(C) COPYRIGHT MICROSOFT CORPORATION

Hamilton Boulevard (deep)

****
ULTIMATE BENDING RESISTANCE AND FLEXURAL RIGIDITY
****

DIAMETER = 36.00 IN
CONCRETE COMPRESSIVE STRENGTH = 3.000000 KIP/IN**2
REBAR YIELD STRENGTH = 60.000000 KIP/IN**2
MODULUS OF ELASTICITY OF STEEL = 29000.000000 KIP/IN**2
NUMBER OF REINFORCING BARS = 13
AREA OF ONE REBAR = .790E+00 IN**2
NUMBER OF ROWS OF REINFORCING BARS = 13
COVER THICKNESS = 3.000 IN

SQUASH LOAD CAPACITY = 3185.60 KIP

ROW NUMBER	AREA OF REINFORCEMENT IN**2	DISTANCE TO CENTROIDAL AXIS IN
1	.790000	14.8906
2	.790000	14.0253
3	.790000	12.3448
4	.790000	9.9469
5	.790000	6.9709
6	.790000	3.5897
7	.790000	.0000
8	.790000	-3.5897
9	.790000	-6.9709
10	.790000	-9.9469
11	.790000	-12.3448
12	.790000	-14.0253
13	.790000	-14.8906

OUTPUT RESULTS FOR AN AXIAL LOAD = 265.21 KIP
****

MOMENT IN-KIP	EI KIP-IN**2	PHI 1/IN	MAX STR IN/IN	N AXIS IN
.281E+03	.28135E+09	.000001	.00010	95.708
.141E+04	.28112E+09	.000005	.00017	33.703
.252E+04	.28003E+09	.000009	.00024	26.883
.265E+04	.20420E+09	.000013	.00029	22.409
.305E+04	.17942E+09	.000017	.00034	20.260
.340E+04	.16168E+09	.000021	.00039	18.793
.371E+04	.14860E+09	.000025	.00044	17.730
.402E+04	.13850E+09	.000029	.00049	16.912
.431E+04	.13053E+09	.000033	.00054	16.269
.459E+04	.12407E+09	.000037	.00058	15.748

.487E+04	.11873E+09	.000041	.00063	15.321
.514E+04	.11425E+09	.000045	.00067	14.970
.541E+04	.11034E+09	.000049	.00072	14.652
.567E+04	.10702E+09	.000053	.00076	14.400
.757E+04	.91146E+08	.000083	.00110	13.224
.917E+04	.81169E+08	.000113	.00143	12.681
.989E+04	.69136E+08	.000143	.00173	12.126
.103E+05	.59400E+08	.000173	.00202	11.691
.105E+05	.51960E+08	.000203	.00231	11.391
.107E+05	.45863E+08	.000233	.00258	11.071
.108E+05	.41127E+08	.000263	.00285	10.843
.109E+05	.37236E+08	.000293	.00314	10.725
.109E+05	.33872E+08	.000323	.00341	10.570
.110E+05	.31039E+08	.000353	.00370	10.473
.110E+05	.28644E+08	.000383	.00398	10.400

THE ULTIMATE BENDING MOMENT AT A CONCRETE STRAIN OF 0.003
IS : .109E+05 IN-KIP

OUTPUT RESULTS FOR AN AXIAL LOAD = 397.82 KIP
****

MOMENT IN-KIP	EI KIP-IN**2	PHI 1/IN	MAX STR IN/IN	N AXIS IN
.275E+03	.27489E+09	.000001	.00014	135.885
.137E+04	.27476E+09	.000005	.00021	41.744
.247E+04	.27431E+09	.000009	.00028	31.366
.355E+04	.27297E+09	.000013	.00036	27.417
.363E+04	.21370E+09	.000017	.00041	23.902
.406E+04	.19354E+09	.000021	.00046	22.034
.444E+04	.17767E+09	.000025	.00052	20.663
.479E+04	.16510E+09	.000029	.00057	19.615
.511E+04	.15480E+09	.000033	.00062	18.774
.541E+04	.14633E+09	.000037	.00067	18.092
.571E+04	.13922E+09	.000041	.00072	17.525
.599E+04	.13317E+09	.000045	.00077	17.048
.627E+04	.12798E+09	.000049	.00082	16.644
.654E+04	.12338E+09	.000053	.00086	16.283
.843E+04	.10154E+09	.000083	.00122	14.681
.101E+05	.89397E+08	.000113	.00158	13.963
.109E+05	.76403E+08	.000143	.00191	13.368
.114E+05	.65640E+08	.000173	.00223	12.903
.116E+05	.57194E+08	.000203	.00255	12.543
.118E+05	.50631E+08	.000233	.00285	12.243
.119E+05	.45177E+08	.000263	.00316	12.028
.119E+05	.40749E+08	.000293	.00350	11.941
.120E+05	.37107E+08	.000323	.00382	11.839

THE ULTIMATE BENDING MOMENT AT A CONCRETE STRAIN OF 0.003
IS : .118E+05 IN-KIP

Hamilton Boulevard (deep)

UNITS--ENGLISH UNITS

I N P U T I N F O R M A T I O N

****

THE LOADING IS STATIC

PILE GEOMETRY AND PROPERTIES

PILE LENGTH = 960.00 IN

2 POINTS

X	DIAMETER	MOMENT OF INERTIA	AREA	MODULUS OF ELASTICITY
IN	IN	IN**4	IN**2	LBS/IN**2
.00	36.000	.824E+05	.102E+04	.312E+07
960.00	36.000	.824E+05	.102E+04	.312E+07

SOILS INFORMATION

X AT THE GROUND SURFACE = .00 IN

SLOPE ANGLE AT THE GROUND SURFACE = .00 DEG.

3 LAYER(S) OF SOIL

LAYER 1

THE SOIL IS A SOFT CLAY

X AT THE TOP OF THE LAYER = .00 IN

X AT THE BOTTOM OF THE LAYER = 180.00 IN

MODULUS OF SUBGRADE REACTION = .500E+03 LBS/IN**3

LAYER 2

THE LAYER IS A WEAK ROCK

X AT THE TOP OF THE LAYER = 180.00 IN

X AT THE BOTTOM OF THE LAYER = 900.00 IN

INITIAL MODULUS OF THE ROCK = .200E+04 LBS/IN**2

LAYER 3

THE LAYER IS A ROCK

X AT THE TOP OF THE LAYER = 900.00 IN

X AT THE BOTTOM OF THE LAYER = 960.00 IN

MODULUS OF SUBGRADE REACTION = .400E+04 LBS/IN**3

DISTRIBUTION OF EFFECTIVE UNIT WEIGHT WITH DEPTH

6 POINTS

X,IN	WEIGHT,LBS/IN**3
.00	.67E-01
180.00	.67E-01
180.00	.70E-01
900.00	.70E-01

```
            900.00        .80E-01
            960.00        .80E-01

    DISTRIBUTION OF STRENGTH PARAMETERS WITH DEPTH
                      6 POINTS
              X,IN       C,LBS/IN**2     PHI,DEGREES     E50
               .00       .150E+02           .000       .600E-02
            180.00       .150E+02           .000       .600E-02
            180.00       .400E+02           .000       .500E-02
            900.00       .400E+02           .000       .500E-02
            900.00       .600E+02           .000       .400E-02
            960.00       .600E+02           .000       .400E-02

BOUNDARY AND LOADING CONDITIONS
-------------------------------

    LOADING NUMBER   1
    BOUNDARY-CONDITION CODE                  =          1
    LATERAL LOAD AT THE PILE HEAD            =    .700E+04 LBS
    MOMENT AT THE PILE HEAD                  =    .400E+06 IN-LBS
    AXIAL LOAD AT THE PILE HEAD              =    .265E+06 LBS

    LOADING NUMBER   2
    BOUNDARY-CONDITION CODE                  =          1
    LATERAL LOAD AT THE PILE HEAD            =    .105E+05 LBS
    MOMENT AT THE PILE HEAD                  =    .599E+06 IN-LBS
    AXIAL LOAD AT THE PILE HEAD              =    .398E+06 LBS

FINITE-DIFFERENCE PARAMETERS
    NUMBER OF PILE INCREMENTS                                  =        100
    DEFLECTION TOLERANCE ON DETERMINATION OF CLOSURE           =   .100E-04 IN
    MAXIMUM NUMBER OF ITERATIONS ALLOWED FOR PILE ANALYSIS     =        100
    MAXIMUM ALLOWABLE DEFLECTION                               =    .10E+03 IN

OUTPUT CODES
    KOUTPT =  1
    KPYOP  =  0
    INC    =  1


                    O U T P U T   I N F O R M A T I O N
                    **********************************

          ************************************************
          * COMPUTE LOAD-DISTRIBUTION AND LOAD-DEFLECTION *
          * CURVES FOR LATERAL LOADING                    *
          ************************************************

    LOADING NUMBER   1

    BOUNDARY CONDITION CODE                  =          1
    LATERAL LOAD AT THE PILE HEAD            =    .700E+04 LBS
    MOMENT AT THE PILE HEAD                  =    .400E+06 IN-LBS
    AXIAL LOAD AT THE PILE HEAD              =    .265E+06 LBS
```

X	DEFLECTION	MOMENT	SHEAR	SLOPE	TOTAL STRESS	FLEXURAL RIGIDITY	SOIL REACTION
IN	IN	LBS-IN	LBS	RAD.	LBS/IN**2	LBS-IN**2	LBS/IN
.0	.881E-02	.400E+06	.700E+04	-.181E-03	.348E+03	.257E+12	-.205E+03
9.6	.714E-02	.458E+06	.504E+04	-.165E-03	.360E+03	.257E+12	-.203E+03
19.2	.564E-02	.497E+06	.311E+04	-.147E-03	.369E+03	.257E+12	-.198E+03
28.8	.431E-02	.518E+06	.125E+04	-.128E-03	.374E+03	.257E+12	-.190E+03
38.4	.317E-02	.522E+06	-.533E+03	-.109E-03	.374E+03	.257E+12	-.180E+03
48.0	.222E-02	.509E+06	-.221E+04	-.897E-04	.372E+03	.257E+12	-.168E+03
57.6	.145E-02	.480E+06	-.375E+04	-.713E-04	.365E+03	.257E+12	-.152E+03
67.2	.852E-03	.437E+06	-.512E+04	-.542E-04	.356E+03	.257E+12	-.133E+03
76.8	.410E-03	.382E+06	-.629E+04	-.389E-04	.344E+03	.257E+12	-.108E+03
86.4	.105E-03	.316E+06	-.717E+04	-.259E-04	.330E+03	.257E+12	-.708E+02
96.0	-.869E-04	.244E+06	-.719E+04	-.154E-04	.314E+03	.257E+12	.709E+02
105.6	-.191E-03	.178E+06	-.642E+04	-.755E-05	.299E+03	.257E+12	.948E+02
115.2	-.232E-03	.121E+06	-.547E+04	-.196E-05	.287E+03	.257E+12	.105E+03
124.8	-.229E-03	.734E+05	-.446E+04	.167E-05	.277E+03	.257E+12	.108E+03
134.4	-.200E-03	.355E+05	-.345E+04	.370E-05	.268E+03	.257E+12	.106E+03
144.0	-.158E-03	.721E+04	-.246E+04	.449E-05	.262E+03	.257E+12	.101E+03
153.6	-.114E-03	-.118E+05	-.153E+04	.441E-05	.263E+03	.257E+12	.937E+02
163.2	-.734E-04	-.222E+05	-.687E+03	.378E-05	.265E+03	.257E+12	.835E+02
172.8	-.411E-04	-.250E+05	.456E+02	.290E-05	.266E+03	.257E+12	.709E+02
182.4	-.177E-04	-.213E+05	.400E+03	.203E-05	.265E+03	.257E+12	.394E+01
192.0	-.203E-05	-.173E+05	.422E+03	.131E-05	.264E+03	.257E+12	.644E+00
201.6	.748E-05	-.132E+05	.411E+03	.744E-06	.263E+03	.257E+12	-.266E+01
211.2	.123E-04	-.940E+04	.373E+03	.322E-06	.263E+03	.257E+12	-.528E+01
220.8	.137E-04	-.607E+04	.315E+03	.337E-07	.262E+03	.257E+12	-.688E+01
230.4	.129E-04	-.336E+04	.246E+03	-.142E-06	.261E+03	.257E+12	-.742E+01
240.0	.109E-04	-.134E+04	.177E+03	-.230E-06	.261E+03	.257E+12	-.708E+01
249.6	.850E-05	.398E+02	.114E+03	-.254E-06	.261E+03	.257E+12	-.612E+01
259.2	.607E-05	.855E+03	.619E+02	-.237E-06	.261E+03	.257E+12	-.481E+01
268.8	.394E-05	.123E+04	.227E+02	-.198E-06	.261E+03	.257E+12	-.341E+01
278.4	.226E-05	.129E+04	-.359E+01	-.151E-06	.261E+03	.257E+12	-.212E+01
288.0	.104E-05	.116E+04	-.187E+02	-.105E-06	.261E+03	.257E+12	-.106E+01
297.6	.237E-06	.934E+03	-.248E+02	-.664E-07	.261E+03	.257E+12	-.245E+00
307.2	-.233E-06	.685E+03	-.248E+02	-.362E-07	.261E+03	.257E+12	.230E+00
316.8	-.458E-06	.458E+03	-.215E+02	-.149E-07	.261E+03	.257E+12	.458E+00
326.4	-.519E-06	.272E+03	-.168E+02	-.129E-08	.261E+03	.257E+12	.521E+00
336.0	-.483E-06	.135E+03	-.120E+02	.630E-08	.261E+03	.257E+12	.485E+00
345.6	-.398E-06	.417E+02	-.777E+01	.959E-08	.261E+03	.257E+12	.401E+00
355.2	-.299E-06	-.145E+02	-.442E+01	.101E-07	.261E+03	.257E+12	.301E+00
364.8	-.205E-06	-.432E+02	-.201E+01	.902E-08	.261E+03	.257E+12	.206E+00
374.4	-.126E-06	-.531E+02	-.419E+00	.722E-08	.261E+03	.257E+12	.127E+00
384.0	-.660E-07	-.513E+02	.501E+00	.527E-08	.261E+03	.257E+12	.667E-01
393.6	-.245E-07	-.435E+02	.935E+00	.351E-08	.261E+03	.257E+12	.250E-01
403.2	.134E-08	-.334E+02	.105E+01	.207E-08	.261E+03	.257E+12	-.112E-02
412.8	.153E-07	-.234E+02	.967E+00	.101E-08	.261E+03	.257E+12	-.152E-01
422.4	.208E-07	-.148E+02	.794E+00	.300E-09	.261E+03	.257E+12	-.208E-01
432.0	.210E-07	-.817E+01	.593E+00	-.128E-09	.261E+03	.257E+12	-.211E-01
441.6	.183E-07	-.344E+01	.404E+00	-.345E-09	.261E+03	.257E+12	-.184E-01
451.2	.144E-07	-.404E+00	.247E+00	-.417E-09	.261E+03	.257E+12	-.145E-01
460.8	.103E-07	.130E+01	.128E+00	-.400E-09	.261E+03	.257E+12	-.104E-01
470.4	.673E-08	.206E+01	.464E-01	-.337E-09	.261E+03	.257E+12	-.679E-02
480.0	.386E-08	.220E+01	-.449E-02	-.258E-09	.261E+03	.257E+12	-.390E-02

489.6	.178E-08	.198E+01	-.316E-01	-.180E-09	.261E+03	.257E+12	-.181E-02
499.2	.411E-09	.159E+01	-.421E-01	-.113E-09	.261E+03	.257E+12	-.425E-03
508.8	-.392E-09	.117E+01	-.422E-01	-.619E-10	.261E+03	.257E+12	.386E-03
518.4	-.777E-09	.780E+00	-.366E-01	-.256E-10	.261E+03	.257E+12	.776E-03
528.0	-.883E-09	.465E+00	-.286E-01	-.233E-11	.261E+03	.257E+12	.885E-03
537.6	-.822E-09	.231E+00	-.205E-01	.106E-10	.261E+03	.257E+12	.825E-03
547.2	-.679E-09	.719E-01	-.133E-01	.163E-10	.261E+03	.257E+12	.682E-03
556.8	-.509E-09	-.241E-01	-.756E-02	.172E-10	.261E+03	.257E+12	.513E-03
566.4	-.349E-09	-.733E-01	-.344E-02	.153E-10	.261E+03	.257E+12	.352E-03
576.0	-.215E-09	-.902E-01	-.730E-03	.123E-10	.261E+03	.257E+12	.217E-03
585.6	-.113E-09	-.873E-01	.843E-03	.899E-11	.261E+03	.257E+12	.114E-03
595.2	-.421E-10	-.741E-01	.159E-02	.598E-11	.261E+03	.257E+12	.429E-04
604.8	.202E-11	-.569E-01	.178E-02	.354E-11	.261E+03	.257E+12	-.163E-05
614.4	.258E-10	-.399E-01	.165E-02	.173E-11	.261E+03	.257E+12	-.257E-04
624.0	.353E-10	-.253E-01	.135E-02	.518E-12	.261E+03	.257E+12	-.354E-04
633.6	.358E-10	-.140E-01	.101E-02	-.214E-12	.261E+03	.257E+12	-.359E-04
643.2	.312E-10	-.590E-02	.689E-03	-.584E-12	.261E+03	.257E+12	-.314E-04
652.8	.245E-10	-.718E-03	.422E-03	-.708E-12	.261E+03	.257E+12	-.247E-04
662.4	.176E-10	.220E-02	.219E-03	-.680E-12	.261E+03	.257E+12	-.177E-04
672.0	.115E-10	.350E-02	.797E-04	-.574E-12	.261E+03	.257E+12	-.116E-04
681.6	.660E-11	.373E-02	-.712E-05	-.439E-12	.261E+03	.257E+12	-.667E-05
691.2	.305E-11	.336E-02	-.535E-04	-.307E-12	.261E+03	.257E+12	-.310E-05
700.8	.713E-12	.271E-02	-.716E-04	-.193E-12	.261E+03	.257E+12	-.736E-06
710.4	-.659E-12	.199E-02	-.718E-04	-.106E-12	.261E+03	.257E+12	.649E-06
720.0	-.132E-11	.133E-02	-.623E-04	-.438E-13	.261E+03	.257E+12	.132E-05
729.6	-.150E-11	.794E-03	-.488E-04	-.420E-14	.261E+03	.257E+12	.150E-05
739.2	-.140E-11	.394E-03	-.349E-04	.180E-13	.261E+03	.257E+12	.140E-05
748.8	-.116E-11	.124E-03	-.226E-04	.276E-13	.261E+03	.257E+12	.116E-05
758.4	-.868E-12	-.401E-04	-.129E-04	.292E-13	.261E+03	.257E+12	.874E-06
768.0	-.595E-12	-.124E-03	-.588E-05	.261E-13	.261E+03	.257E+12	.600E-06
777.6	-.367E-12	-.153E-03	-.127E-05	.210E-13	.261E+03	.257E+12	.370E-06
787.2	-.193E-12	-.148E-03	.142E-05	.153E-13	.261E+03	.257E+12	.195E-06
796.8	-.722E-13	-.126E-03	.269E-05	.102E-13	.261E+03	.257E+12	.736E-07
806.4	.322E-14	-.969E-04	.302E-05	.605E-14	.261E+03	.257E+12	-.256E-08
816.0	.440E-13	-.681E-04	.279E-05	.298E-14	.261E+03	.257E+12	-.438E-07
825.6	.604E-13	-.433E-04	.229E-05	.903E-15	.261E+03	.257E+12	-.605E-07
835.2	.613E-13	-.240E-04	.171E-05	-.352E-15	.261E+03	.257E+12	-.615E-07
844.8	.537E-13	-.104E-04	.116E-05	-.994E-15	.261E+03	.257E+12	-.539E-07
854.4	.422E-13	-.180E-05	.697E-06	-.122E-14	.261E+03	.257E+12	-.425E-07
864.0	.302E-13	.295E-05	.349E-06	-.120E-14	.261E+03	.257E+12	-.304E-07
873.6	.192E-13	.492E-05	.112E-06	-.105E-14	.261E+03	.257E+12	-.193E-07
883.2	.994E-14	.512E-05	-.273E-07	-.867E-15	.261E+03	.257E+12	-.101E-07
892.8	.253E-14	.440E-05	-.871E-07	-.690E-15	.261E+03	.257E+12	-.260E-08
902.4	-.331E-14	.345E-05	-.973E-07	-.544E-15	.261E+03	.257E+12	.392E-09
912.0	-.791E-14	.253E-05	-.909E-07	-.432E-15	.261E+03	.257E+12	.948E-09
921.6	-.116E-13	.170E-05	-.796E-07	-.353E-15	.261E+03	.257E+12	.140E-08
931.2	-.147E-13	.101E-05	-.645E-07	-.303E-15	.261E+03	.257E+12	.177E-08
940.8	-.174E-13	.468E-06	-.460E-07	-.275E-15	.261E+03	.257E+12	.210E-08
950.4	-.200E-13	.124E-06	-.245E-07	-.264E-15	.261E+03	.257E+12	.241E-08
960.0	-.225E-13	.000E+00	.000E+00	-.262E-15	.261E+03	.257E+12	.271E-08

OUTPUT VERIFICATION

THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = -.159E-07 IN-LBS
THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = .985E-09 LBS

OUTPUT SUMMARY

PILE-HEAD DEFLECTION = .881E-02 IN
COMPUTED SLOPE AT PILE HEAD = -.181E-03
MAXIMUM BENDING MOMENT = .522E+06 LBS-IN
MAXIMUM SHEAR FORCE = -.719E+04 LBS
NO. OF ITERATIONS = 12
NO. OF ZERO DEFLECTION POINTS = 9

LOADING NUMBER 2

BOUNDARY CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .105E+05 LBS
MOMENT AT THE PILE HEAD = .599E+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .398E+06 LBS

X	DEFLECTION	MOMENT	SHEAR	SLOPE	TOTAL STRESS	FLEXURAL RIGIDITY	SOIL REACTION
IN	IN	LBS-IN	LBS	RAD.	LBS/IN**2	LBS-IN**2	LBS/IN
.0	.178E-01	.599E+06	.105E+05	-.320E-03	.522E+03	.257E+12	-.260E+03
9.6	.148E-01	.689E+06	.801E+04	-.296E-03	.541E+03	.257E+12	-.259E+03
19.2	.121E-01	.755E+06	.555E+04	-.269E-03	.556E+03	.257E+12	-.255E+03
28.8	.963E-02	.798E+06	.313E+04	-.240E-03	.565E+03	.257E+12	-.249E+03
38.4	.747E-02	.817E+06	.777E+03	-.210E-03	.569E+03	.257E+12	-.240E+03
48.0	.559E-02	.814E+06	-.147E+04	-.180E-03	.569E+03	.257E+12	-.228E+03
57.6	.401E-02	.790E+06	-.360E+04	-.150E-03	.563E+03	.257E+12	-.214E+03
67.2	.271E-02	.747E+06	-.557E+04	-.121E-03	.554E+03	.257E+12	-.196E+03
76.8	.168E-02	.684E+06	-.734E+04	-.947E-04	.540E+03	.257E+12	-.174E+03
86.4	.896E-03	.606E+06	-.888E+04	-.706E-04	.523E+03	.257E+12	-.146E+03
96.0	.327E-03	.514E+06	-.101E+05	-.497E-04	.503E+03	.257E+12	-.108E+03
105.6	-.585E-04	.412E+06	-.103E+05	-.324E-04	.481E+03	.257E+12	.646E+02
115.2	-.296E-03	.316E+06	-.951E+04	-.188E-04	.460E+03	.257E+12	.113E+03
124.8	-.420E-03	.230E+06	-.834E+04	-.865E-05	.441E+03	.257E+12	.132E+03
134.4	-.462E-03	.156E+06	-.704E+04	-.145E-05	.425E+03	.257E+12	.140E+03
144.0	-.448E-03	.948E+05	-.568E+04	.323E-05	.411E+03	.257E+12	.143E+03
153.6	-.400E-03	.468E+05	-.432E+04	.587E-05	.401E+03	.257E+12	.142E+03
163.2	-.335E-03	.119E+05	-.298E+04	.697E-05	.393E+03	.257E+12	.138E+03
172.8	-.266E-03	-.103E+05	-.168E+04	.700E-05	.393E+03	.257E+12	.132E+03
182.4	-.201E-03	-.205E+05	-.842E+03	.642E-05	.395E+03	.257E+12	.438E+02
192.0	-.143E-03	-.266E+05	-.434E+03	.555E-05	.397E+03	.257E+12	.413E+02
201.6	-.942E-04	-.288E+05	-.736E+02	.451E-05	.397E+03	.257E+12	.340E+02
211.2	-.561E-04	-.280E+05	.205E+03	.345E-05	.397E+03	.257E+12	.242E+02
220.8	-.279E-04	-.249E+05	.389E+03	.246E-05	.396E+03	.257E+12	.140E+02
230.4	-.875E-05	-.206E+05	.480E+03	.162E-05	.395E+03	.257E+12	.500E+01
240.0	.308E-05	-.157E+05	.495E+03	.939E-06	.394E+03	.257E+12	-.201E+01
249.6	.928E-05	-.111E+05	.453E+03	.440E-06	.393E+03	.257E+12	-.667E+01
259.2	.115E-04	-.703E+04	.378E+03	.102E-06	.392E+03	.257E+12	-.909E+01
268.8	.112E-04	-.382E+04	.288E+03	-.100E-06	.392E+03	.257E+12	-.967E+01
278.4	.959E-05	-.150E+04	.199E+03	-.200E-06	.391E+03	.257E+12	-.893E+01
288.0	.741E-05	.112E+01	.121E+03	-.228E-06	.391E+03	.257E+12	-.743E+01
297.6	.523E-05	.819E+03	.600E+02	-.212E-06	.391E+03	.257E+12	-.524E+01
307.2	.334E-05	.115E+04	.189E+02	-.175E-06	.391E+03	.257E+12	-.334E+01
316.8	.186E-05	.118E+04	-.605E+01	-.132E-06	.391E+03	.257E+12	-.186E+01

326.4	.803E-06	.104E+04	-.188E+02	-.904E-07	.391E+03	.257E+12	-.803E+00
336.0	.121E-06	.822E+03	-.233E+02	-.557E-07	.391E+03	.257E+12	-.120E+00
345.6	-.267E-06	.593E+03	-.226E+02	-.294E-07	.391E+03	.257E+12	.269E+00
355.2	-.443E-06	.389E+03	-.191E+02	-.110E-07	.391E+03	.257E+12	.444E+00
364.8	-.479E-06	.226E+03	-.147E+02	.419E-09	.391E+03	.257E+12	.480E+00
374.4	-.435E-06	.106E+03	-.103E+02	.661E-08	.391E+03	.257E+12	.436E+00
384.0	-.352E-06	.270E+02	-.656E+01	.909E-08	.391E+03	.257E+12	.353E+00
393.6	-.260E-06	-.198E+02	-.363E+01	.923E-08	.391E+03	.257E+12	.260E+00
403.2	-.175E-06	-.426E+02	-.154E+01	.807E-08	.391E+03	.257E+12	.175E+00
412.8	-.105E-06	-.494E+02	-.195E+00	.635E-08	.391E+03	.257E+12	.105E+00
422.4	-.529E-07	-.464E+02	.563E+00	.456E-08	.391E+03	.257E+12	.529E-01
432.0	-.174E-07	-.386E+02	.901E+00	.298E-08	.391E+03	.257E+12	.174E-01
441.6	.426E-08	-.292E+02	.964E+00	.171E-08	.391E+03	.257E+12	-.433E-02
451.2	.155E-07	-.201E+02	.869E+00	.796E-09	.391E+03	.257E+12	-.156E-01
460.8	.196E-07	-.125E+02	.701E+00	.189E-09	.391E+03	.257E+12	-.196E-01
470.4	.191E-07	-.664E+01	.515E+00	-.167E-09	.391E+03	.257E+12	-.192E-01
480.0	.163E-07	-.257E+01	.345E+00	-.339E-09	.391E+03	.257E+12	-.164E-01
489.6	.126E-07	-.107E-01	.206E+00	-.387E-09	.391E+03	.257E+12	-.127E-01
499.2	.891E-08	.139E+01	.103E+00	-.361E-09	.391E+03	.257E+12	-.893E-02
508.8	.569E-08	.196E+01	.325E-01	-.299E-09	.391E+03	.257E+12	-.570E-02
518.4	.317E-08	.201E+01	-.101E-01	-.225E-09	.391E+03	.257E+12	-.318E-02
528.0	.138E-08	.177E+01	-.319E-01	-.154E-09	.391E+03	.257E+12	-.138E-02
537.6	.212E-09	.140E+01	-.395E-01	-.952E-10	.391E+03	.257E+12	-.209E-03
547.2	-.451E-09	.101E+01	-.384E-01	-.502E-10	.391E+03	.257E+12	.454E-03
556.8	-.752E-09	.664E+00	-.326E-01	-.189E-10	.391E+03	.257E+12	.755E-03
566.4	-.815E-09	.385E+00	-.251E-01	.618E-12	.391E+03	.257E+12	.817E-03
576.0	-.740E-09	.182E+00	-.176E-01	.112E-10	.391E+03	.257E+12	.742E-03
585.6	-.600E-09	.467E-01	-.112E-01	.155E-10	.391E+03	.257E+12	.601E-03
595.2	-.443E-09	-.333E-01	-.620E-02	.157E-10	.391E+03	.257E+12	.444E-03
604.8	-.298E-09	-.724E-01	-.264E-02	.137E-10	.391E+03	.257E+12	.299E-03
614.4	-.179E-09	-.840E-01	-.343E-03	.108E-10	.391E+03	.257E+12	.180E-03
624.0	-.905E-10	-.790E-01	.952E-03	.778E-11	.391E+03	.257E+12	.905E-04
633.6	-.300E-10	-.658E-01	.153E-02	.508E-11	.391E+03	.257E+12	.299E-04
643.2	.707E-11	-.497E-01	.164E-02	.293E-11	.391E+03	.257E+12	-.719E-05
652.8	.263E-10	-.343E-01	.148E-02	.136E-11	.391E+03	.257E+12	-.264E-04
662.4	.332E-10	-.213E-01	.119E-02	.327E-12	.391E+03	.257E+12	-.334E-04
672.0	.326E-10	-.113E-01	.879E-03	-.281E-12	.391E+03	.257E+12	-.327E-04
681.6	.278E-10	-.441E-02	.589E-03	-.575E-12	.391E+03	.257E+12	-.279E-04
691.2	.215E-10	-.397E-04	.352E-03	-.658E-12	.391E+03	.257E+12	-.216E-04
700.8	.152E-10	.235E-02	.175E-03	-.615E-12	.391E+03	.257E+12	-.152E-04
710.4	.972E-11	.333E-02	.559E-04	-.509E-12	.391E+03	.257E+12	-.973E-05
720.0	.542E-11	.342E-02	-.168E-04	-.383E-12	.391E+03	.257E+12	-.543E-05
729.6	.236E-11	.301E-02	-.541E-04	-.263E-12	.391E+03	.257E+12	-.236E-05
739.2	.370E-12	.239E-02	-.672E-04	-.162E-12	.391E+03	.257E+12	-.366E-06
748.8	-.762E-12	.172E-02	-.654E-04	-.858E-13	.391E+03	.257E+12	.768E-06
758.4	-.128E-11	.113E-02	-.556E-04	-.325E-13	.391E+03	.257E+12	.128E-05
768.0	-.139E-11	.658E-03	-.428E-04	.877E-15	.391E+03	.257E+12	.139E-05
777.6	-.126E-11	.311E-03	-.301E-04	.190E-13	.391E+03	.257E+12	.126E-05
787.2	-.102E-11	.806E-04	-.191E-04	.263E-13	.391E+03	.257E+12	.103E-05
796.8	-.756E-12	-.558E-04	-.106E-04	.267E-13	.391E+03	.257E+12	.758E-06
806.4	-.510E-12	-.123E-03	-.450E-05	.234E-13	.391E+03	.257E+12	.510E-06
816.0	-.307E-12	-.142E-03	-.579E-06	.185E-13	.391E+03	.257E+12	.307E-06
825.6	-.155E-12	-.134E-03	.164E-05	.133E-13	.391E+03	.257E+12	.155E-06
835.2	-.514E-13	-.111E-03	.263E-05	.874E-14	.391E+03	.257E+12	.512E-07
844.8	.127E-13	-.834E-04	.282E-05	.512E-14	.391E+03	.257E+12	-.129E-07
854.4	.469E-13	-.570E-04	.253E-05	.250E-14	.391E+03	.257E+12	-.471E-07
864.0	.607E-13	-.349E-04	.201E-05	.785E-15	.391E+03	.257E+12	-.609E-07

873.6	.620E-13	-.183E-04	.142E-05	-.207E-15	.391E+03	.257E+12	-.621E-07
883.2	.567E-13	-.752E-05	.855E-06	-.689E-15	.391E+03	.257E+12	-.568E-07
892.8	.487E-13	-.192E-05	.349E-06	-.865E-15	.391E+03	.257E+12	-.488E-07
902.4	.401E-13	-.810E-06	.921E-07	-.916E-15	.391E+03	.257E+12	-.482E-08
912.0	.311E-13	-.143E-06	.511E-07	-.934E-15	.391E+03	.257E+12	-.374E-08
921.6	.221E-13	.179E-06	.204E-07	-.933E-15	.391E+03	.257E+12	-.266E-08
931.2	.132E-13	.256E-06	.454E-10	-.925E-15	.391E+03	.257E+12	-.158E-08
940.8	.438E-14	.187E-06	-.101E-07	-.917E-15	.391E+03	.257E+12	-.519E-09
950.4	-.439E-14	.691E-07	-.101E-07	-.912E-15	.391E+03	.257E+12	.536E-09
960.0	-.131E-13	.000E+00	.000E+00	-.911E-15	.391E+03	.257E+12	.159E-08

OUTPUT VERIFICATION

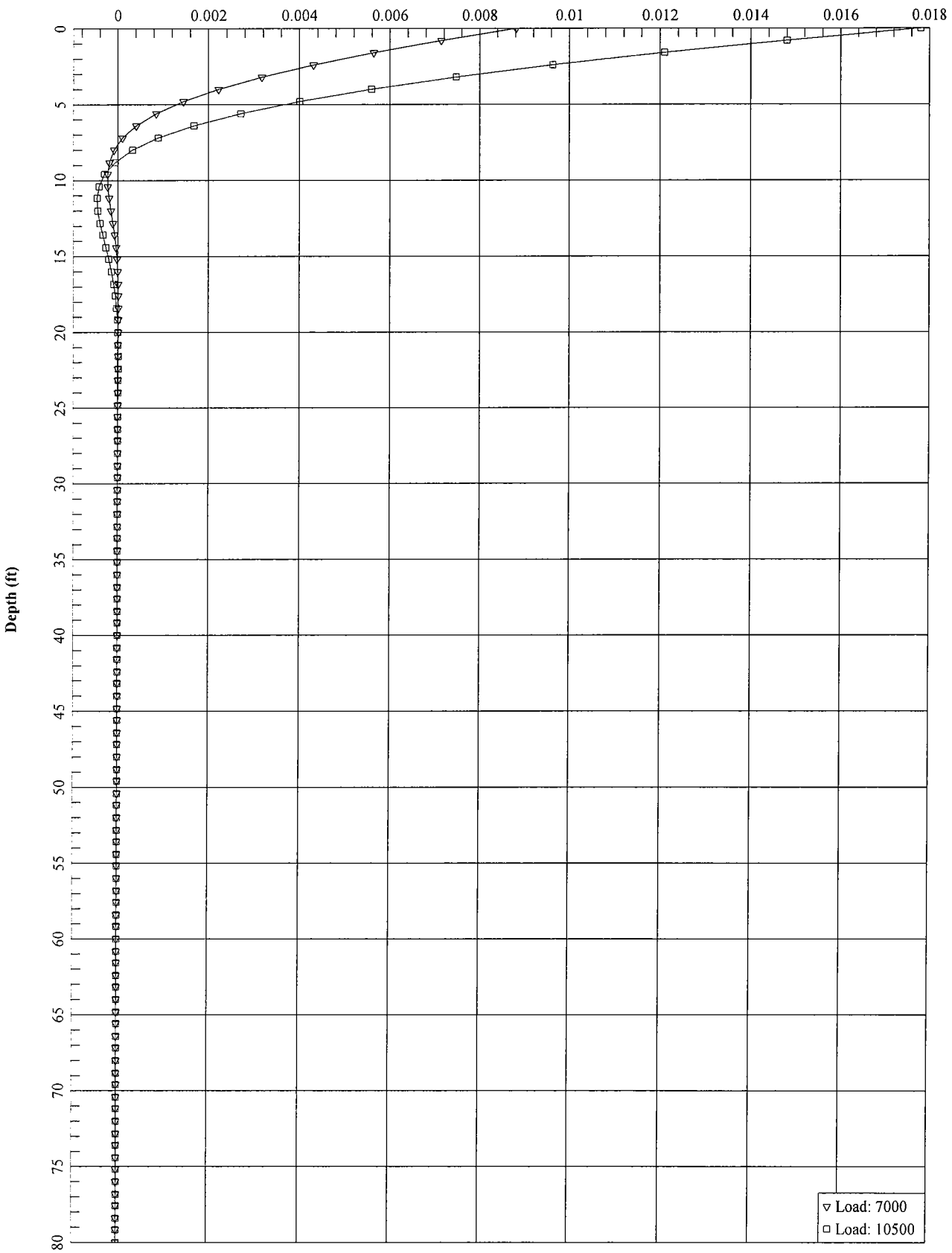
THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = .237E-07 IN-LBS
THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = -.255E-08 LBS

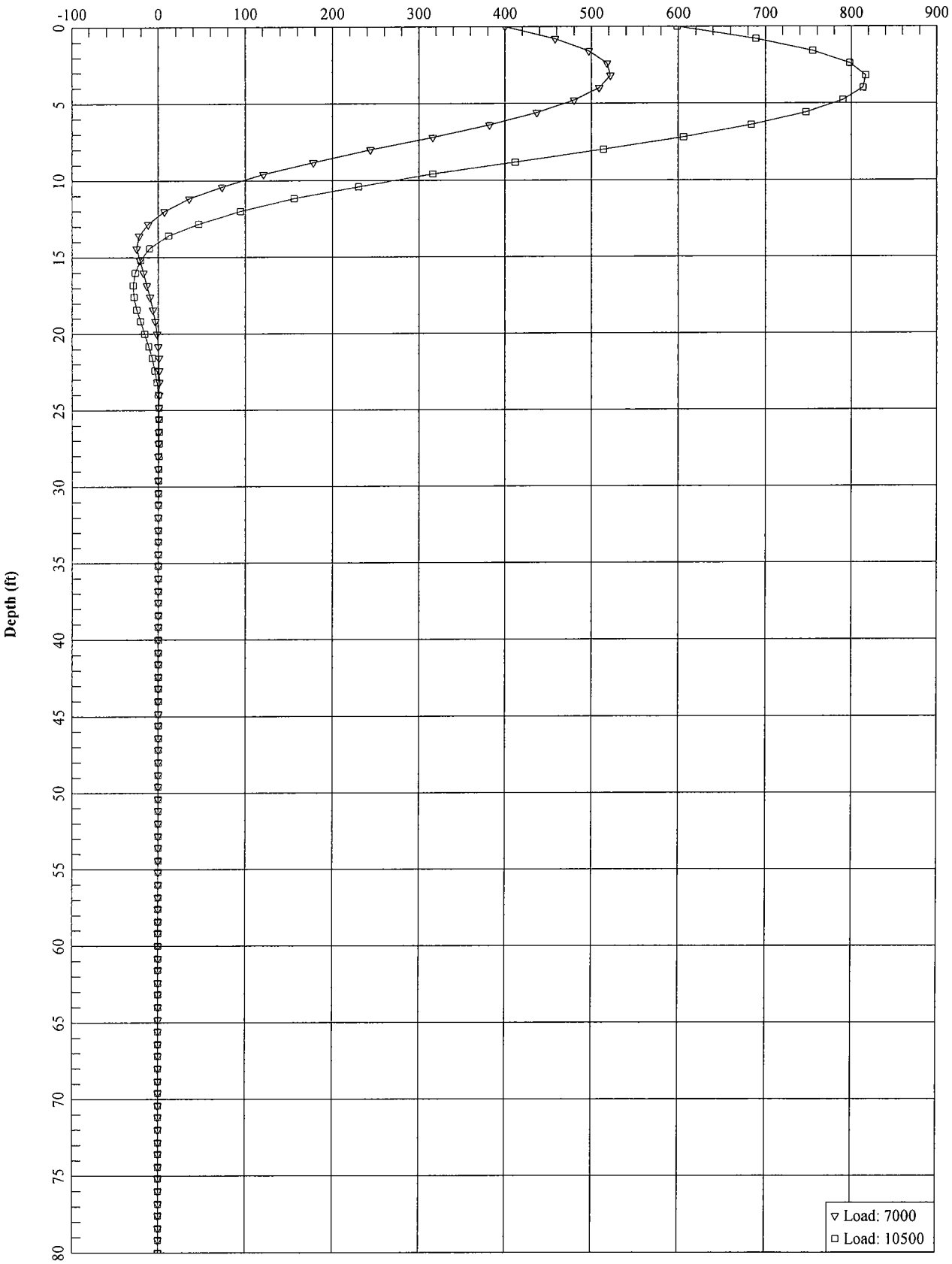
OUTPUT SUMMARY

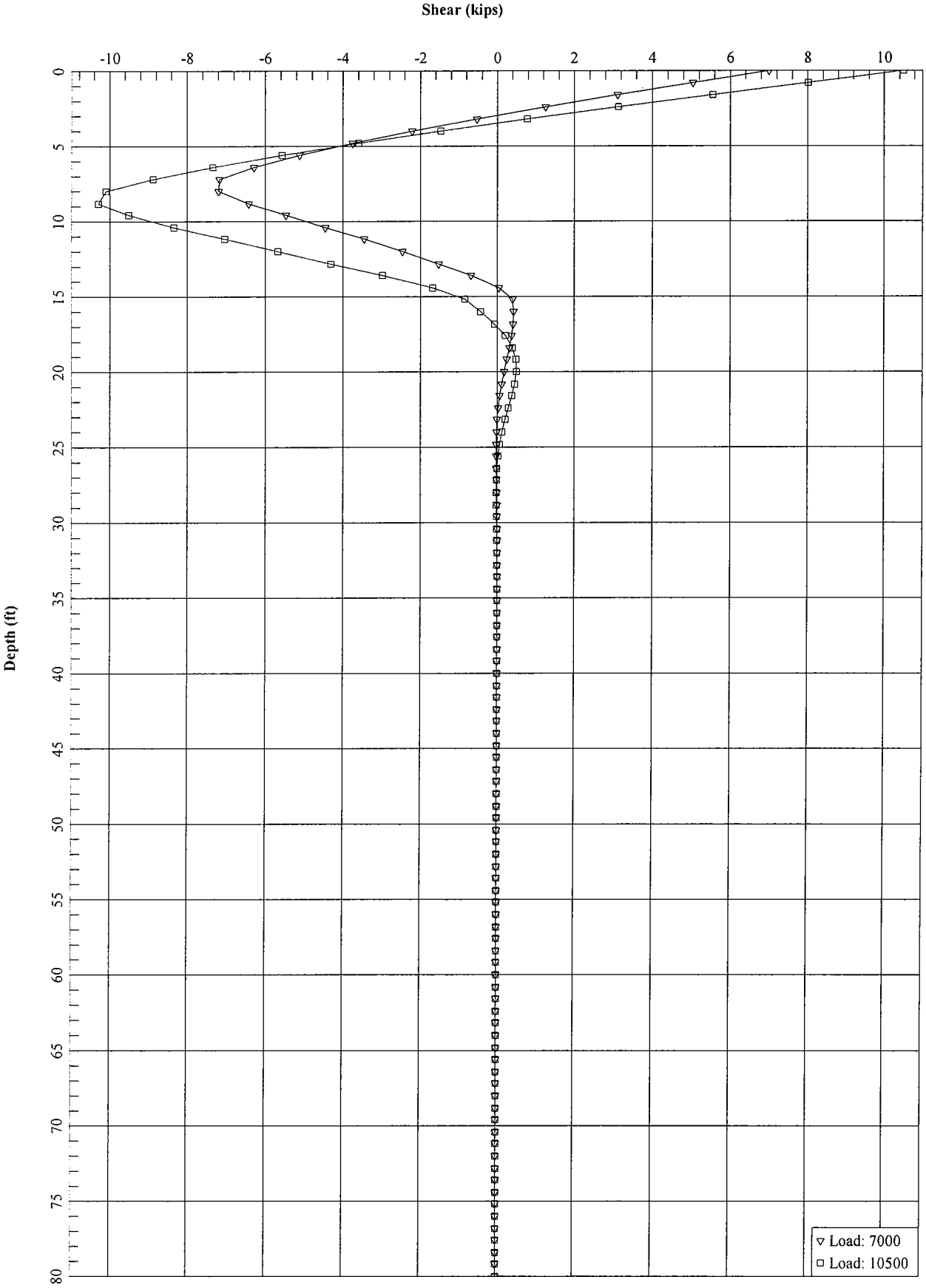
PILE-HEAD DEFLECTION = .178E-01 IN
COMPUTED SLOPE AT PILE HEAD = -.320E-03
MAXIMUM BENDING MOMENT = .817E+06 LBS-IN
MAXIMUM SHEAR FORCE = .105E+05 LBS
NO. OF ITERATIONS = 14
NO. OF ZERO DEFLECTION POINTS = 9

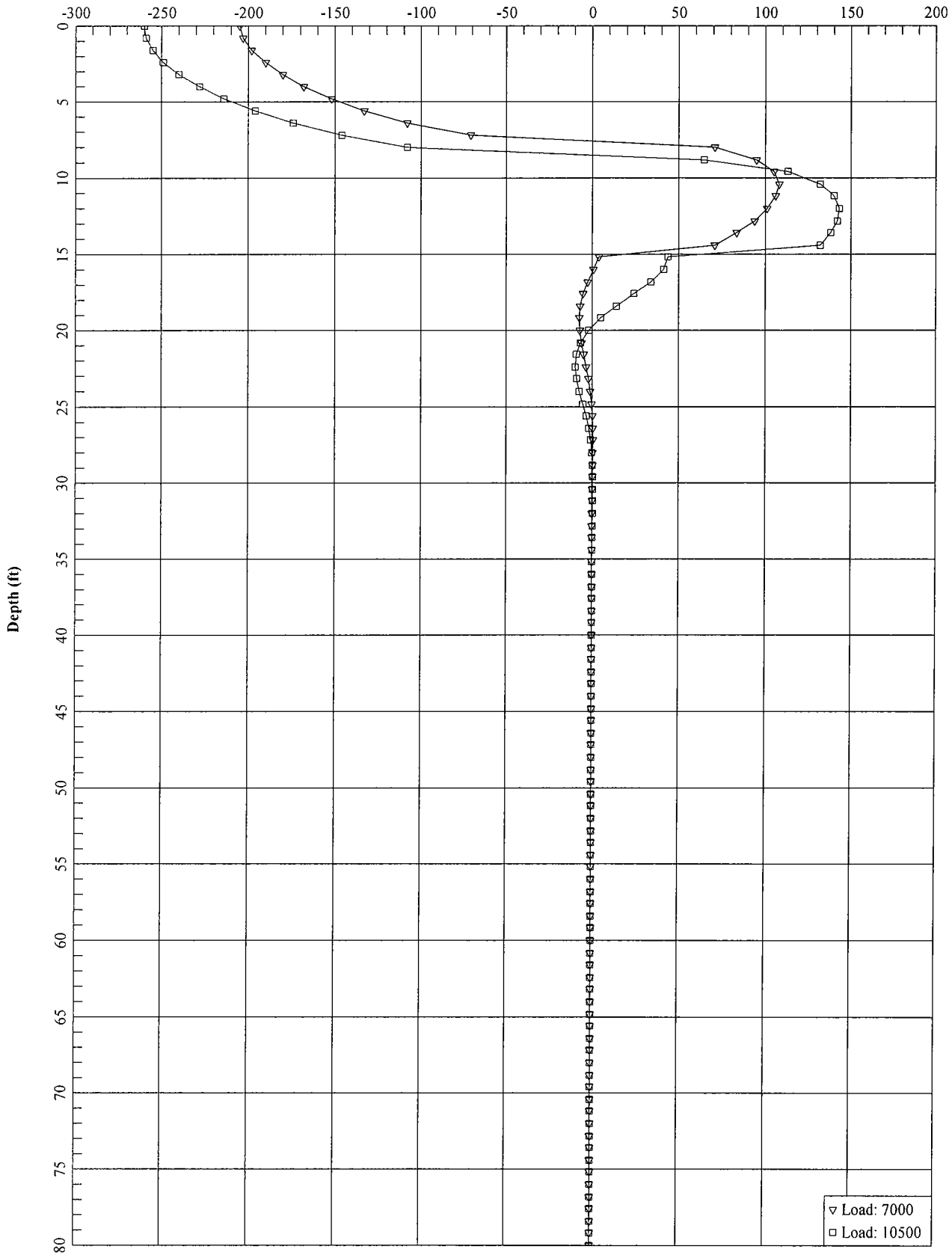
S U M M A R Y T A B L E
****

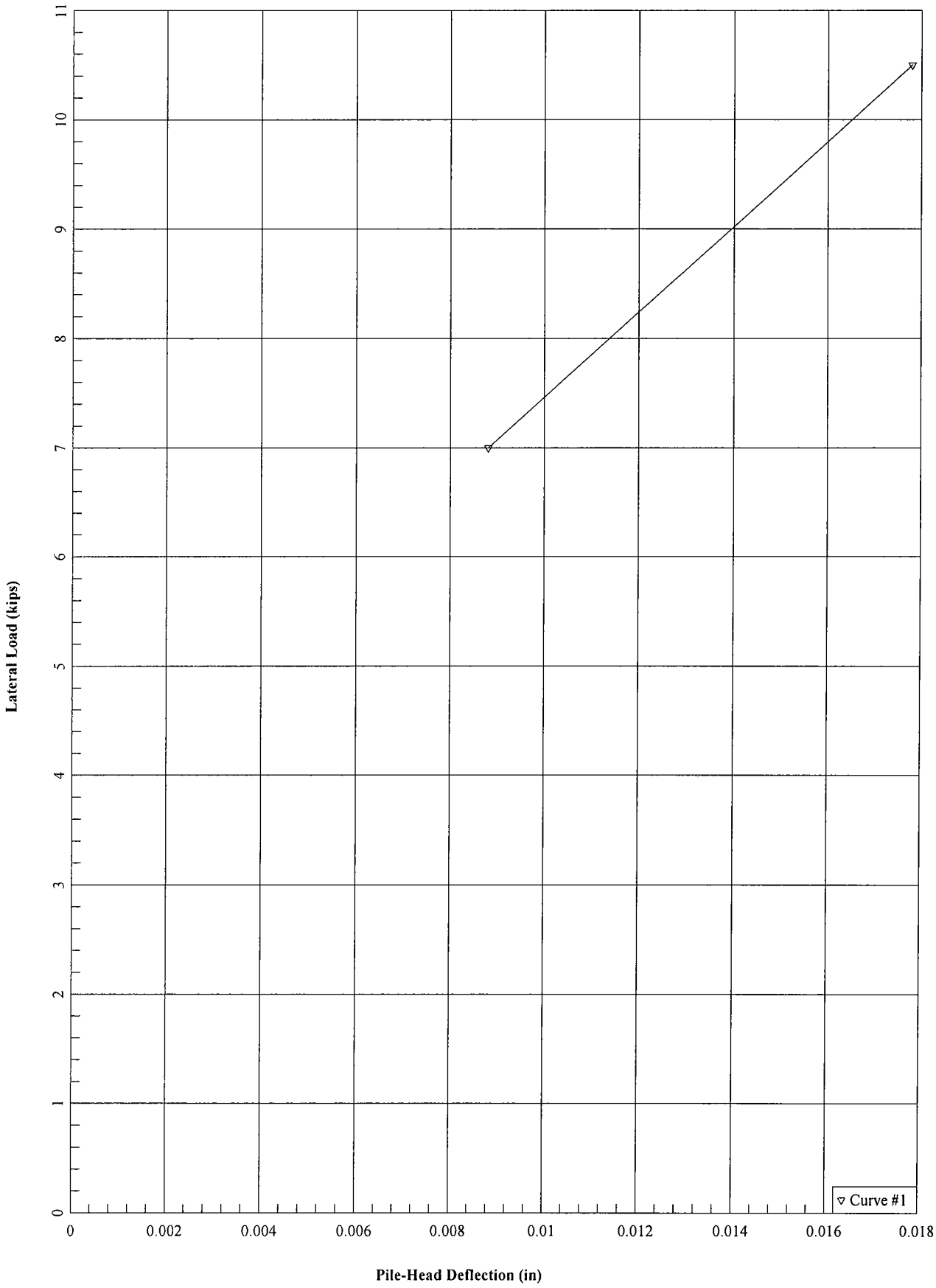
BOUNDARY CONDITION BC1	BOUNDARY CONDITION BC2	AXIAL LOAD LBS	PILE HEAD DEFLECTION IN	MAX. MOMENT IN-LBS	MAX. SHEAR LBS
.7000E+04	.3996E+06	.2652E+06	.8806E-02	.5218E+06	-.7193E+04
.1050E+05	.5994E+06	.3978E+06	.1778E-01	.8173E+06	.1050E+05

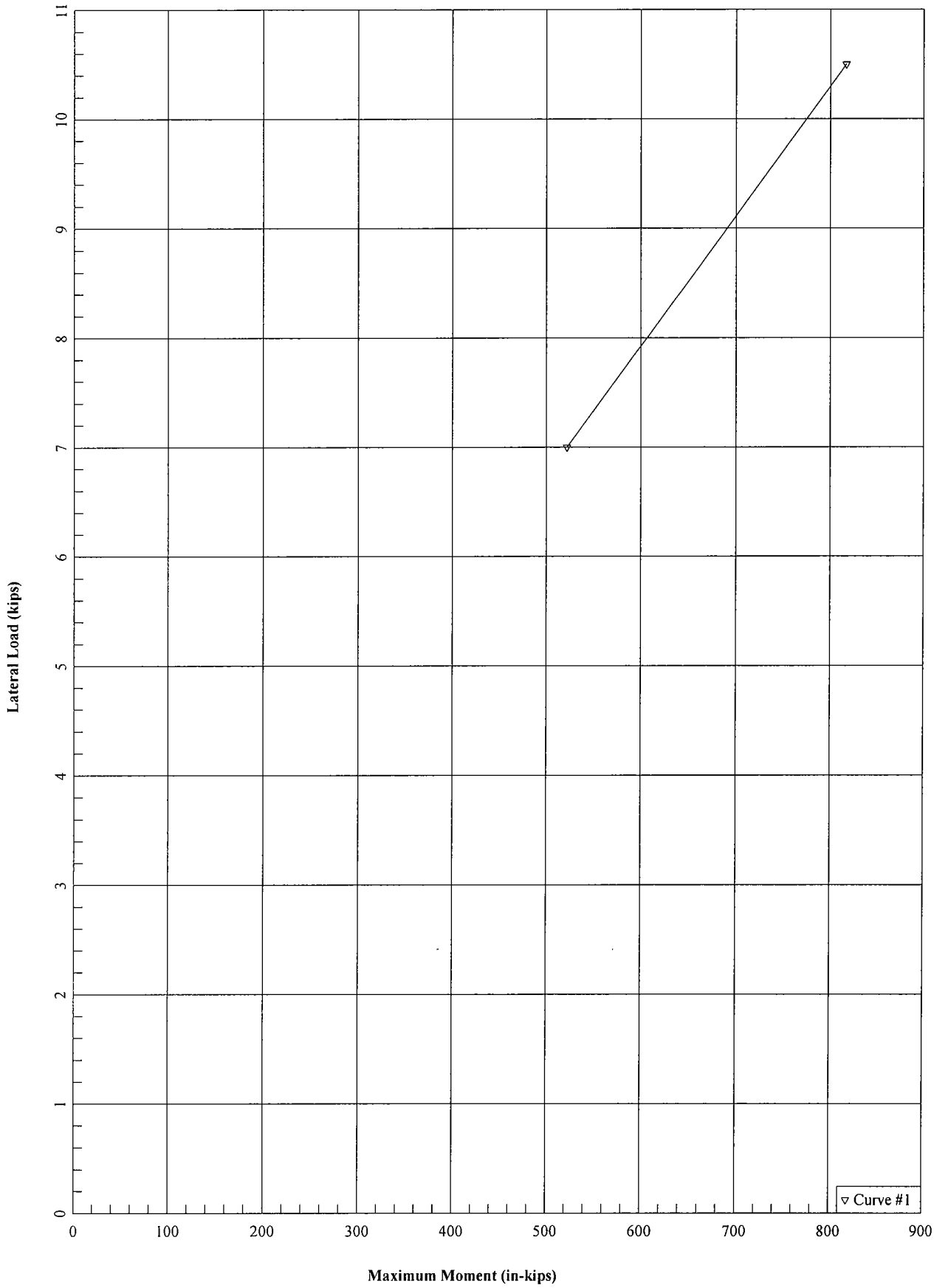

Deflection (in)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Load: 7000
Load: 10500

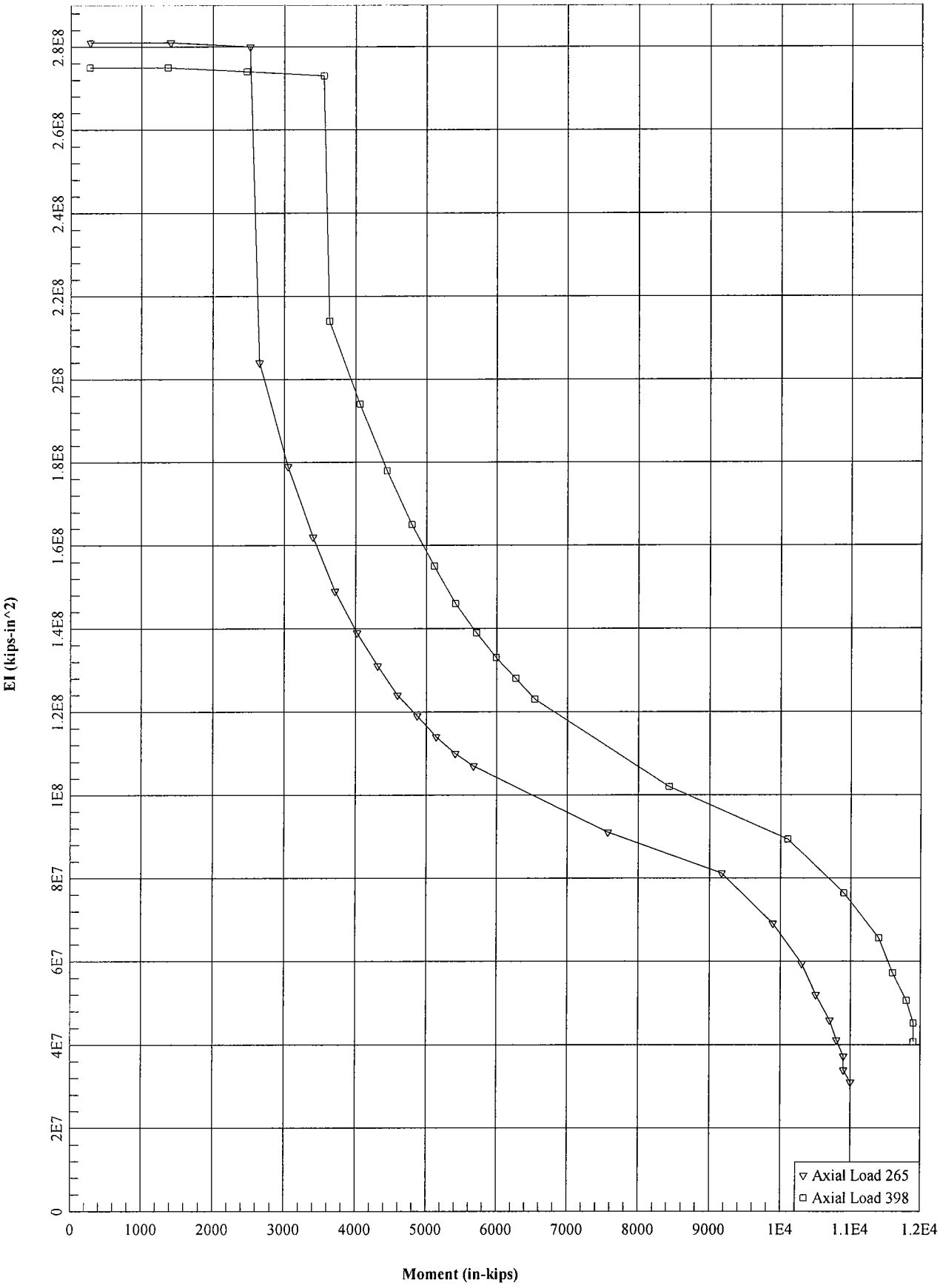

Bending Moment (in-kips)
-100
0
100
200
300
400
500
600
700
800
900
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Load: 7000
Load: 10500

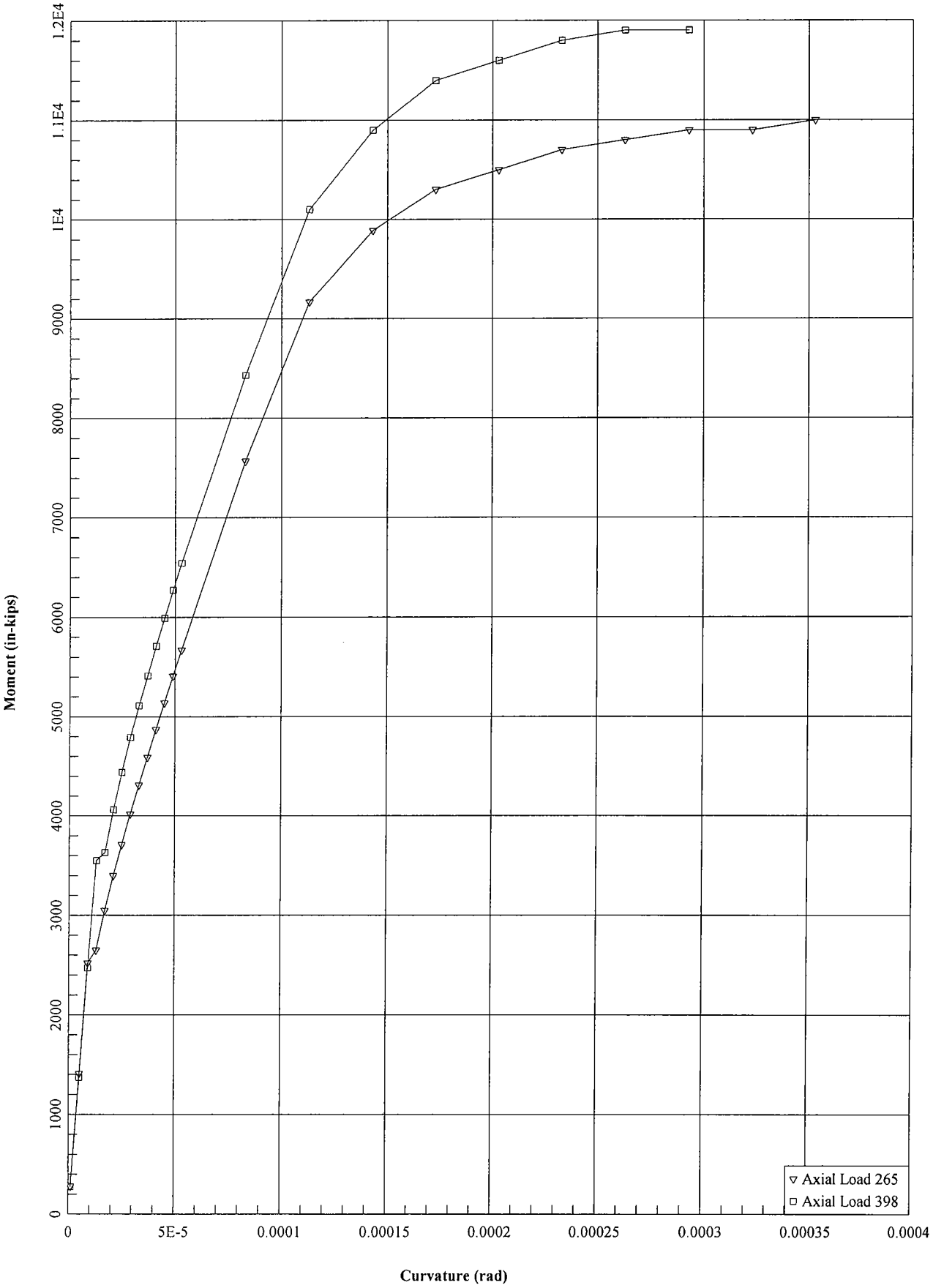

Shear (kips)
-10
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Load: 7000
Load: 10500

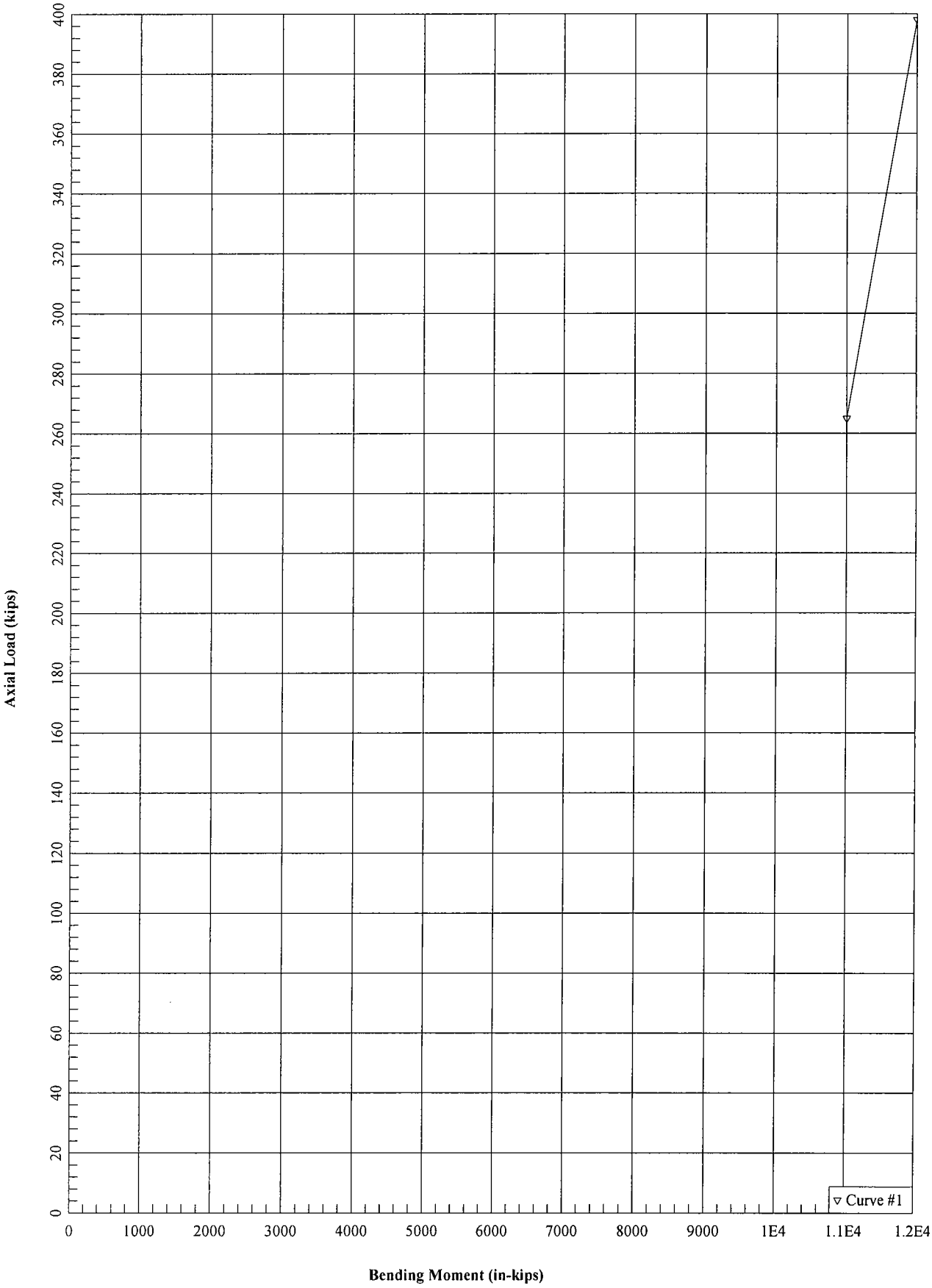

Soil Reaction (lbs/in)
-300
-250
-200
-150
-100
-50
0
50
100
150
200
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Load: 7000
Load: 10500


Lateral Load (kips)
0
1
2
3
4
5
6
7
8
9
10
11
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
Pile-Head Deflection (in)
Curve #1


Lateral Load (kips)
0
1
2
3
4
5
6
7
8
9
10
11
0
100
200
300
400
500
600
700
800
900
Maximum Moment (in-kips)
Curve #1


EI (kips-in^2)
0
2E7
4E7
6E7
8E7
1E8
1.2E8
1.4E8
1.6E8
1.8E8
2E8
2.2E8
2.4E8
2.6E8
2.8E8
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
1.1E4
1.2E4
Moment (in-kips)
Axial Load 265
Axial Load 398


Moment (in-kips)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
1.1E4
1.2E4
0
5E-5
0.0001
0.00015
0.0002
0.00025
0.0003
0.00035
0.0004
Curvature (rad)
Axial Load 265
Axial Load 398


Axial Load (kips)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
1.1E4
1.2E4
Bending Moment (in-kips)
Curve #1

Licensed to: CBradburn
Earth Exploration

LATERALLY LOADED PILE ANALYSIS PROGRAM LPILE plus
PC VERSION 3.0 (C) COPYRIGHT ENSOFT,INC. 1997
THE PROGRAM WAS COMPILED USING MICROSOFT FORTRAN COMPILER,
(C) COPYRIGHT MICROSOFT CORPORATION

Hamilton Boulevard (shallow)

****
ULTIMATE BENDING RESISTANCE AND FLEXURAL RIGIDITY
****

DIAMETER = 36.00 IN
CONCRETE COMPRESSIVE STRENGTH = 3.000000 KIP/IN**2
REBAR YIELD STRENGTH = 60.000000 KIP/IN**2
MODULUS OF ELASTICITY OF STEEL = 29000.000000 KIP/IN**2
NUMBER OF REINFORCING BARS = 13
AREA OF ONE REBAR = .790E+00 IN**2
NUMBER OF ROWS OF REINFORCING BARS = 13
COVER THICKNESS = 3.000 IN

SQUASH LOAD CAPACITY = 3185.60 KIP

ROW NUMBER	AREA OF REINFORCEMENT IN**2	DISTANCE TO CENTROIDAL AXIS IN
1	.790000	14.8906
2	.790000	14.0253
3	.790000	12.3448
4	.790000	9.9469
5	.790000	6.9709
6	.790000	3.5897
7	.790000	.0000
8	.790000	-3.5897
9	.790000	-6.9709
10	.790000	-9.9469
11	.790000	-12.3448
12	.790000	-14.0253
13	.790000	-14.8906

OUTPUT RESULTS FOR AN AXIAL LOAD = 265.21 KIP
****

MOMENT IN-KIP	EI KIP-IN**2	PHI 1/IN	MAX STR IN/IN	N AXIS IN
.281E+03	.28135E+09	.000001	.00010	95.708
.141E+04	.28112E+09	.000005	.00017	33.703
.252E+04	.28003E+09	.000009	.00024	26.883
.265E+04	.20420E+09	.000013	.00029	22.409
.305E+04	.17942E+09	.000017	.00034	20.260
.340E+04	.16168E+09	.000021	.00039	18.793
.371E+04	.14860E+09	.000025	.00044	17.730
.402E+04	.13850E+09	.000029	.00049	16.912
.431E+04	.13053E+09	.000033	.00054	16.269
.459E+04	.12407E+09	.000037	.00058	15.748

.487E+04	.11873E+09	.000041	.00063	15.321
.514E+04	.11425E+09	.000045	.00067	14.970
.541E+04	.11034E+09	.000049	.00072	14.652
.567E+04	.10702E+09	.000053	.00076	14.400
.757E+04	.91146E+08	.000083	.00110	13.224
.917E+04	.81169E+08	.000113	.00143	12.681
.989E+04	.69136E+08	.000143	.00173	12.126
.103E+05	.59400E+08	.000173	.00202	11.691
.105E+05	.51960E+08	.000203	.00231	11.391
.107E+05	.45863E+08	.000233	.00258	11.071
.108E+05	.41127E+08	.000263	.00285	10.843
.109E+05	.37236E+08	.000293	.00314	10.725
.109E+05	.33872E+08	.000323	.00341	10.570
.110E+05	.31039E+08	.000353	.00370	10.473
.110E+05	.28644E+08	.000383	.00398	10.400

THE ULTIMATE BENDING MOMENT AT A CONCRETE STRAIN OF 0.003
IS : .109E+05 IN-KIP

OUTPUT RESULTS FOR AN AXIAL LOAD = 397.82 KIP
****

MOMENT IN-KIP	EI KIP-IN**2	PHI 1/IN	MAX STR IN/IN	N AXIS IN
.275E+03	.27489E+09	.000001	.00014	135.885
.137E+04	.27476E+09	.000005	.00021	41.744
.247E+04	.27431E+09	.000009	.00028	31.366
.355E+04	.27297E+09	.000013	.00036	27.417
.363E+04	.21370E+09	.000017	.00041	23.902
.406E+04	.19354E+09	.000021	.00046	22.034
.444E+04	.17767E+09	.000025	.00052	20.663
.479E+04	.16510E+09	.000029	.00057	19.615
.511E+04	.15480E+09	.000033	.00062	18.774
.541E+04	.14633E+09	.000037	.00067	18.092
.571E+04	.13922E+09	.000041	.00072	17.525
.599E+04	.13317E+09	.000045	.00077	17.048
.627E+04	.12798E+09	.000049	.00082	16.644
.654E+04	.12338E+09	.000053	.00086	16.283
.843E+04	.10154E+09	.000083	.00122	14.681
.101E+05	.89397E+08	.000113	.00158	13.963
.109E+05	.76403E+08	.000143	.00191	13.368
.114E+05	.65640E+08	.000173	.00223	12.903
.116E+05	.57194E+08	.000203	.00255	12.543
.118E+05	.50631E+08	.000233	.00285	12.243
.119E+05	.45177E+08	.000263	.00316	12.028
.119E+05	.40749E+08	.000293	.00350	11.941
.120E+05	.37107E+08	.000323	.00382	11.839

THE ULTIMATE BENDING MOMENT AT A CONCRETE STRAIN OF 0.003
IS : .118E+05 IN-KIP

Hamilton Boulevard (shallow)

UNITS--ENGLISH UNITS

I N P U T I N F O R M A T I O N

****

THE LOADING IS STATIC

PILE GEOMETRY AND PROPERTIES

PILE LENGTH = 240.00 IN

2 POINTS

X	DIAMETER	MOMENT OF INERTIA	AREA	MODULUS OF ELASTICITY
IN	IN	IN**4	IN**2	LBS/IN**2
.00	36.000	.824E+05	.102E+04	.312E+07
240.00	36.000	.824E+05	.102E+04	.312E+07

SOILS INFORMATION

X AT THE GROUND SURFACE = .00 IN

SLOPE ANGLE AT THE GROUND SURFACE = .00 DEG.

2 LAYER(S) OF SOIL

LAYER 1

THE SOIL IS A SOFT CLAY

X AT THE TOP OF THE LAYER = .00 IN

X AT THE BOTTOM OF THE LAYER = 180.00 IN

MODULUS OF SUBGRADE REACTION = .500E+03 LBS/IN**3

LAYER 2

THE LAYER IS A ROCK

X AT THE TOP OF THE LAYER = 180.00 IN

X AT THE BOTTOM OF THE LAYER = 240.00 IN

MODULUS OF SUBGRADE REACTION = .400E+04 LBS/IN**3

DISTRIBUTION OF EFFECTIVE UNIT WEIGHT WITH DEPTH

4 POINTS

X,IN	WEIGHT,LBS/IN**3
.00	.67E-01
180.00	.67E-01
180.00	.80E-01
240.00	.80E-01

DISTRIBUTION OF STRENGTH PARAMETERS WITH DEPTH

4 POINTS

X,IN	C,LBS/IN**2	PHI,DEGREES	E50
.00	.150E+02	.000	.600E-02
180.00	.150E+02	.000	.600E-02
180.00	.600E+02	.000	.400E-02
240.00	.600E+02	.000	.400E-02

BOUNDARY AND LOADING CONDITIONS

LOADING NUMBER 1
BOUNDARY-CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .700E+04 LBS
MOMENT AT THE PILE HEAD = .400E+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .265E+06 LBS

LOADING NUMBER 2
BOUNDARY-CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .105E+05 LBS
MOMENT AT THE PILE HEAD = .599E+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .398E+06 LBS

FINITE-DIFFERENCE PARAMETERS
NUMBER OF PILE INCREMENTS = 100
DEFLECTION TOLERANCE ON DETERMINATION OF CLOSURE = .100E-04 IN
MAXIMUM NUMBER OF ITERATIONS ALLOWED FOR PILE ANALYSIS = 100
MAXIMUM ALLOWABLE DEFLECTION = .10E+03 IN

OUTPUT CODES
KOUTPT = 1
KPYOP = 0
INC = 1

O U T P U T   I N F O R M A T I O N
****

****
* COMPUTE LOAD-DISTRIBUTION AND LOAD-DEFLECTION *
* CURVES FOR LATERAL LOADING *
****

LOADING NUMBER 1

BOUNDARY CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .700E+04 LBS
MOMENT AT THE PILE HEAD = .400E+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .265E+06 LBS

X IN	DEFLECTION IN	MOMENT LBS-IN	SHEAR LBS	SLOPE RAD.	TOTAL STRESS LBS/IN**2	FLEXURAL RIGIDITY LBS-IN**2	SOIL REACTION LBS/IN
*****	*********	*********	*********	*********	*********	*********	*********
.0	.883E-02	.400E+06	.700E+04	-.181E-03	.348E+03	.257E+12	-.205E+03
2.4	.839E-02	.416E+06	.651E+04	-.178E-03	.351E+03	.257E+12	-.205E+03
4.8	.797E-02	.431E+06	.601E+04	-.174E-03	.355E+03	.257E+12	-.204E+03
7.2	.756E-02	.445E+06	.552E+04	-.170E-03	.358E+03	.257E+12	-.204E+03
9.6	.716E-02	.458E+06	.504E+04	-.165E-03	.360E+03	.257E+12	-.203E+03
12.0	.677E-02	.469E+06	.455E+04	-.161E-03	.363E+03	.257E+12	-.202E+03
14.4	.639E-02	.480E+06	.407E+04	-.157E-03	.365E+03	.257E+12	-.201E+03
16.8	.602E-02	.489E+06	.359E+04	-.152E-03	.367E+03	.257E+12	-.199E+03
19.2	.566E-02	.497E+06	.311E+04	-.148E-03	.369E+03	.257E+12	-.198E+03

21.6	.531E-02	.504E+06	.263E+04	-.143E-03	.371E+03	.257E+12	-.196E+03
24.0	.497E-02	.510E+06	.216E+04	-.138E-03	.372E+03	.257E+12	-.195E+03
26.4	.464E-02	.515E+06	.170E+04	-.133E-03	.373E+03	.257E+12	-.193E+03
28.8	.433E-02	.518E+06	.124E+04	-.129E-03	.374E+03	.257E+12	-.191E+03
31.2	.403E-02	.521E+06	.783E+03	-.124E-03	.374E+03	.257E+12	-.188E+03
33.6	.374E-02	.522E+06	.333E+03	-.119E-03	.375E+03	.257E+12	-.186E+03
36.0	.346E-02	.523E+06	-.111E+03	-.114E-03	.375E+03	.257E+12	-.183E+03
38.4	.319E-02	.522E+06	-.549E+03	-.109E-03	.374E+03	.257E+12	-.181E+03
40.8	.293E-02	.520E+06	-.980E+03	-.104E-03	.374E+03	.257E+12	-.178E+03
43.2	.269E-02	.517E+06	-.140E+04	-.994E-04	.373E+03	.257E+12	-.175E+03
45.6	.246E-02	.514E+06	-.182E+04	-.946E-04	.373E+03	.257E+12	-.171E+03
48.0	.223E-02	.509E+06	-.223E+04	-.898E-04	.372E+03	.257E+12	-.168E+03
50.4	.202E-02	.503E+06	-.263E+04	-.851E-04	.370E+03	.257E+12	-.164E+03
52.8	.183E-02	.496E+06	-.302E+04	-.805E-04	.369E+03	.257E+12	-.161E+03
55.2	.164E-02	.489E+06	-.340E+04	-.759E-04	.367E+03	.257E+12	-.157E+03
57.6	.146E-02	.480E+06	-.377E+04	-.714E-04	.365E+03	.257E+12	-.152E+03
60.0	.130E-02	.471E+06	-.414E+04	-.669E-04	.363E+03	.257E+12	-.148E+03
62.4	.114E-02	.460E+06	-.449E+04	-.626E-04	.361E+03	.257E+12	-.143E+03
64.8	.995E-03	.449E+06	-.483E+04	-.583E-04	.359E+03	.257E+12	-.138E+03
67.2	.860E-03	.437E+06	-.516E+04	-.542E-04	.356E+03	.257E+12	-.133E+03
69.6	.735E-03	.424E+06	-.547E+04	-.502E-04	.353E+03	.257E+12	-.128E+03
72.0	.619E-03	.411E+06	-.577E+04	-.463E-04	.350E+03	.257E+12	-.122E+03
74.4	.513E-03	.397E+06	-.606E+04	-.425E-04	.347E+03	.257E+12	-.116E+03
76.8	.415E-03	.382E+06	-.633E+04	-.389E-04	.344E+03	.257E+12	-.109E+03
79.2	.326E-03	.366E+06	-.659E+04	-.354E-04	.341E+03	.257E+12	-.101E+03
81.6	.245E-03	.350E+06	-.682E+04	-.321E-04	.337E+03	.257E+12	-.928E+02
84.0	.172E-03	.334E+06	-.704E+04	-.289E-04	.333E+03	.257E+12	-.831E+02
86.4	.106E-03	.317E+06	-.723E+04	-.259E-04	.330E+03	.257E+12	-.711E+02
88.8	.478E-04	.299E+06	-.739E+04	-.230E-04	.326E+03	.257E+12	-.542E+02
91.2	-.402E-05	.281E+06	-.744E+04	-.203E-04	.322E+03	.257E+12	.308E+02
93.6	-.496E-04	.263E+06	-.735E+04	-.177E-04	.318E+03	.257E+12	.589E+02
96.0	-.892E-04	.246E+06	-.721E+04	-.154E-04	.314E+03	.257E+12	.715E+02
98.4	-.123E-03	.229E+06	-.703E+04	-.132E-04	.310E+03	.257E+12	.801E+02
100.8	-.152E-03	.212E+06	-.684E+04	-.111E-04	.307E+03	.257E+12	.865E+02
103.2	-.177E-03	.196E+06	-.663E+04	-.920E-05	.303E+03	.257E+12	.916E+02
105.6	-.197E-03	.180E+06	-.641E+04	-.745E-05	.300E+03	.257E+12	.957E+02
108.0	-.212E-03	.165E+06	-.618E+04	-.584E-05	.297E+03	.257E+12	.991E+02
110.4	-.225E-03	.151E+06	-.594E+04	-.437E-05	.293E+03	.257E+12	.102E+03
112.8	-.233E-03	.137E+06	-.569E+04	-.303E-05	.290E+03	.257E+12	.104E+03
115.2	-.239E-03	.123E+06	-.545E+04	-.181E-05	.287E+03	.257E+12	.106E+03
117.6	-.242E-03	.111E+06	-.519E+04	-.722E-06	.285E+03	.257E+12	.107E+03
120.0	-.243E-03	.984E+05	-.494E+04	.252E-06	.282E+03	.257E+12	.108E+03
122.4	-.241E-03	.869E+05	-.468E+04	.112E-05	.279E+03	.257E+12	.109E+03
124.8	-.237E-03	.760E+05	-.442E+04	.188E-05	.277E+03	.257E+12	.109E+03
127.2	-.232E-03	.657E+05	-.416E+04	.254E-05	.275E+03	.257E+12	.109E+03
129.6	-.225E-03	.560E+05	-.391E+04	.310E-05	.273E+03	.257E+12	.109E+03
132.0	-.217E-03	.469E+05	-.365E+04	.358E-05	.271E+03	.257E+12	.108E+03
134.4	-.208E-03	.385E+05	-.339E+04	.398E-05	.269E+03	.257E+12	.108E+03
136.8	-.198E-03	.306E+05	-.314E+04	.430E-05	.267E+03	.257E+12	.107E+03
139.2	-.187E-03	.234E+05	-.288E+04	.455E-05	.266E+03	.257E+12	.106E+03
141.6	-.176E-03	.168E+05	-.263E+04	.474E-05	.264E+03	.257E+12	.104E+03
144.0	-.164E-03	.108E+05	-.239E+04	.487E-05	.263E+03	.257E+12	.103E+03
146.4	-.153E-03	.531E+04	-.215E+04	.495E-05	.262E+03	.257E+12	.101E+03
148.8	-.141E-03	.444E+03	-.191E+04	.497E-05	.261E+03	.257E+12	.993E+02
151.2	-.129E-03	-.386E+04	-.168E+04	.496E-05	.261E+03	.257E+12	.971E+02
153.6	-.117E-03	-.761E+04	-.145E+04	.490E-05	.262E+03	.257E+12	.948E+02
156.0	-.105E-03	-.108E+05	-.123E+04	.482E-05	.263E+03	.257E+12	.922E+02

158.4	-.938E-04	-.135E+05	-.101E+04	.470E-05	.263E+03	.257E+12	.895E+02
160.8	-.826E-04	-.157E+05	-.805E+03	.457E-05	.264E+03	.257E+12	.864E+02
163.2	-.719E-04	-.174E+05	-.605E+03	.441E-05	.264E+03	.257E+12	.832E+02
165.6	-.615E-04	-.186E+05	-.414E+03	.425E-05	.265E+03	.257E+12	.796E+02
168.0	-.515E-04	-.194E+05	-.232E+03	.407E-05	.265E+03	.257E+12	.756E+02
170.4	-.419E-04	-.197E+05	-.599E+02	.389E-05	.265E+03	.257E+12	.712E+02
172.8	-.328E-04	-.197E+05	.100E+03	.370E-05	.265E+03	.257E+12	.662E+02
175.2	-.242E-04	-.192E+05	.247E+03	.352E-05	.265E+03	.257E+12	.604E+02
177.6	-.159E-04	-.185E+05	.377E+03	.335E-05	.265E+03	.257E+12	.532E+02
180.0	-.811E-05	-.174E+05	.438E+03	.318E-05	.264E+03	.257E+12	.108E+01
182.4	-.679E-06	-.164E+05	.440E+03	.302E-05	.264E+03	.257E+12	.176E+00
184.8	.639E-05	-.153E+05	.439E+03	.287E-05	.264E+03	.257E+12	-.679E+00
187.2	.131E-04	-.143E+05	.436E+03	.273E-05	.264E+03	.257E+12	-.149E+01
189.6	.195E-04	-.132E+05	.431E+03	.261E-05	.263E+03	.257E+12	-.227E+01
192.0	.256E-04	-.122E+05	.425E+03	.249E-05	.263E+03	.257E+12	-.301E+01
194.4	.314E-04	-.112E+05	.417E+03	.238E-05	.263E+03	.257E+12	-.372E+01
196.8	.370E-04	-.102E+05	.407E+03	.228E-05	.263E+03	.257E+12	-.440E+01
199.2	.424E-04	-.926E+04	.395E+03	.219E-05	.263E+03	.257E+12	-.505E+01
201.6	.475E-04	-.833E+04	.382E+03	.211E-05	.262E+03	.257E+12	-.567E+01
204.0	.525E-04	-.743E+04	.368E+03	.203E-05	.262E+03	.257E+12	-.627E+01
206.4	.573E-04	-.656E+04	.352E+03	.197E-05	.262E+03	.257E+12	-.685E+01
208.8	.619E-04	-.574E+04	.335E+03	.191E-05	.262E+03	.257E+12	-.742E+01
211.2	.664E-04	-.496E+04	.316E+03	.186E-05	.262E+03	.257E+12	-.797E+01
213.6	.708E-04	-.422E+04	.297E+03	.182E-05	.261E+03	.257E+12	-.850E+01
216.0	.752E-04	-.354E+04	.276E+03	.178E-05	.261E+03	.257E+12	-.903E+01
218.4	.794E-04	-.290E+04	.253E+03	.175E-05	.261E+03	.257E+12	-.954E+01
220.8	.836E-04	-.232E+04	.230E+03	.173E-05	.261E+03	.257E+12	-.101E+02
223.2	.877E-04	-.180E+04	.205E+03	.171E-05	.261E+03	.257E+12	-.106E+02
225.6	.918E-04	-.134E+04	.179E+03	.169E-05	.261E+03	.257E+12	-.110E+02
228.0	.958E-04	-.940E+03	.152E+03	.168E-05	.261E+03	.257E+12	-.115E+02
230.4	.998E-04	-.609E+03	.124E+03	.167E-05	.261E+03	.257E+12	-.120E+02
232.8	.104E-03	-.346E+03	.949E+02	.167E-05	.261E+03	.257E+12	-.125E+02
235.2	.108E-03	-.155E+03	.644E+02	.167E-05	.261E+03	.257E+12	-.130E+02
237.6	.112E-03	-.390E+02	.328E+02	.167E-05	.261E+03	.257E+12	-.135E+02
240.0	.116E-03	.000E+00	.000E+00	.167E-05	.261E+03	.257E+12	-.140E+02

OUTPUT VERIFICATION

THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = -.871E-06 IN-LBS
THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = -.183E-06 LBS

OUTPUT SUMMARY

PILE-HEAD DEFLECTION = .883E-02 IN
COMPUTED SLOPE AT PILE HEAD = -.181E-03
MAXIMUM BENDING MOMENT = .523E+06 LBS-IN
MAXIMUM SHEAR FORCE = -.744E+04 LBS
NO. OF ITERATIONS = 10
NO. OF ZERO DEFLECTION POINTS = 2

LOADING NUMBER 2

BOUNDARY CONDITION CODE = 1
LATERAL LOAD AT THE PILE HEAD = .105E+05 LBS
MOMENT AT THE PILE HEAD = .599E+06 IN-LBS
AXIAL LOAD AT THE PILE HEAD = .398E+06 LBS

X	DEFLECTION	MOMENT	SHEAR	SLOPE	TOTAL STRESS	FLEXURAL RIGIDITY	SOIL REACTION
IN	IN	LBS-IN	LBS	RAD.	LBS/IN**2	LBS-IN**2	LBS/IN
.0	.178E-01	.599E+06	.105E+05	-.321E-03	.522E+03	.257E+12	-.260E+03
2.4	.171E-01	.624E+06	.988E+04	-.316E-03	.527E+03	.257E+12	-.260E+03
4.8	.163E-01	.647E+06	.925E+04	-.310E-03	.532E+03	.257E+12	-.260E+03
7.2	.156E-01	.669E+06	.863E+04	-.304E-03	.537E+03	.257E+12	-.259E+03
9.6	.148E-01	.689E+06	.801E+04	-.297E-03	.541E+03	.257E+12	-.259E+03
12.0	.141E-01	.708E+06	.739E+04	-.291E-03	.545E+03	.257E+12	-.258E+03
14.4	.134E-01	.725E+06	.677E+04	-.284E-03	.549E+03	.257E+12	-.257E+03
16.8	.128E-01	.741E+06	.615E+04	-.277E-03	.553E+03	.257E+12	-.256E+03
19.2	.121E-01	.755E+06	.554E+04	-.270E-03	.556E+03	.257E+12	-.255E+03
21.6	.115E-01	.768E+06	.493E+04	-.263E-03	.559E+03	.257E+12	-.254E+03
24.0	.109E-01	.780E+06	.432E+04	-.256E-03	.561E+03	.257E+12	-.253E+03
26.4	.102E-01	.789E+06	.371E+04	-.249E-03	.563E+03	.257E+12	-.251E+03
28.8	.966E-02	.798E+06	.311E+04	-.241E-03	.565E+03	.257E+12	-.249E+03
31.2	.909E-02	.805E+06	.252E+04	-.234E-03	.567E+03	.257E+12	-.247E+03
33.6	.854E-02	.810E+06	.193E+04	-.226E-03	.568E+03	.257E+12	-.245E+03
36.0	.800E-02	.815E+06	.134E+04	-.219E-03	.569E+03	.257E+12	-.243E+03
38.4	.749E-02	.817E+06	.761E+03	-.211E-03	.569E+03	.257E+12	-.240E+03
40.8	.699E-02	.819E+06	.187E+03	-.203E-03	.570E+03	.257E+12	-.238E+03
43.2	.651E-02	.819E+06	-.381E+03	-.196E-03	.569E+03	.257E+12	-.235E+03
45.6	.605E-02	.817E+06	-.941E+03	-.188E-03	.569E+03	.257E+12	-.232E+03
48.0	.561E-02	.814E+06	-.149E+04	-.181E-03	.569E+03	.257E+12	-.229E+03
50.4	.518E-02	.810E+06	-.204E+04	-.173E-03	.568E+03	.257E+12	-.225E+03
52.8	.478E-02	.805E+06	-.258E+04	-.165E-03	.567E+03	.257E+12	-.222E+03
55.2	.439E-02	.798E+06	-.310E+04	-.158E-03	.565E+03	.257E+12	-.218E+03
57.6	.402E-02	.790E+06	-.362E+04	-.151E-03	.563E+03	.257E+12	-.214E+03
60.0	.367E-02	.781E+06	-.413E+04	-.143E-03	.561E+03	.257E+12	-.210E+03
62.4	.333E-02	.771E+06	-.463E+04	-.136E-03	.559E+03	.257E+12	-.205E+03
64.8	.301E-02	.759E+06	-.512E+04	-.129E-03	.557E+03	.257E+12	-.201E+03
67.2	.271E-02	.747E+06	-.559E+04	-.122E-03	.554E+03	.257E+12	-.196E+03
69.6	.243E-02	.733E+06	-.606E+04	-.115E-03	.551E+03	.257E+12	-.190E+03
72.0	.216E-02	.718E+06	-.651E+04	-.108E-03	.547E+03	.257E+12	-.185E+03
74.4	.191E-02	.702E+06	-.695E+04	-.102E-03	.544E+03	.257E+12	-.179E+03
76.8	.167E-02	.685E+06	-.737E+04	-.952E-04	.540E+03	.257E+12	-.173E+03
79.2	.145E-02	.666E+06	-.778E+04	-.889E-04	.536E+03	.257E+12	-.167E+03
81.6	.125E-02	.647E+06	-.817E+04	-.827E-04	.532E+03	.257E+12	-.160E+03
84.0	.105E-02	.627E+06	-.855E+04	-.768E-04	.528E+03	.257E+12	-.153E+03
86.4	.876E-03	.606E+06	-.891E+04	-.710E-04	.523E+03	.257E+12	-.145E+03
88.8	.713E-03	.585E+06	-.925E+04	-.655E-04	.518E+03	.257E+12	-.137E+03
91.2	.562E-03	.562E+06	-.957E+04	-.601E-04	.514E+03	.257E+12	-.128E+03
93.6	.424E-03	.539E+06	-.987E+04	-.550E-04	.508E+03	.257E+12	-.117E+03
96.0	.298E-03	.515E+06	-.101E+05	-.501E-04	.503E+03	.257E+12	-.105E+03
98.4	.184E-03	.490E+06	-.104E+05	-.454E-04	.498E+03	.257E+12	-.901E+02
100.8	.800E-04	.465E+06	-.106E+05	-.410E-04	.492E+03	.257E+12	-.685E+02
103.2	-.131E-04	.440E+06	-.106E+05	-.367E-04	.487E+03	.257E+12	.408E+02
105.6	-.963E-04	.414E+06	-.105E+05	-.328E-04	.481E+03	.257E+12	.758E+02
108.0	-.170E-03	.389E+06	-.103E+05	-.290E-04	.476E+03	.257E+12	.920E+02
110.4	-.236E-03	.365E+06	-.101E+05	-.255E-04	.470E+03	.257E+12	.103E+03
112.8	-.293E-03	.341E+06	-.980E+04	-.222E-04	.465E+03	.257E+12	.112E+03
115.2	-.342E-03	.318E+06	-.952E+04	-.191E-04	.460E+03	.257E+12	.119E+03
117.6	-.385E-03	.296E+06	-.923E+04	-.163E-04	.455E+03	.257E+12	.125E+03
120.0	-.420E-03	.274E+06	-.893E+04	-.136E-04	.451E+03	.257E+12	.129E+03
122.4	-.450E-03	.253E+06	-.862E+04	-.112E-04	.446E+03	.257E+12	.134E+03
124.8	-.474E-03	.232E+06	-.829E+04	-.890E-05	.442E+03	.257E+12	.137E+03

127.2	-.493E-03	.213E+06	-.796E+04	-.682E-05	.437E+03	.257E+12	.140E+03
129.6	-.507E-03	.194E+06	-.763E+04	-.492E-05	.433E+03	.257E+12	.142E+03
132.0	-.516E-03	.176E+06	-.728E+04	-.320E-05	.429E+03	.257E+12	.144E+03
134.4	-.522E-03	.159E+06	-.693E+04	-.163E-05	.426E+03	.257E+12	.146E+03
136.8	-.524E-03	.143E+06	-.658E+04	-.222E-06	.422E+03	.257E+12	.147E+03
139.2	-.523E-03	.128E+06	-.623E+04	.104E-05	.419E+03	.257E+12	.149E+03
141.6	-.519E-03	.113E+06	-.587E+04	.216E-05	.415E+03	.257E+12	.149E+03
144.0	-.513E-03	.995E+05	-.552E+04	.315E-05	.412E+03	.257E+12	.150E+03
146.4	-.504E-03	.867E+05	-.516E+04	.402E-05	.410E+03	.257E+12	.150E+03
148.8	-.493E-03	.747E+05	-.480E+04	.477E-05	.407E+03	.257E+12	.150E+03
151.2	-.481E-03	.636E+05	-.444E+04	.542E-05	.405E+03	.257E+12	.150E+03
153.6	-.467E-03	.534E+05	-.408E+04	.596E-05	.402E+03	.257E+12	.150E+03
156.0	-.452E-03	.441E+05	-.372E+04	.642E-05	.400E+03	.257E+12	.149E+03
158.4	-.436E-03	.356E+05	-.336E+04	.679E-05	.399E+03	.257E+12	.149E+03
160.8	-.420E-03	.279E+05	-.301E+04	.709E-05	.397E+03	.257E+12	.148E+03
163.2	-.402E-03	.211E+05	-.265E+04	.731E-05	.395E+03	.257E+12	.147E+03
165.6	-.385E-03	.151E+05	-.230E+04	.748E-05	.394E+03	.257E+12	.146E+03
168.0	-.367E-03	.100E+05	-.196E+04	.760E-05	.393E+03	.257E+12	.144E+03
170.4	-.348E-03	.574E+04	-.161E+04	.767E-05	.392E+03	.257E+12	.143E+03
172.8	-.330E-03	.227E+04	-.127E+04	.771E-05	.391E+03	.257E+12	.141E+03
175.2	-.311E-03	-.383E+03	-.935E+03	.772E-05	.391E+03	.257E+12	.140E+03
177.6	-.293E-03	-.223E+04	-.603E+03	.771E-05	.391E+03	.257E+12	.138E+03
180.0	-.274E-03	-.329E+04	-.398E+03	.768E-05	.391E+03	.257E+12	.330E+02
182.4	-.256E-03	-.416E+04	-.322E+03	.765E-05	.392E+03	.257E+12	.307E+02
184.8	-.237E-03	-.485E+04	-.251E+03	.761E-05	.392E+03	.257E+12	.285E+02
187.2	-.219E-03	-.538E+04	-.185E+03	.756E-05	.392E+03	.257E+12	.264E+02
189.6	-.201E-03	-.575E+04	-.125E+03	.751E-05	.392E+03	.257E+12	.242E+02
192.0	-.183E-03	-.599E+04	-.692E+02	.745E-05	.392E+03	.257E+12	.220E+02
194.4	-.165E-03	-.610E+04	-.190E+02	.740E-05	.392E+03	.257E+12	.199E+02
196.8	-.148E-03	-.610E+04	.261E+02	.734E-05	.392E+03	.257E+12	.177E+02
199.2	-.130E-03	-.599E+04	.661E+02	.728E-05	.392E+03	.257E+12	.156E+02
201.6	-.113E-03	-.579E+04	.101E+03	.723E-05	.392E+03	.257E+12	.135E+02
204.0	-.955E-04	-.552E+04	.131E+03	.717E-05	.392E+03	.257E+12	.115E+02
206.4	-.783E-04	-.518E+04	.156E+03	.712E-05	.392E+03	.257E+12	.940E+01
208.8	-.613E-04	-.478E+04	.176E+03	.708E-05	.392E+03	.257E+12	.735E+01
211.2	-.443E-04	-.435E+04	.191E+03	.704E-05	.392E+03	.257E+12	.531E+01
213.6	-.275E-04	-.388E+04	.202E+03	.700E-05	.392E+03	.257E+12	.329E+01
216.0	-.108E-04	-.339E+04	.207E+03	.696E-05	.392E+03	.257E+12	.127E+01
218.4	.591E-05	-.290E+04	.208E+03	.693E-05	.391E+03	.257E+12	-.734E+00
220.8	.225E-04	-.241E+04	.204E+03	.691E-05	.391E+03	.257E+12	-.273E+01
223.2	.391E-04	-.193E+04	.195E+03	.689E-05	.391E+03	.257E+12	-.472E+01
225.6	.556E-04	-.148E+04	.181E+03	.687E-05	.391E+03	.257E+12	-.671E+01
228.0	.721E-04	-.107E+04	.163E+03	.686E-05	.391E+03	.257E+12	-.869E+01
230.4	.885E-04	-.713E+03	.140E+03	.685E-05	.391E+03	.257E+12	-.107E+02
232.8	.105E-03	-.415E+03	.112E+03	.685E-05	.391E+03	.257E+12	-.126E+02
235.2	.121E-03	-.189E+03	.794E+02	.685E-05	.391E+03	.257E+12	-.146E+02
237.6	.138E-03	-.468E+02	.421E+02	.684E-05	.391E+03	.257E+12	-.166E+02
240.0	.154E-03	.000E+00	.000E+00	.684E-05	.391E+03	.257E+12	-.186E+02

OUTPUT VERIFICATION

THE MAXIMUM MOMENT IMBALANCE FOR ANY ELEMENT = .247E-06 IN-LBS
THE MAX. LATERAL FORCE IMBALANCE FOR ANY ELEMENT = .101E-06 LBS

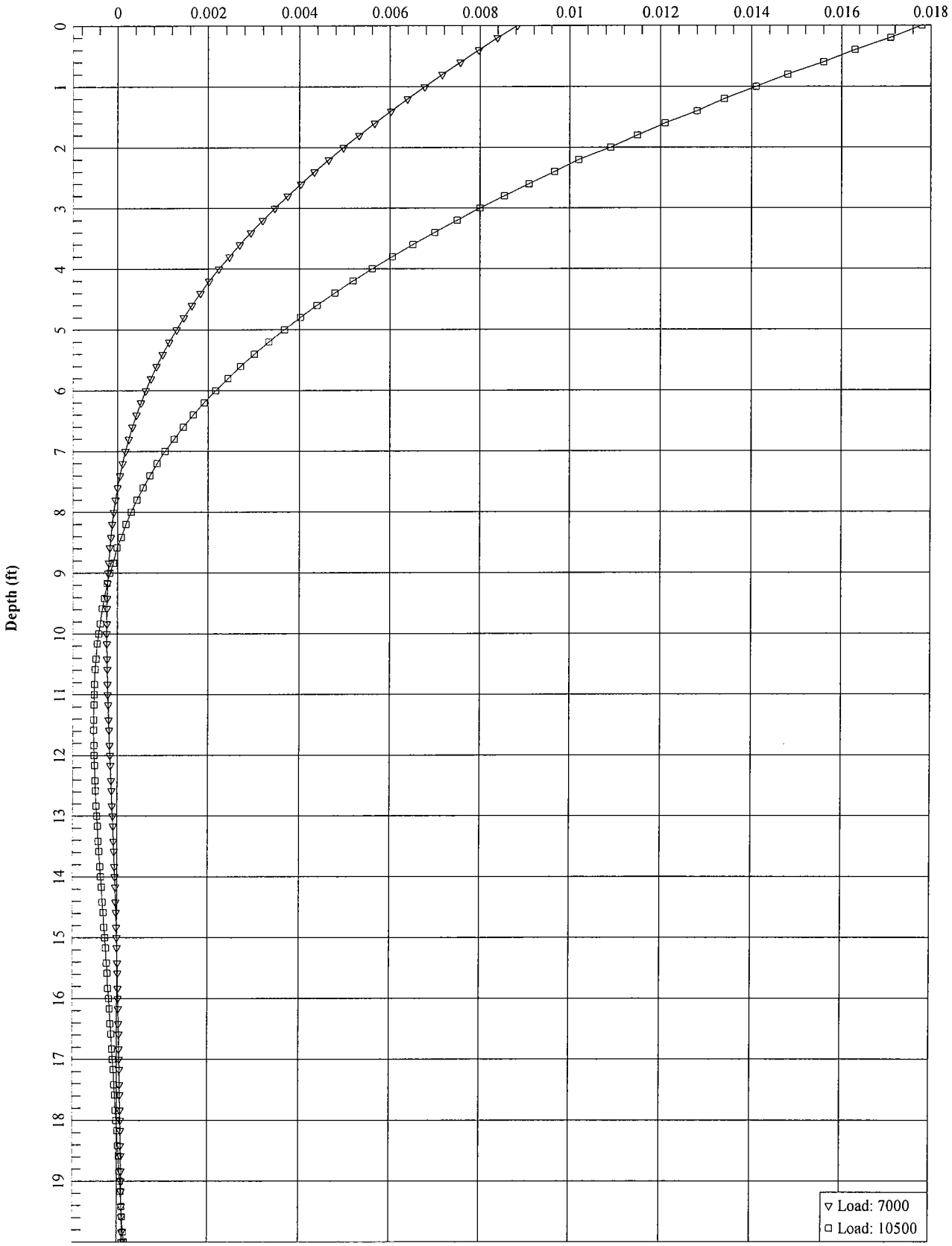
OUTPUT SUMMARY

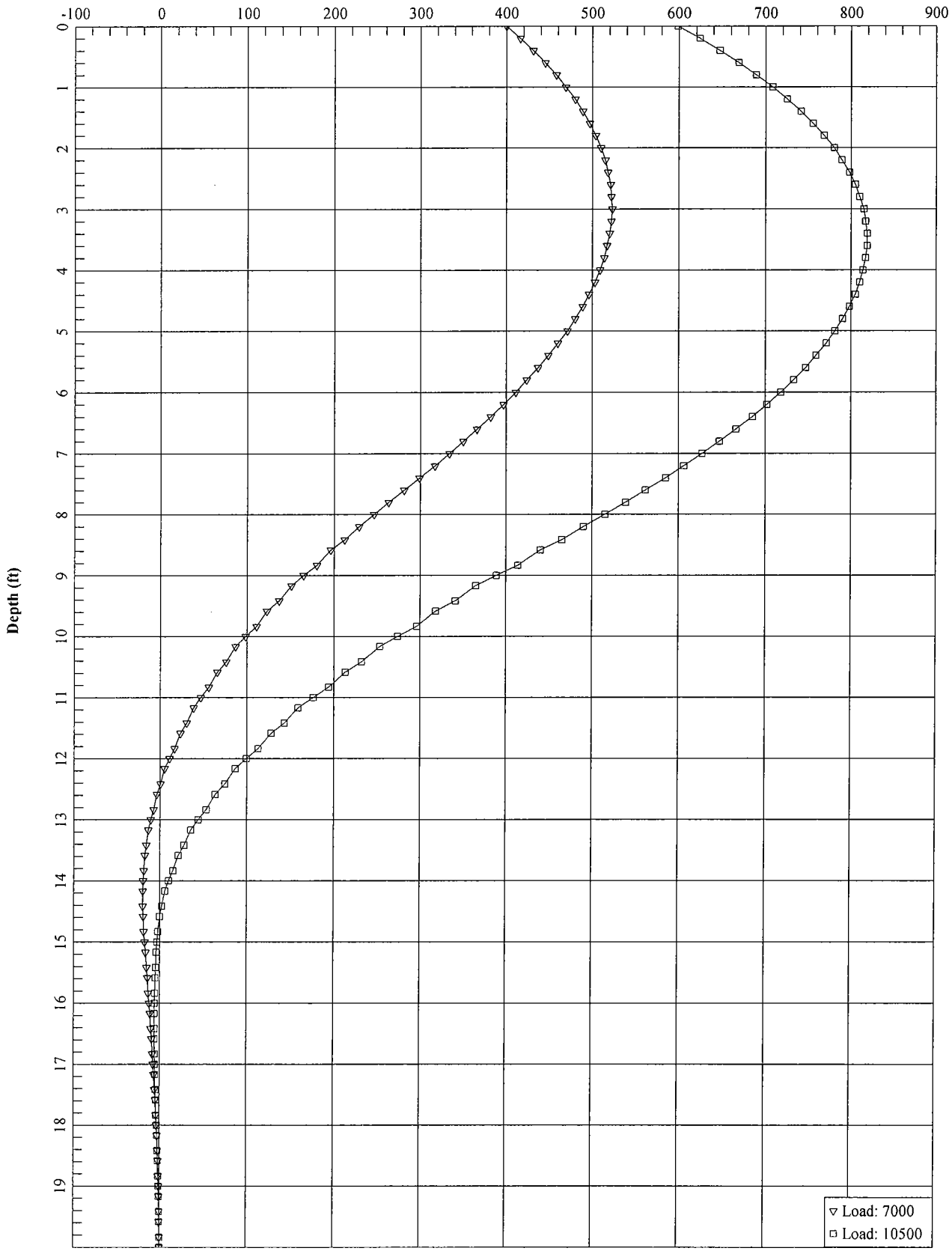
PILE-HEAD DEFLECTION	=	.178E-01 IN
COMPUTED SLOPE AT PILE HEAD	=	-.321E-03
MAXIMUM BENDING MOMENT	=	.819E+06 LBS-IN
MAXIMUM SHEAR FORCE	=	-.106E+05 LBS
NO. OF ITERATIONS	=	14
NO. OF ZERO DEFLECTION POINTS	=	2

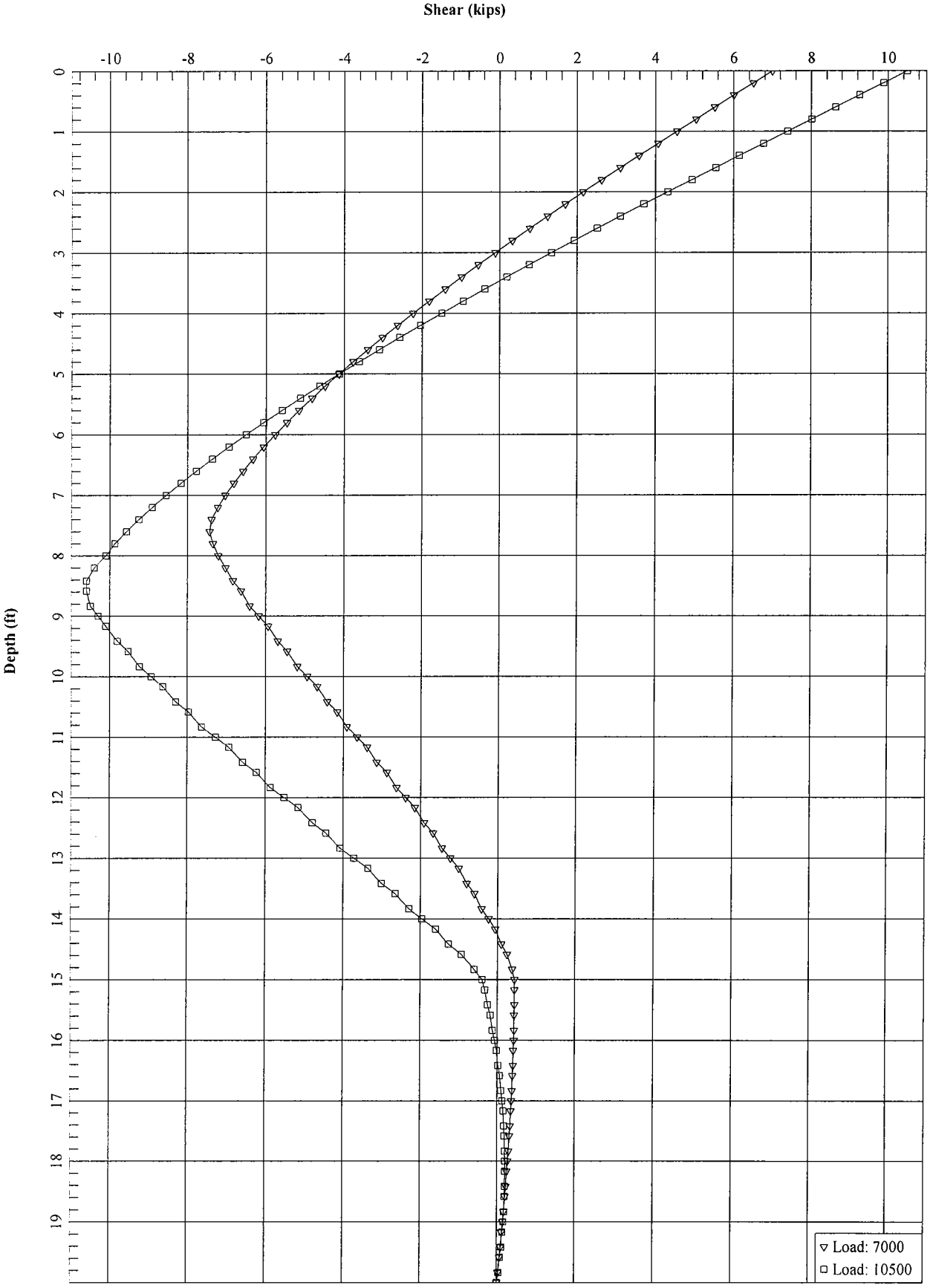
S U M M A R Y T A B L E

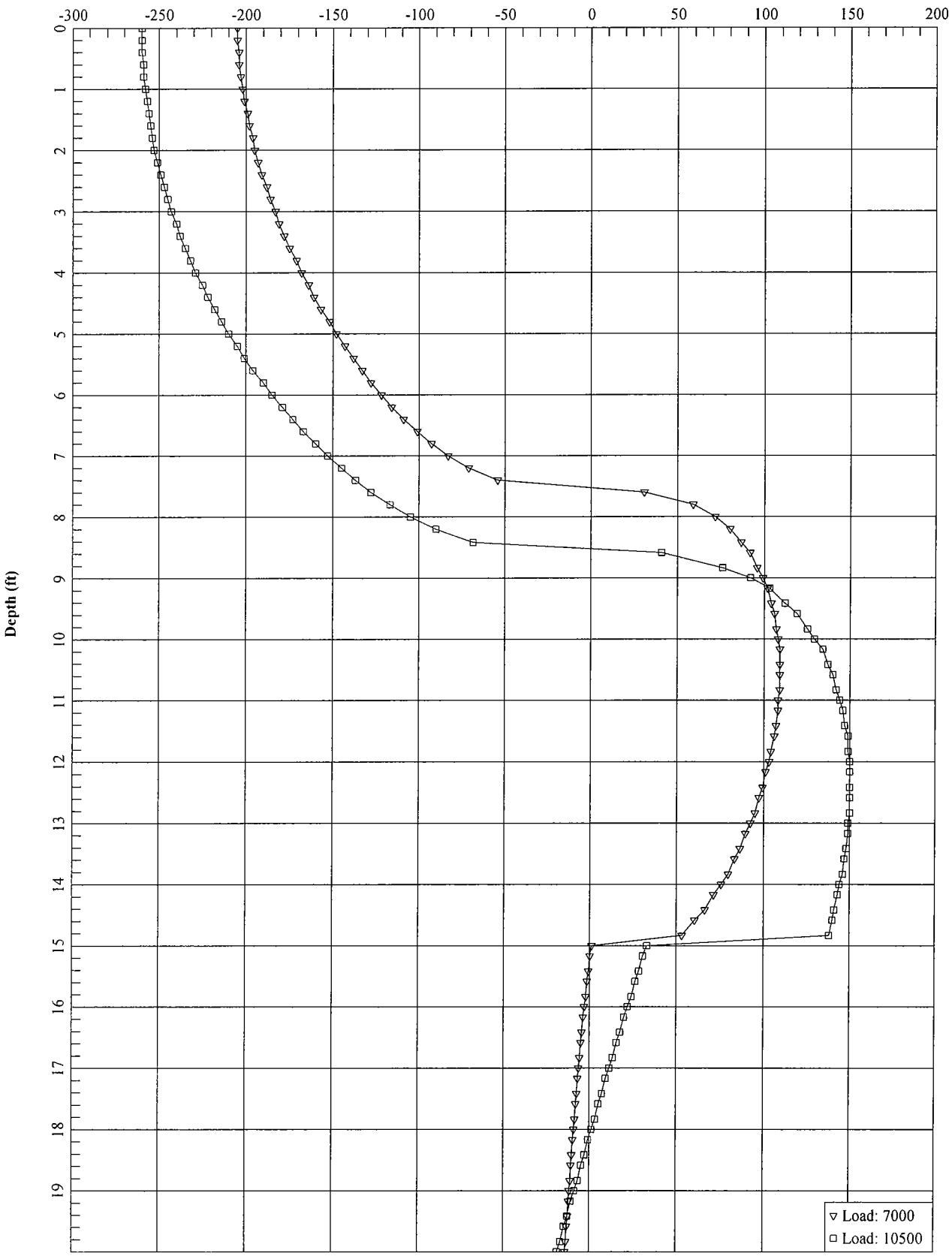
****

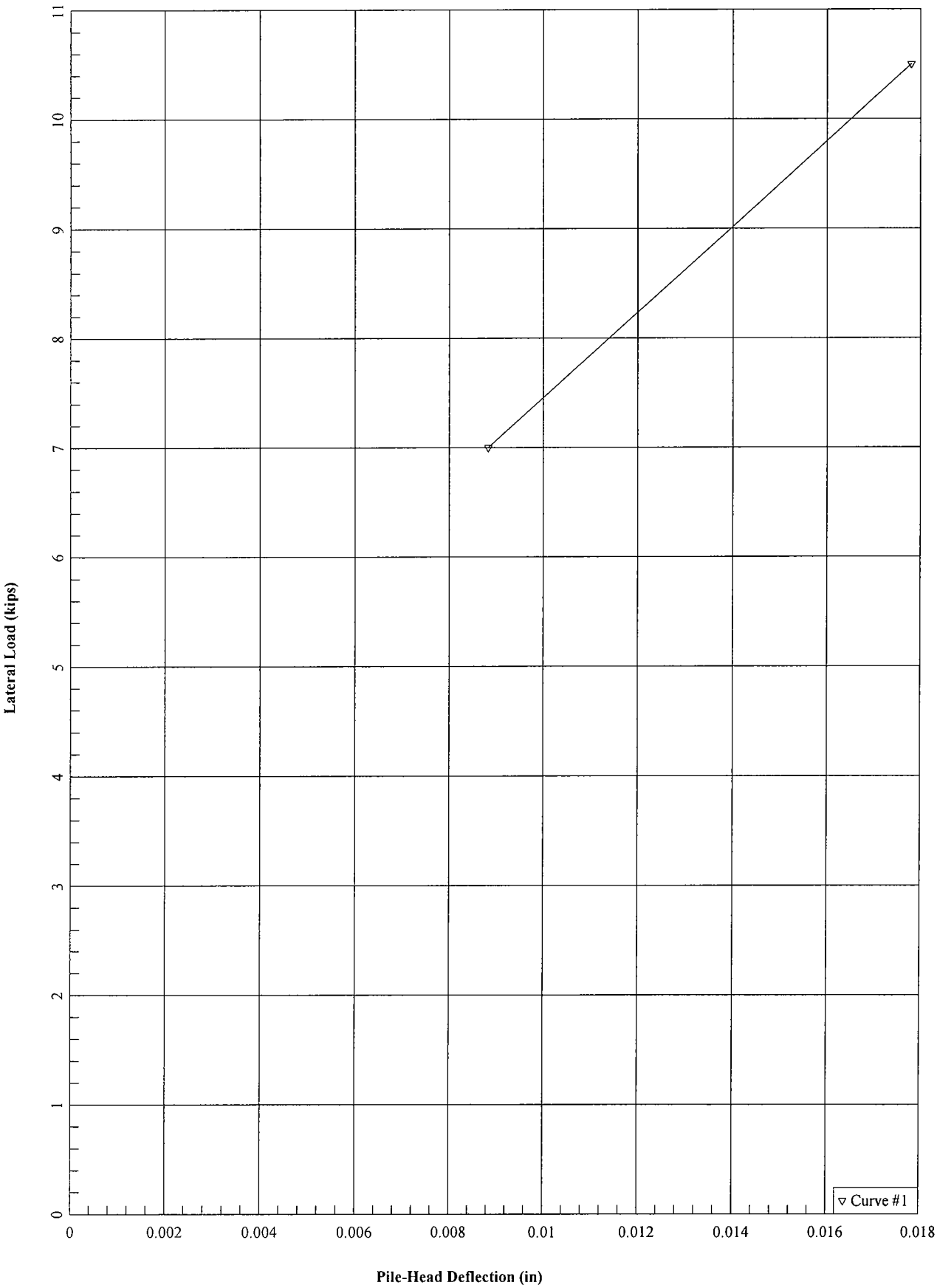
BOUNDARY CONDITION BC1	BOUNDARY CONDITION BC2	AXIAL LOAD LBS	PILE HEAD DEFLECTION IN	MAX. MOMENT IN-LBS	MAX. SHEAR LBS
.7000E+04	.3996E+06	.2652E+06	.8826E-02	.5226E+06	-.7440E+04
.1050E+05	.5994E+06	.3978E+06	.1782E-01	.8186E+06	-.1061E+05

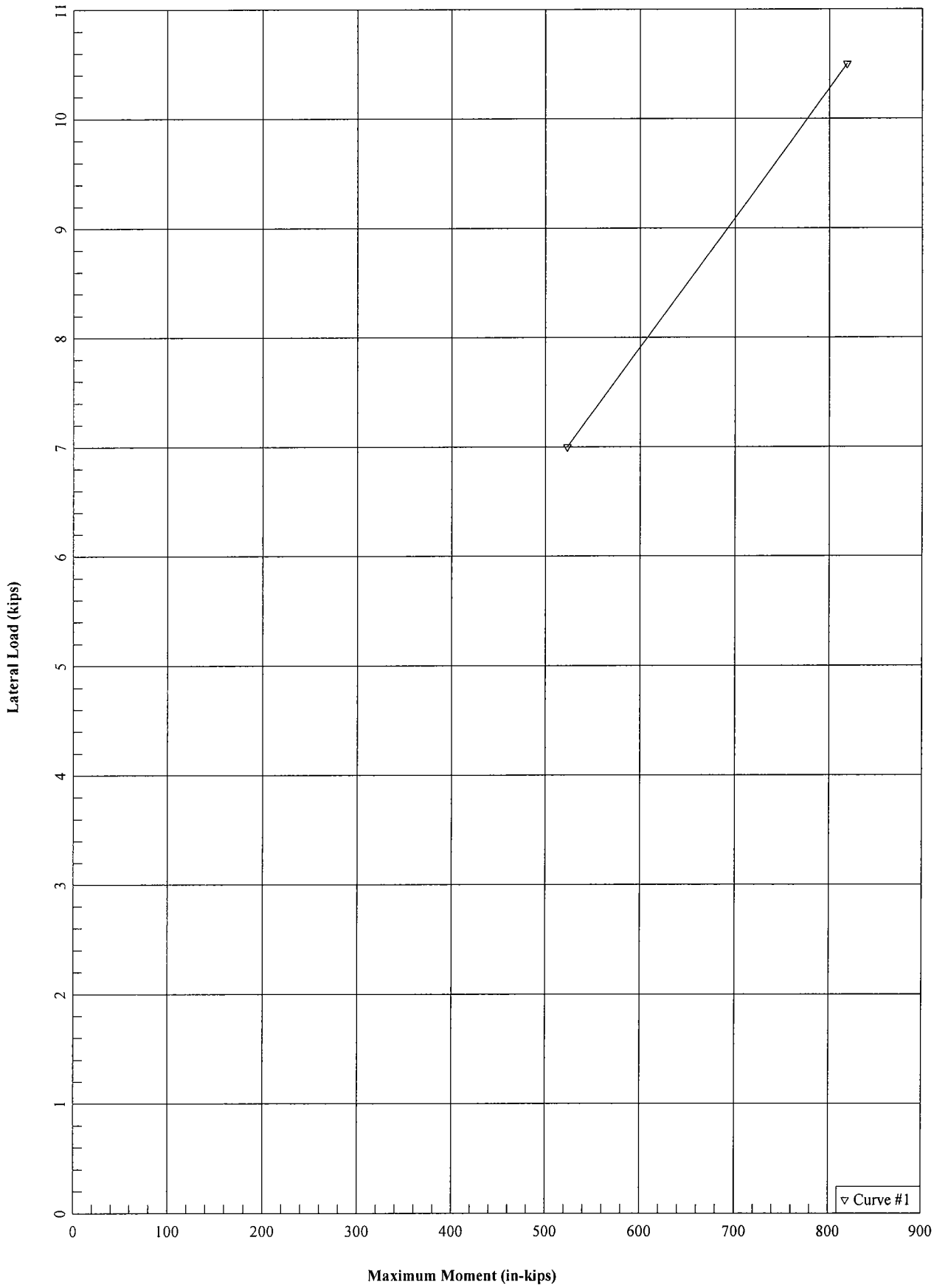

Deflection (in)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Load: 7000
Load: 10500

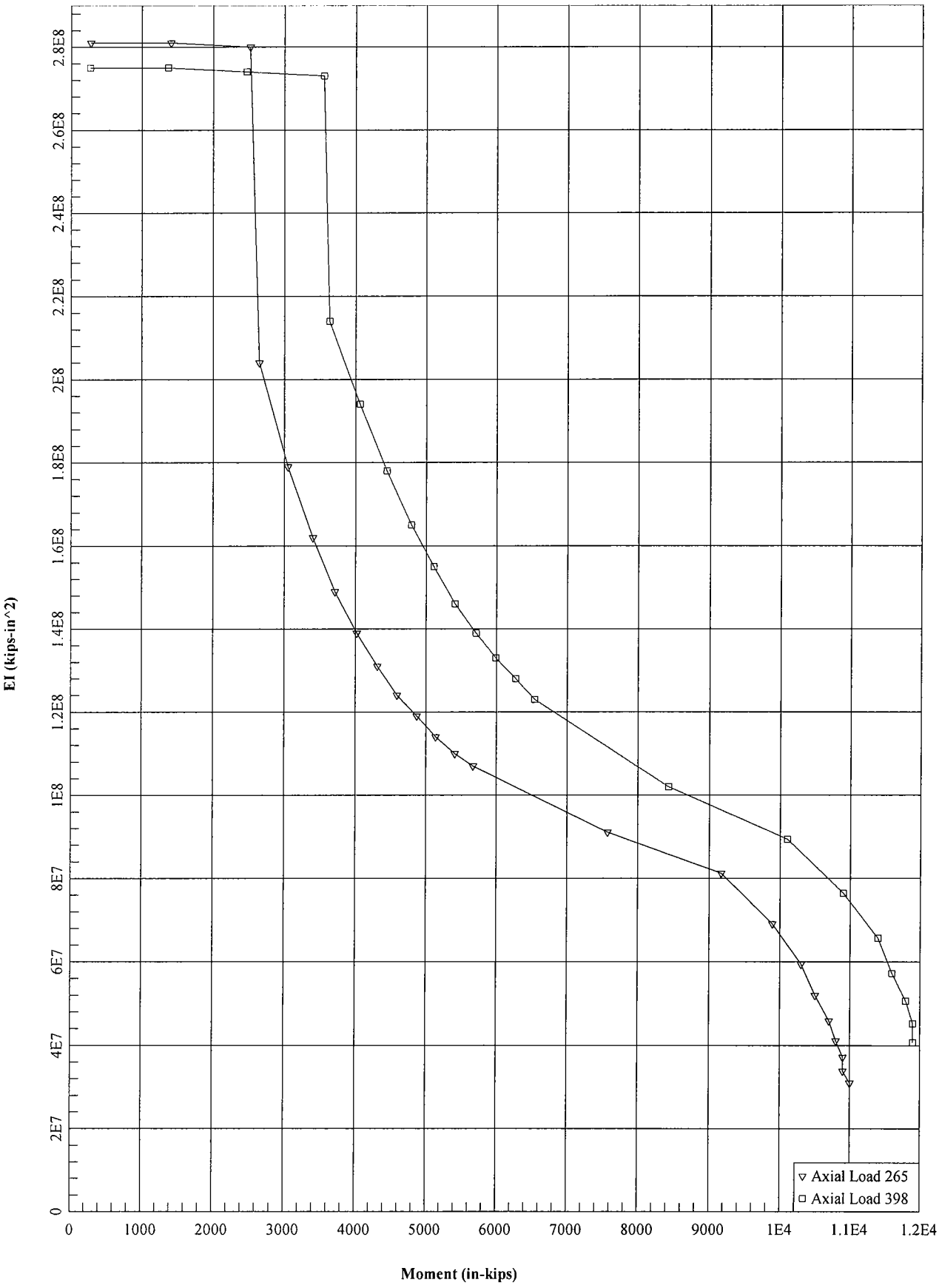

Bending Moment (in-kips)
-100
0
100
200
300
400
500
600
700
800
900
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Load: 7000
Load: 10500

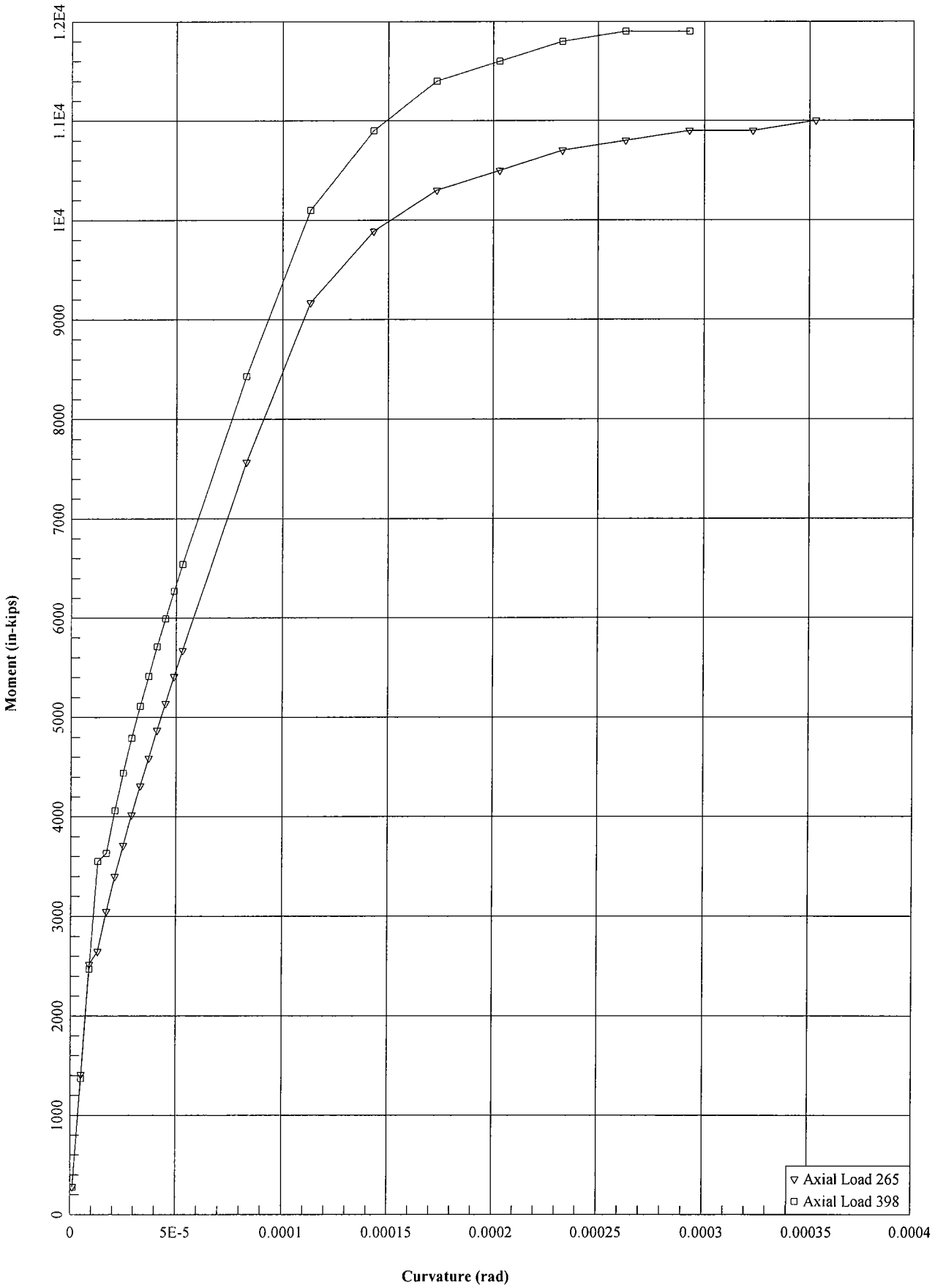

Shear (kips)
-10
-8
-6
-4
-2
0
2
4
6
8
10
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Load: 7000
Load: 10500

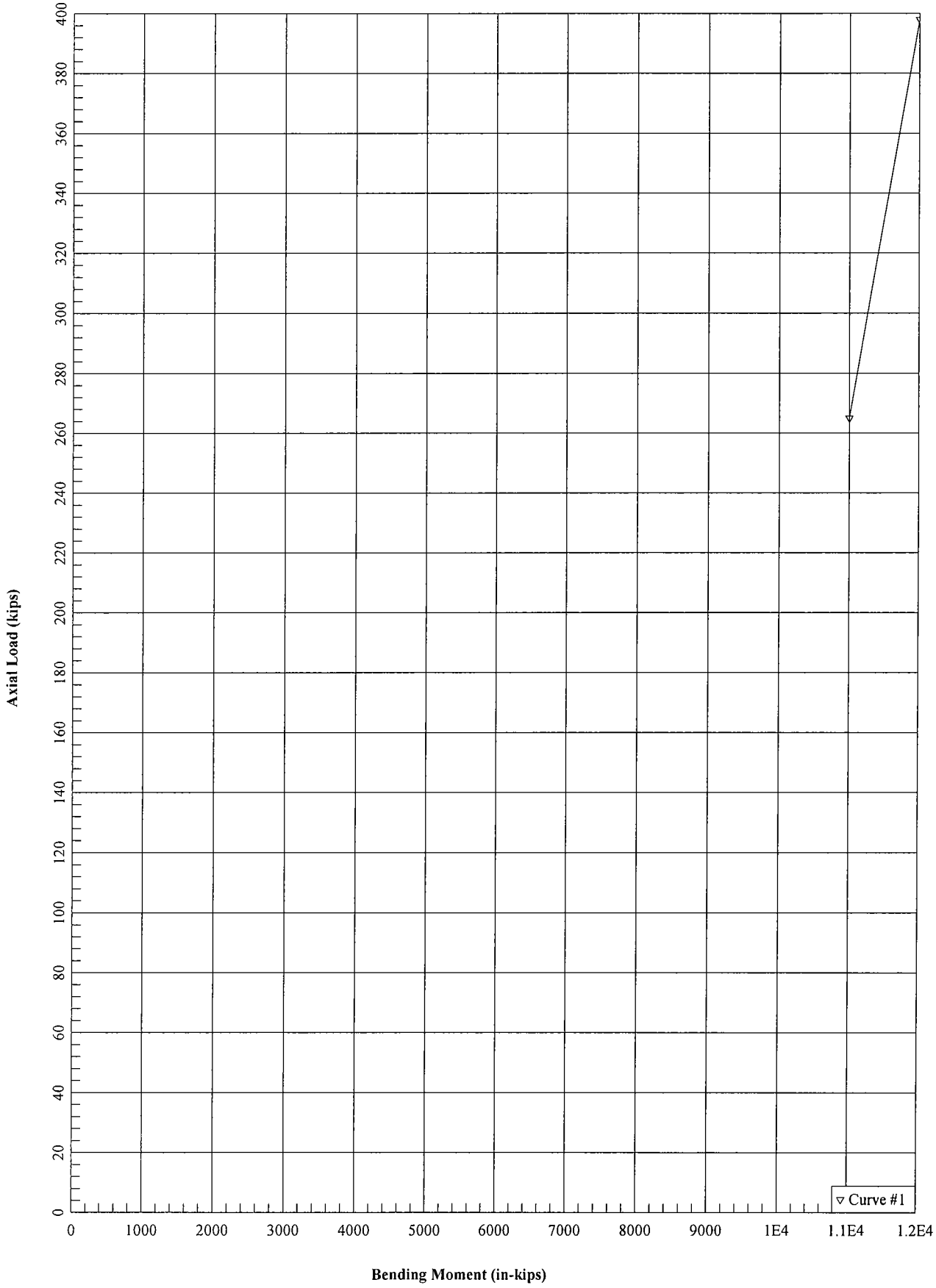

Soil Reaction (lbs/in)
-300
-250
-200
-150
-100
-50
0
50
100
150
200
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
Load: 7000
Load: 10500


Lateral Load (kips)
0
1
2
3
4
5
6
7
8
9
10
11
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
Pile-Head Deflection (in)
▽ Curve #1


Lateral Load (kips)
0
1
2
3
4
5
6
7
8
9
10
11
0
100
200
300
400
500
600
700
800
900
Maximum Moment (in-kips)
Curve #1


EI (kips-in^2)
2.8E8
2.6E8
2.4E8
2.2E8
2E8
1.8E8
1.6E8
1.4E8
1.2E8
1E8
8E7
6E7
4E7
2E7
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
1.1E4
1.2E4
Moment (in-kips)
Axial Load 265
Axial Load 398


Moment (in-kips)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
1.1E4
1.2E4
0
5E-5
0.0001
0.00015
0.0002
0.00025
0.0003
0.00035
0.0004
Curvature (rad)
Axial Load 265
Axial Load 398


Axial Load (kips)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1E4
1.1E4
1.2E4
Bending Moment (in-kips)
Curve #1

SPECIAL PROVISION
FOR
DRILLED SHAFT FOUNDATIONS

734.01 DESCRIPTION

This work consists of furnishing all labor, materials, equipment and services necessary for construction of reinforced concrete drilled straight shafts. Work shall be in strict conformance with the Engineer's plans, special provisions, Geotechnical Investigation Report and INDOT Standard Specifications.

734.02 QUALIFICATIONS OF DRILLED SHAFT CONTRACTOR

The contractor performing the work described in this specification shall have installed drilled shafts of both diameter and length similar to those shown on the plans for a minimum of three (3) years prior to bid date for this project.

734.03 SUBMITTALS

At the time of bid, the contractor shall submit both a list containing at least three (3) projects completed in the last three (3) years on which the contractor has installed drilled shafts of a diameter and length similar to those shown on the plans, and a signed statement that the contractor has inspected both the project site and all the subsurface information including any soil reports/geotechnical reports made available in the contract documents. The list of projects shall contain names and phone numbers of owner's representatives who can verify the contractor's participation on those projects.

No later than one month prior to constructing drilled shafts, the contractor shall submit an installation plan for review by the engineer. This plan will provide information on the following:

(a) Name and experience record of the drilled shaft superintendent in charge of drilled shaft operations for this project.

(b) List of proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casing, etc.

(c) Details of overall construction operation sequence and the sequence of shaft construction in bents or groups.

(d) Details of shaft excavation methods.

(e) When slurry is required, details of the methods to mix, circulate and desand slurry.

(f) Details of methods to clean the shaft excavation.

(g) Details of reinforcement placement including support and centralization methods.

(h) Details of concrete placement including proposed operational procedures for free fall, tremie or pumping methods.

(i) Details of temporary casing removal including quality control procedure to minimize concrete contamination.

The engineer will evaluate the drilled shaft installation plan for conformance with the plans, specifications and special provisions. Within 14 days after receipt of the plan, the engineer will

notify the contractor of any additional information required and/or changes necessary to meet the contract requirements. All procedural approvals given by the engineer shall be subject to trial in the field and shall not relieve the contractor of the responsibility to satisfactorily complete the work as detailed in the plans and specifications.

734.04 **MATERIALS**

All materials shall meet the requirements of the INDOT-Standard Specification or as otherwise described herein.

(a) CONCRETE: Concrete shall be Class B as per Section 702 of INDOT-Standard Specifications, except that air content requirement are waived.

(b) REINFORCEMENT: Reinforcing steel shall be in accordance with the sizes, dimensions and the details shown on the plans.

734.05 **CONSTRUCTION METHODS AND EQUIPMENT**

(a) PROTECTION OF EXISTING STRUCTURES: The contractor shall control his operations to prevent damage to existing structures and utilities. Preventive measures shall include, but are not limited to, selecting construction methods and procedures that will prevent caving of the shaft excavation, monitoring and controlling the vibrations from construction activities such as the driving of casing or sheeting, drilling of the shaft, or from blasting, if permitted.

(b) GENERAL: Drilled shafts shall be installed by the contractor or subcontractor who is experienced in this type of work. The drilled shaft contractor shall visit and examine the work site, and all conditions thereon, and take into consideration all such conditions that may affect his work.

The contractor shall perform the excavation required for the straight shafts through whatever materials encountered, to the dimensions and elevations shown on the plans or as otherwise required.

Prior to beginning drilled shaft work, the contractor shall submit to the engineer for approval a detailed sequence of construction of drilled shafts including materials, methods, and equipment to be used such as: mineral slurry, casings, drilling equipment, methods and equipment for cleaning shaft excavations, methods and equipment for casting concrete, removing temporary casings etc. The contractor shall demonstrate the adequacy of his methods and equipment during construction of the first drilled shaft. Failure to demonstrate the adequacy of his methods and equipment is cause for the engineer to require appropriate procedure alterations to eliminate unsatisfactory results prior to continuing drilled shaft construction.

(c) DRY CONSTRUCTION METHOD: The dry construction method shall be used only at sites where the ground water table and soil conditions make it feasible to construct the shaft in a relatively dry excavation.

The dry construction method consists of drilling the shaft excavation, removing accumulated seepage water and loose material from the excavation and placing the shaft concrete in a relatively dry excavation.

The dry construction method shall be used only when shaft excavations have 12 inches or less of water that can be removed along with any accumulated seepage water and loose material.

(d) WET CONSTRUCTION METHOD: The wet construction method consists of drilling the shaft excavation below the water table, cleaning the excavation by means of a bailor bucket, air lift pump or other approved devices and placing the shaft concrete which displaces the water or slurry as the shaft excavation is concreted.

Where drilling is through materials having a tendency to cave, the drilling shall be advanced by drilling with a mineral slurry or by any other approved method which will control the size of the excavation.

(e) CASING CONSTRUCTION METHOD: The casing method shall be used when directed or required. In this method, the hole is advanced through caving material by the wet method as described above. When a formation is reached that is nearly impervious, a casing shall be placed in the hole and sealed in the nearly impervious formation. Drilling can proceed as with the dry method to the project depth.

The placement of the concrete shall proceed as with the dry method except that the casing shall be withdrawn when the concrete is placed. Before the casing is withdrawn the level of the fresh concrete shall be at such a point that the fluid trapped behind casing is displaced upward. As the casing is withdrawn care shall be exercised to maintain the level of concrete within the casing so that fluid trapped behind the casing is displaced upward out of the shaft excavation without mixing with or displacing the shaft concrete.

(f) EXCAVATION AND DRILLING EQUIPMENT: The excavation and drilling equipment shall have adequate capacity including power, torque and down thrust to excavate a hole of both the maximum diameter and to a depth of 20 percent beyond the depths shown on the plans.

The excavation and overreaming tools shall be of adequate design, size and strength to perform the work shown in the plans or described herein. When the material encountered cannot be drilled using conventional earth augers with soil or rock teeth, drill buckets, and/or underreaming tools, the contractor shall provide special drilling equipment including but not limited to: rock core barrels, rock tools, air tools, blasting materials, and other equipment as necessary to construct the shaft excavation to the size and depth required. Approval of the engineer is required before excavation by blasting is permitted.

Sidewall overreaming shall be required when the sidewall of the hole is determined by the engineer to have either softened due to excavation methods, swelled due to delays in concreting, or degraded because of slurry cake buildup. Overreaming may be accomplished with a grooving tool, or overreaming bucket as directed by the engineer. The contractor shall bear all costs associated with both sidewall overreaming and additional shaft concrete placement.

734.06 **EXCAVATIONS**

Shaft excavations shall be made at the locations, and to the top of shaft elevations, estimated bottom of shaft elevations, shaft geometry, and dimensions as shown in the contract documents. The contractor shall extend drilled shaft tip elevations when the engineer determines that the material encountered during excavation is unsuitable and/or differs from that anticipated in the design of the drilled shaft.

The contractor shall maintain a construction method log during shaft excavation. The log shall contain information such as; the description and approximate top and bottom elevation of each soil or rock material, seepage or groundwater, and remarks.

Excavated materials which are removed from shaft excavations shall be disposed of by the contractor in accordance with the applicable specifications for disposal of excavated materials.

Any drilled shaft concrete over the theoretical amount required to fill any excavations for shafts dimensioned on the plans shall be furnished at the contractor's expense.

The contractor shall not permit workmen to enter the shaft excavation for any reason unless; both a suitable casing has been installed and the water level has been lowered and stabilized below

the level to be occupied, and adequate safety equipment and procedures have been provided to workmen entering the excavation.

(a) UNCLASSIFIED EXCAVATION: When drilled shaft excavation is designated as unclassified in the contract documents the contractor shall provide the necessary equipment to remove and dispose of any materials encountered in forming the drilled shaft excavation to the dimensions shown on the plans or as directed by the engineer. No separate payment will be made for either excavation of materials of different densities and character or employment of special tools and procedures necessary to accomplish the excavation in an acceptable fashion. Obstruction removal shall be paid separately.

(b) OBSTRUCTIONS: Surface and subsurface obstructions at drilled shaft locations shall be removed by the contractor. Such obstructions may include man-made materials such as old concrete foundations and materials such as boulders. Special procedures and/or tools shall be employed by the contractor after the hole cannot be advanced using conventional augers fitted with soil or rock teeth, drilling buckets and/or underreaming tools. Such special procedures/tools may include but are not limited to; chisels, boulder breakers, core barrels, air tools, hand excavation, temporary casing, and increasing the hole diameter. Blasting shall not be permitted unless specifically approved in writing by the engineer.

(c) LOST TOOLS: Drilling tools which are lost in the excavation shall not be considered obstructions and shall be promptly removed by the contractor without compensation. All costs due to lost tool removal shall be borne by the contractor including but not limited to, costs associated with hole degradation due to removal operations or the time the hole remains open.

734.07 **CASINGS**

Casings shall be steel, smooth, clean, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of both concrete and the surrounding earth materials. The outside diameter of casing shall not be less than the specified size of shaft. No extra compensation will be allowed for concrete required to fill an oversized casing or oversized excavation. All casings, except permanent casing, shall be removed from shaft excavations. Any length of permanent casing installed below the shaft cutoff elevation, shall remain in place.

When the shaft extends above ground or through a body of water, the portion exposed above ground or through a body of water may be formed with a removable casing except when the permanent casing is specified. Removable casing shall be stripped from the shaft in a manner that will not damage the concrete. Casings can be removed when the concrete has attained sufficient strength provided; curing of the concrete is continued for the full 72 hours period in accordance with specification; the shaft concrete is not exposed to salt water or moving water for 7 days; and the concrete reaches a compressive strength of at least 2500 psi as determined from concrete cylinder breaks.

(a) TEMPORARY CASING: All subsurface casing shall be considered temporary unless specifically shown as permanent casing in the contract documents. The contractor shall be required to remove temporary casing before completion of concreting the drilled shaft. Telescoping, predrilling with slurry and/or overreaming to beyond the outside diameter of the casing may be required to install casing.

If the contractor elects to remove a casing and substitute a longer or larger diameter casing through caving soils, the excavation shall be either stabilized with slurry or backfilled before the new casing is installed. Other methods, as approved by the engineer may be used to control the stability of the excavation and protect the integrity of the foundation soils.

Before the casing is withdrawn, the level of fresh concrete in the casing shall be a minimum of five feet above either the hydrostatic water level of drilling fluid whichever is higher. As the casing

is withdrawn, care shall be exercised to maintain an adequate level of concrete within the casing so that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the shaft concrete.

Temporary casings which become bound or fouled during shaft construction and cannot be practically removed shall constitute a defect in the drilled shaft. The contractor shall be responsible to improve such defective shafts to the satisfaction of the engineer. Such improvement may consist of, but is not limited to removing the shaft concrete and extending the shaft deeper to compensate for loss of frictional capacity in the cased zone, providing straddle shafts to compensate for capacity loss, or providing a replacement shaft. All corrective measures including redesign of footings caused by defective shafts shall be done to the satisfaction of the engineer by the contractor without either compensation or an extension of the completion date of the project. In addition, no compensation will be paid for casing remaining in place.

734.08 **SLURRY**

Only mineral slurries shall be employed when slurry is used in the drilling process unless other drilling fluids are approved by the engineer. The slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. During construction, the level of the slurry shall be maintained at a height sufficient to prevent caving of the hole. In the event of a sudden significant loss of slurry to the hole, the construction of that foundation shall be stopped until either methods to stop slurry loss or an alternate construction procedure has been approved by the engineer.

The mineral slurry shall be premixed thoroughly with clean fresh water and adequate time (as prescribed by the mineral manufacturer) allotted for hydration prior to introduction into the shaft excavation. Slurry tanks of adequate capacity will be required for slurry circulation, storage, and treatment. No excavated slurry pits will be allowed in lieu of slurry tanks without the written permission of the engineer. Desanding equipment shall be provided by the contractor as necessary to control slurry sand content to less than 4 percent by volume at any point in the borehole. Desanding will not be required for setting temporary casing, sign post, or lighting mast foundations unless shown in the plans or special provisions. The contractor shall take all steps necessary to prevent the slurry from "setting up" in the shaft. Such methods may include but are not limited to: agitation, circulation and/or adjusting the properties of the slurry. Disposal of all slurry shall be done offsite in suitable areas by the contract.

At the option of the contractor and with the approval of the engineer, polymer slurry can be used in lieu of mineral slurry.

Control tests using suitable apparatus shall be carried out on the slurry by the contractor to determine density, viscosity and pH. An acceptable range of values for those physical properties is shown in the following table:

MINERAL SLURRY (OR POLYMER SLURRY)
Sodium Bentonite or Attapulgite in Fresh Water

Acceptable Range of Values

Property (Units)	At Time of Slurry Introduction	In Hole at Time of Concreting	Test Method
Density (pcf)	64.3** - 69.1**(<64)	64.3**-75.0**(<64)	Density Balance
Viscosity (seconds/quarts)	28-45 (40-90)	28 – 45 (40-90)	Marsh Cone
pH	8 – 11 (7-11)	8 – 11 (7-11)	pH paper pH meter

**Increase by 2 pcf in salt water

Notes:

a) *Tests should be performed when the slurry temperature is above 40 degrees Fahrenheit.*

b) *If desanding is required sand content shall not exceed 4 percent (by volume)at any point in the borehole as determined by the American Petroleum Institute sand content test.*

Tests to determine density, viscosity, and pH value shall be done during the shaft excavation to establish a consistent working pattern. A minimum of four sets of tests shall be made during the first 8 hours of slurry use. When the results show consistent behavior the testing frequency may be descreased to one set every four hours of slurry use.

The contractor shall insure that heavily contaminated slurry suspension, which could impair the free flow of concrete, has not accumulated in the bottom of the shaft. Prior to placing concrete in any shaft excavation, the contractor shall take slurry samples using a sampling tool. Slurry samples shall be extracted from the base of the shaft and at intervals not exceeding 10 feet up the shaft, until two consecutive samples produce acceptable values for density, viscosity, pH, and sand content.

When any slurry samples are found to be unacceptable, the contractor shall take whatever action is necessary to bring the slurry within specification requirements. Concrete shall not be poured until resampling and testing results produce acceptable values.

Reports of all tests required above signed by an authorized representative of the contractor, shall be furnished to the engineer on completion of each drilled shaft.

During construction, the level of mineral slurry in the shaft excavation shall be maintained at a level not less than 4 feet above the highest expected piezometric pressure head along the depth of the shaft. If at any time, the slurry construction method fails, in the opinion of the engineer, to produce the desired final results, then the contractor shall both discontinue this method and propose an alternate method for approval of the engineer.

734.09 **EXCAVATION INSPECTION**

The contractor shall provide equipment for checking the dimensions and alignment of each permanent shaft excavation. The dimensions and alignment shall be determined by the contractor under the direction of the engineer. Final shaft depths shall be measured with a suitable weighted tape or other approved methods after final cleaning. Unless otherwise stated in

the specifications, shaft bottoms shall be cleaned mechanically such that a minimum of 50 percent of the base of each shaft will have less than ½ inch of sediment at the time of placement of the concrete. The maximum depth of sediment or any debris at any place on the base of the shaft shall not exceed 1 ½ inches. Shaft cleanliness will be determined by the engineer, by visual inspection and sounding with the weighted tape for dry shafts or other methods deemed appropriate to the engineer for wet shafts. In addition, for dry excavations, the maximum depth of water shall not exceed 3 inches prior to concrete pour.

734.10 CONSTRUCTION TOLERANCES

The following construction tolerances apply to drilled shafts unless otherwise stated in the contract documents:

(a) The drilled shaft out shall be within 3 inches of plan position in the horizontal plane at the plan elevation for the top of the shaft.

(b) The vertical alignment of a vertical shaft excavation shall not vary from the plan alignment by more than ¼ inch per foot of depth. The alignment of a battered shaft excavation shall not vary by more than ½ inch per foot of depth from the prescribed batter.

(c) After all the concrete is placed, the top of the reinforcing steel cage shall be no more than 6 inches above and no more than 3 inches below plan position.

(d) All casing diameters shown on the plans refer to O.D. (outside diameter) dimensions. The dimensions of casings are subject to American Pipe Institute tolerances applicable to regular steel pipe. When approved, the contractor may elect to provide a casing larger in diameter than shown in the plans.

(e) The top elevation of the shaft shall have a tolerance of plus 1 inch or minus 3 inches from the plan top of shaft elevation.

(f) Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of + ⅜ inch per foot of diameter.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The contractor shall be responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the engineer. Materials and work necessary, including engineering analysis and redesign, to complete corrections for out of tolerance drilled shaft excavations shall be furnished without either cost to the State or an extension of the completion dates of the project.

734.11 REINFORCING STEEL CAGE CONSTRUCTION AND PLACEMENT

The reinforcing steel cage, consisting of longitudinal bars, ties, cage stiffener bars, spacers, centralizers, and other necessary appurtenances, shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement.

The reinforcing steel in the shaft shall be tied and supported so that the reinforcing steel will remain within allowable tolerances given in INDOT Standard Specifications unless modified by this special provision. Concrete spacers or other approved noncorrosive spacing devices shall be used at sufficient intervals (near the bottom and at intervals not exceeding 10 feet of the shaft) to insure concentric spacing for the entire cage length. Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to insure a minimum 3 inch annular space between the outside of the

reinforcing cage and the side of the excavated hole. Approved cylindrical concrete feet (bottom supports) shall be provided to insure that the bottom of the cage is maintained the proper distance above the base.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the rebar cage is not maintained within the specified tolerances, corrections shall be made by the contractor to the satisfaction of the engineer. No additional shafts shall be constructed until the contractor has modified his rebar cage support in a manner satisfactory to the engineer.

734.12 CONCRETE PLACEMENT

Concrete placement shall be performed in accordance with the applicable portions of the INDOT Standard specifications on concrete materials in section 702 except as modified in this special provision and with the requirements herein.

Concrete shall be placed as soon as possible after reinforcing steel placement. Concrete placement shall be continuous from the bottom to the top elevation of the shaft. Concrete placement shall continue after the shaft excavation is full until good quality concrete is evident at the top of shaft. Concrete shall be placed either by free fall or through a tremie or concrete pump. The free fall placement shall only be permitted in dry holes. Concrete placed by free fall shall fall directly to the base without contacting either the rebar cage or hole sidewall. Drop chutes may be used to direct concrete to the base during free fall placement.

The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed 2 hours. Admixtures such as water reducers, plasticizers, and retarders shall not be used in the concrete mix unless permitted in the contract documents. All admixtures, when approved for use, shall be adjusted for the conditions encountered on the job so the concrete remains in a workable plastic state throughout the 2 hour placement limit. Prior to concrete placement the contractor shall provide test results of both a trial mix and a slump loss test conducted by an approved testing laboratory using approved methods to demonstrate that the concrete meets the 2 hour requirement. The Contractor may request a longer placement time provided he supplies a concrete mix that will maintain a slump of 4 inches or greater over the longer placement time as demonstrated by trial mix and slump loss tests. The trial mix and slump loss tests shall be conducted using concrete and ambient temperatures appropriate for site conditions.

Minimum concrete slump for placement under slurry by tremie or pump shall be 6 inches. The contractor shall maintain a concrete volume vs. depth chart for all concrete placed under slurry. Minimum depth measurements shall be taken after every truck load of tremie placed concrete and every 2 to 3 feet if pumped.

734.13 TREMIES

Tremies may be used for concrete placement in wet holes. Tremies used to place concrete shall consist of a tube of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The tremie shall not contain aluminum parts which will have contact with the concrete. The tremie inside diameter shall be at least 6 times the maximum size of aggregate used in the concrete mix but shall not be less than 10 inches. The inside and outside surfaces of the tremie shall be clean and smooth to permit both flow of concrete and unimpeded withdrawal during concreting. The wall thickness of the tremie shall be adequate to prevent crimping or sharp bends which restrict concrete placement.

The tremie used for concrete placement shall be watertight. Underwater placement shall not begin until the tremie is placed to the shaft base elevation. Valves, bottom plates or plugs may be used only if concrete discharge can begin within one-half tremie diameter of the base. Plugs

shall either be removed from the excavation or be of a material, approved by the Engineer, which will not cause a defect in the shaft if not removed. The discharge end of the tremie shall be constructed to permit the free radial flow of concrete during placement operations. The tremie discharge end shall be immersed at least 5 feet in concrete at all times after starting the flow of concrete. The flow of concrete shall be continuous. The concrete in the tremie shall be maintained at a positive pressure differential at all times to prevent water or slurry intrusion into the shaft concrete.

If at any time during the concrete pour, the tremie line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the shaft shall be considered defective. In such case, the contractor shall remove the reinforcing cage and concrete, complete any necessary sidewall removal directed by the Engineer and repour the shaft. All costs of replacement of defective shafts shall be the responsibility of the Contractor.

734.14 **PUMPED CONCRETE**

Concrete pumps and lines may be used for concrete placement in either wet or dry excavations. All pump lines shall have a minimum 4 inch diameter and be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

For wet excavations, a plug or similar device shall be used to separate the concrete from the fluid in the hole until pumping begins. The plug shall either be removed from the excavation or be of a material, approved by the Engineer, which will not cause a defect in the shaft if not removed.

The discharge orifice shall remain at least 5 feet below the surface of the fluid concrete. When lifting the pump line during concreting, the Contractor may temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation.

If at any time during the concrete pour, the pump line orifice is removed from the fluid concrete column and discharges concrete above the rising concrete level, the shaft shall be considered defective. In such case, the contractor shall remove the reinforcing cage and concrete, complete any necessary sidewall removal directed by the Engineer, and repour the shaft. All costs of replacement of defective shafts shall be the responsibility of the Contractor.

734.15 **DROP CHUTES**

Drop chutes may be used to direct placement of free fall concrete in excavations where the maximum depth of water does not exceed 3 inches. Free fall is not permitted in wet excavations. Drop chutes shall consist of a smooth tube of one piece construction. Concrete may be placed through either a hopper at the top of the tube or side openings as the drop chute is retrieved during concrete placement. The drop chute shall be supported so that the free fall of the concrete measured from the bottom of the chute is less than 60 feet at all times. If concrete placement causes the shaft excavation to cave or slough, or if the concrete strikes the rebar cage or sidewall, the contractor shall reduce the height of free fall and/or reduce the rate of concrete flow into the excavation. If placement cannot be satisfactorily accomplished by free fall in the opinion of the Engineer, the Contractor shall use either tremie or pumping to accomplish the pour.

734.16 **DRILLED SHAFT INTEGRITY TESTING**

INTEGRITY TESTING: All drilled shafts constructed under slurry shall be tested by the Engineer, using the crosshole sonic logging and impulse response test methods on each shaft.

A. CROSSHOLE SONIC LOGGING TEST: All of the drilled shafts drilled under slurry on this project, shall be equipped with access tubes for the crosshole (CSL) sonic logging test. Provision and installation of the tubes shall be the responsibility of the Contractor.

PRINCIPLE: The CSL test provides continuous vertical profiles of the ultrasonic pulse velocity (UPV) of the concrete. The UPV is a function of the density and modulus of the concrete, and can therefore be used to assess the uniformity and homogeneity of the concrete.

Access tubes are attached to the reinforcing cage and installed in the drilled shaft before concrete is placed. Transducer probes, a transmitter and a receiver, are lowered down adjacent pairs of access tubes. An ultrasonic pulse emitted by the transmitter travels through the concrete between the tubes to the receiver. The probes are connected to a control unit that contains a pulse generator/timer/recorder system.

The cables attached to the probes are withdrawn over a measurement wheel that is also connected to the control unit. This system takes a continuous series of measurements as the probes are raised up the access tubes. The data recorded is the position of the probes for each measurement, the amplitude of the received signal, and the time taken for the ultrasonic pulse to travel from the transmitter to the receiver.

MATERIALS: The contractor shall supply the following materials for the CSL test installation:

(a) Schedule 40 mild steel tubing of 37.5 mm (1.5") internal diameter and threaded sleeve couplers sufficient to install eight full length access tubes in each of the 8 ft (2.44 m) and 10 ft (3.0 m) diameter drilled shafts. In addition, each tube shall have a threaded steel end cap fitted to the bottom.

(b) Clean, potable water sufficient to fill the access tubes completely.

(c) Cement grout sufficient to fill the access tubes on completion of testing.

EQUIPMENT: The contractor shall supply the following equipment and labor for the installation and performance of the CLS test.

(a) Small quantity grout mixing equipment and operator.

(b) Small grout pumping equipment with 25 mm (1.0") tremie pipe capable of reaching the bottom of the access tubes, and operator.

(c) Hosepipe, pump or other means of placing clean water in the access tubes prior to testing, and for topping up the tubes during testing.

The Engineer shall provide the testing equipment required for the CSL tests.

The contractor shall supply suitable access to the tops of the shafts and tubes, and a stable work platform for the test operators and equipment close to the head of each shaft. The platform shall, at a minimum, be large enough to accommodate two operators with a standard surveyor's tripod and a small bench or table.

INSTALLATION PROCEDURE: The Contractor shall provide and install the access tubes required for the CSL test according to the following schedule and instructions.

(a) All drilled shafts constructed under slurry shall have CSL access installed in them. Eight (8) tubes shall be placed in each of the 8 ft. (2.44 m) and 10 ft (3.00 m) diameter shafts. The bottom of each tube shall be sealed watertight with a threaded end-cap. Any coupling of tubing needed to make up the required lengths shall be made using threaded sleeve couplers, sealed watertight.

The tubing shall be round and regular in section, with a clean interior surface, free of defects or obstructions that would prevent the passage of a 30 mm diameter probe through the tube. The exterior surfaces shall be free of any contaminants such as dirt, oil, grease, or heavy rust scale which may inhibit formation of a good mechanical bond with the concrete. The use of used or recycled tubing or slightly rusted tubing, is acceptable provided that it meets the requirements above.

(b) The tubes shall be installed at approximately equidistant points around the interior of the reinforcing cage, i.e., eight tubes in 8 ft (2.44 m) to 10 ft (3.00 m) diameter shafts shall be spaced approximately 45 degrees apart. Tubes shall be installed parallel to each other and securely attached to the reinforcing cage to prevent excessive movement during reinforcing cage handling and installation or placement of concrete.

The bottoms of the tubes shall be set 150 mm above the bottom of the reinforcing cage. No tubes are to be placed in contact with the bottom of the drilled shaft. The tops of the tubes shall extend at least 1.0 m, and no more than 2.0 m, above the proposed top of the concrete in the shaft. If the top of the concrete will be subsurface or in the river the tubes shall extend at least 1.0 m and no more than 2.0 m above grade or water level, or other reasonable access level if coffer dams or casings are used.

(c) The reinforcing cages shall be handled in such a manner as to prevent excessive bending or distortion during lifting or placement. "Excessive" in this instance means bending or distortion that results in kinking or permanent bending of the access tubes, or displacement of the tubes so that they are no longer regularly spaced and parallel to each other. Longitudinal twisting or "spiraling" of the cage that may occur during lifting or placement is not significant, provided that the tubes remain parallel, undamaged, and securely fixed.

(d) When the reinforcing cage and tubes are installed in the shaft, and before concrete is placed, the Contractor shall plumb and record the full depth of the shaft, and the full depth of the interior of at least one of the access tubes, relative to proposed top of concrete, or other site datum. After concrete placement, these figures, together with the elevation of the top of the finished concrete, the concreted length, and the date of concrete placement, shall be tabulated for each shaft and provided to the Engineer.

(e) Before concrete is placed, the tubes shall be filled completely with clean, potable water, and the tops of the tubes shall be sealed to prevent ingress of concrete or other foreign material. If scheduling conflicts prevent filling of the tubes before concrete placement, the tops shall be temporarily sealed before concrete is placed. The tubes shall then be filled with potable water no later than four hours after placement of concrete. The sealing method may be selected by the Contractor, but shall be such that no significant hammering or horizontal, vertical, or torsional force is required to unseal the tubes. Excessive force could result in breaking the bond between the concrete and the upper portion of the tube.

(f) Before commencing this work, the Contractor shall submit to the Engineer his selection of tube type, size, and source, together with his proposed methods of installation, fixing, and sealing. Where the top of concrete will be subsurface, or in the river, the Contractor will also submit his proposed finish level for the tubing, and means of access for the testing team.

(g) CSL tests shall be performed no earlier than five (5) days after placement of the concrete if high early strength is not used. On completion of testing and acceptance of the shafts by the Engineer, the Contractor shall remove the water from the CSL access tubes and fill the tubes completely with grout placed by tremie or pumped from the bottom.

B. IMPULSE RESPONSE SPECTRUM (IRS) TEST: Concurrently with the CSL test, the Engineer shall perform the impulse response test on each of the drilled shafts.

PRINCIPLE: The impulse test can be used to corroborate shaft integrity, and to evaluate the likely performance of a shaft by comparing the impulse response test data for that shaft with the data from a similar shaft that has been load-tested and also tested by the impulse response method.

The head of the shaft is struck axially with a small sledge hammer that contains a load-cell. The response of the shaft is monitored by a geophone velocity transducer. Both instruments are connected to a data acquisition and processing system, where the raw data are converted into the frequency domain, and velocity is divided by force. The resultant graph of mobility against frequency contains information on:

The dynamic stiffness of the shaft/soil complex
The length of the shaft, or depth of significant anomalies
The regularity of the shaft's cross-section
The average quality of the concrete

MATERIALS: Since impulse response testing will be performed concurrently with the CSL test, no additional materials are required for the performance of this test.

EQUIPMENT: The Contractor shall prepare the heads of the shafts for the impulse response test, and assist in performance of the test by providing the following equipment and labor:

(a) Access to the concrete at the heads of the shafts shall be provided for the Contractor's staff and the Engineer's testing personnel. This access shall include provision for the Contractor's and the Engineer's personnel to enter or be lowered into the inside of the reinforcing steel cage to prepare the concrete surface and perform the test.

(b) Small pneumatic or electric chipping hammer, hand tools, and operators for removing gout, laitence, and contaminated materials from the surface of the concrete, and providing reasonably smooth and level areas of clean, sound concrete.

PROCEDURE: The impulse response test shall be performed no earlier than five days after placement of the concrete in a shaft, unless otherwise determined by the Engineer.

The Contractor shall prepare each shaft for testing by providing a safe means of personnel access to the concrete surface inside the reinforcing cage, removing any loose debris, and providing on each shaft a minimum of two areas of clean, sound, level concrete, free of laitence, grout, cracking, honeycombing, or contamination.

The surface of the shafts shall be free of standing water, and at least 25 mm (1.0") above any water, slurry, or loose mud around the top of the shaft. The prepared areas shall, at a minimum, be as follows:

(a) In the center of the shaft, with a minimum 75 mm (3.0") diameter, and not more than 25 mm (1.0") above or below the surrounding surface, such that a short handled sledge hammer (2# or 3#) can be used to strike the surface squarely, with the handle parallel to the surface, and without the operators fingers touching the surface.

(b) Near the perimeter of the shaft, within the reinforcing cage, not less than 450 mm (18.0") from the center of the shaft. Minimum 75 mm diameter, and not more than 12.5 mm (0.5") below the surrounding material.

The Engineer shall make a preliminary interpretation of the test results on site. If anomalous responses are recorded, or the data indicate low modulus or contaminated concrete near the head of the shaft, the Contractor will assist in preparing a new test area near the perimeter of the

shaft, at a minimum of 60 degrees from the first test location. The Engineer will then repeat the test, at the new location.

EVALUATION OF TEST RESULTS: If the tests indicate that there are zones of defective concrete within a shaft, the defects shall be jointly evaluated by the Engineer and the Contractor. In cases where the nature or extent of a defect remains uncertain, excavation or core-sampling of the defective zone may be required in order to permit visual or laboratory assessment of the material. Such excavation or core-sampling shall be performed by the Contractor under the supervision of the Engineer. There will be no extra compensation to the contractor for core-sampling or excavation work necessitated by a defect within the concrete.

In the event that a defect is considered deleterious to the performance of the shaft, options for the repair or replacement of the shaft shall be considered. Such repair or replacement shall be completed to the satisfaction of the Engineer, at no extra cost to the Owner.

The decision to accept or reject a drilled shaft shall be made by the Engineer.

734.17 **METHOD OF MEASUREMENT**

(a) FURNISHING DRILLED SHAFT DRILLING EQUIPMENT: There will be no measurement of the work performed under this item.

(b) DRILLED SHAFTS: The quantities to be paid for shall be the volume in cubic yards or cubic meters of the completed concrete drilled shaft, of the diameter and containing the reinforcement shown on the plans. The length for the calculation of the quantity, shall be determined as the difference between the plan top of shaft elevation and the final bottom of shaft elevation.

(c) UNCLASSIFIED SHAFT EXCAVATION: The quantities to be paid shall be the volume in cubic yards or cubic meters of completed unclassified shaft excavation of the diameter shown on the plans measured along the centerline of the shaft, including bells. The pay quantity shall be computed as the difference between the plan top of shaft elevation and the plan estimated tip elevation.

(d) EXTRA UNCLASSIFIED SHAFT EXCAVATION: The quantities to be paid shall be the volume in cubic yards or cubic meters of completed unclassified shaft excavation of the diameter shown on the plan measured from the shaft estimated tip elevation shown on the plan to the final authorized and accepted bottom of shaft elevation.

(e) OBSTRUCTIONS: The quantities to be paid shall be the number of hours of work, or fraction thereof per obstruction, after designation as an obstruction by the engineer required to remove the obstruction and resume excavation.

(f) TRIAL SHAFT: The quantity to be paid shall be the authorized linear feet of trial shaft holes, drilled of the diameter shown on the plans, completed (including backfill when required) and accepted. The linear feet of trial shaft holes shall be determined as the difference between the existing ground surface elevation at the center of the trial shaft hole prior to drilling and the authorized bottom elevation of the hole.

(g) EXPLORATION (SHAFT EXCAVATION): The quantity to be paid shall be the length in liner feet, measured from the bottom of the shaft elevation to the bottom of the exploration hole, for each authorized exploration drilled below the shaft excavation.

(h) INSTRUMENTATION INTEGRITY TESTING AND DTA COLLECTION: The quantity to be paid shall be lump sum for payment of all specified instrumentation, integrity testing, all cost associated with collection of data, all required analyses and any required reports.

733.18 **BASIS OF PAYMENT**

(a) FURNISHING DRILLED SHAFT DRILLING EQUIPMENT: Payment for this item when made at the contract lump sum amount will be full and complete payment for furnishing and moving the drilling equipment to the project, setting the equipment up at the locations and removing the equipment from the project. Payment of 60 percent of the amount bid for this item will be made when all drilling equipment is on the job, assembled and ready to drill foundation shafts. Payment for the remaining 40 percent of the bid amount will be made when all shafts have been drilled and all shaft concrete has been placed up to the top of the shafts.

(b) DRILLED SHAFTS: Drilled shafts shall be paid for at the contract unit price per cubic yard or cubic meter for drilled shaft of the diameter specified. Such payment shall include the cost of concrete, and reinforcing steel, sonic logging tubes, all labor, materials, equipment, temporary casings, and incidentals necessary to complete the drilled shaft.

(c) UNCLASSIFIED SHAFT EXCAVATION: Unclassified shaft excavation shall be paid for at the contract unit price per cubic yard or cubic meter for drilled shafts of the diameter specified. Such payment shall be full compensation for the shaft excavation including temporary casing, removal from the site and disposal of excavated materials, using slurry as necessary, using drilling equipment, blasting procedures, special tools and drilling equipment to excavate the shaft to the depth indicated on the plans, and furnishing all other labor, materials and equipment necessary to complete the work.

(d) UNCLASSIFIED EXTRA DEPTH EXCAVATION: Unclassified extra depth excavation (UCEDE) shall be paid for at 150 percent of the contract price per linear foot for the unclassified Shaft Excavation item of the diameter specified. Such payment shall be full compensation for all costs of excavating below the bottom of shaft elevations shown on the plans, except for the additional costs included under the associated pay items for permanent casing. Work under this item is the same as that described under classified shaft excavation together with any additional work as a result of excavating below the plan bottom of shaft elevation. Compensation under this item shall be paid only when the extra depth excavation is authorized by the engineer.

(e) OBSTRUCTIONS: Removal of obstructions shall be paid at the contract unit price per hour for obstructions. The maximum payment per designated obstruction shall not exceed 20 times the unit cost bid for either standard excavation or unclassified excavation, whichever is less. Such payment shall be full compensation for all labor, materials, and equipment necessary to complete the work.

(f) TRIAL SHAFT HOLES: Trial shaft holes of the specified diameter will be paid for at the contractor unit price per linear foot for trial shaft holes. Such payment shall be full compensation for excavating the trial shaft hole through whatever materials are encountered to the bottom of shaft elevation shown on the plans or as authorized by the engineer (using mineral slurry as necessary), providing inspection facilities, backfilling the hole, restoring the site as required and all other expenses to complete the work.

(g) EXPLORATION (SHAFT EXCAVATION): Soil samples and/or rock cores of the diameter and length required and authorized by the engineer will be paid for at the contract unit price linear foot for either soil sample or rock core. Such payment shall be full compensation for drilling, extracting, packaging and classifying the samples or cores, delivering them to the Engineer, furnishing concrete to fill the core hole and all other expenses necessary to complete the work.

(h) INSTRUMENTATION INTEGRITY TESTING AND DATA COLLECTION: The lump sum bid price shall include all labor, equipment and material incidental to instrumentation, integrity testing and, when required, data collection and reports.

(i) ITEMS OF PAYMENT:

Payment shall be made under:

1. Furnishing Drilled Shaft Drilling Equipment	Lump Sum
2. Drilled Shaft concrete	cu yd. (m^3).
3. Unclassified Shaft Excavation	cu yd. (m^3).
4. Unclassified Extra Depth Excavation	cu yd. (m^3).
5. Obstructions	Hour
6. Trial Shaft Holes	linear foot (m).
7. Exploration (Shaft Excavation)	linear foot (m).

8. Instrumentation, Integrity Testing and Data Collection Lump Sum.

APPENDIX G

ADDITIONAL CALCULATIONS/ANALYSIS PERFORMED FOR PRELIMINARY REPORT

(Shaft Supported Embankment Analysis,
Rock socket analysis for drilled shaft,
Embankment Settlement Analysis &
MSE Abutment Wall Analysis)

Project: Hamilton Boulevard			
EEI Proj. No.: 1-04-132	Date: 10/10/05	By: CRB	Rev. By: SJL

Shaft Supported Embankment Analysis

FROM TERZAGHI & MARSTON

$\tau_z = 2 \gamma_{avg} R$ * $T_{REQ} = \tau_z R \Omega$

$\gamma_{AVG} = 125$ pcF

$R = \frac{1}{2}$ (DISTANCE BETWEEN PILE CAPS)

ASSUME: 7 Ft PILE SPACING & 30" DIA. CAPS

$7' - 2(\frac{30"}{2}) = 4.5$ FT

$R = 4.5/2 = 2.25$ FT

$\tau_z = 2(125)(2.25) = 562.5$ psF

$T_{REQ} = (562.5 psF)(2.25)(\Omega)$

WHERE $\Omega = 0.73$ (i.e., AT 10% STRAIN)

$T_{REQ} = (562.5)(2.25)(0.73)$

≈ 924 lbl Ft

MINIMUM FACTOR OF SAFETY = 1.25

$\therefore T_{ALLOW} = (924)(1.25)$

$= 1,155$ lbl Ft

NOTE: ULTIMATE TENSILE OF BX1100 = 850 lbl Ft

OF BX1200 = 1,310 lbl Ft

USING BX1200: $FS = \frac{1,310}{1,155} = 1.4$ OK

NEGLECTING SUPPORT FROM UNDERLYING SOIL AND USING A MAXIMUM EMBANKMENT HEIGHT OF 31 FT

$\gamma = 125$ pcF

$\therefore$ 31 Ft x 125 pcF = 3,875 psF

USING BX1200: $\frac{3,875}{1,310} = 2.95$ THEREFORE USE 3 LAYERS OF GRID

Project: Hamilton Boulevard			
EEI Proj. No.: 1-04-132	Date: 11/10/05	By: CRB	Rev. By: SJL

Rock Socket Analysis for Drilled Shaft at Embankment

DETERMINE REQUIRED ROCK SOCKET TO ADEQUATELY SUPPORT A SERVICE LOAD OF 210 K (i.e., [6 x 140 K] / 4 = 210 K)

NEGLECT END BEARING FROM SHAFT AND ONLY CONSIDER SIDE SHEAR INTERACTION BETWEEN SHAFT AND ROCK. ASSUME A 3-Ft DIAMETER SHAFT.

$F_c' = 3$ ksi , $f_u > F_c'$

FOR A "SMOOTH" ROCK SOCKET, DETERMINE THE SOCKET DEPTH.

$F_{MAX} = 0.65 p_a [F_c'/p_a]^{0.5}$; $F_c' = 3$ ksi $= 432$ ksf

$p_a = 2.1$

$= 0.65(2.1)[432/2.1]^{0.5} = 19.6$ ksf

$R_T = \cancel{R_B}^{0} + R_S$

$R_S = \pi B L F_{MAX}$ ∴

$(210K)(2) = \pi(3)(L)(19.6)$

$L = 2.3$ Ft

HOWEVER, GIVEN THE INCONSISTENCIES IN THE ROCK AND THE NEED TO USE CASING, A 5-Ft LONG ROCK SOCKET IS RECOMMENDED.

Project: Hamilton Boulevard			
EEI Proj. No.: 1-04-132	Date: 10/05/05	By: CRB	Rev. By: SJL

Embankment Settlement Analysis

BORING B-13
STA : 59+00, 63 Pt Rt "A"
MAXIMUM EMBANKMENT HEIGHT = 36FT
SOFT to VERY STIFF COHESIVE SOILS to 28 FT.
UNDERLAIN BY LIMESTONE ROCK.

BASE OF EMBANKMENT ELEV 678.0
ELEV 678
NEGLECT
675
SILTY CLAY LOAM
&
SILTY CLAY ①
PI = 11 → 28
LL = 30 → 43
γ = 115 pcf
$S_{u_{AVG}}$ = 2.25 KSF (1.75 TO LOW → 3.000 HIGH)
660
CLAY ②
PI = 77
LL = 104
γ = 120 pcf
$S_{u_{AVG}}$ = 1.25 KSF
650
LIMESTONE

FROM TERZAGHI & PECK (1967)

$C_c = 0.009(LL-10)$ & $C_r = 5\% C_c$

	C_c	C_r
① =	0.18 → 0.29	.009-.015
② =	.85	.042

FROM HOLTZ & KOVACS (1981): a = 92FT b = 25FT

① : z = 11.5 Ft ∴ I_1 = 0.49 x 2 = 0.98
② : z = 23 Ft ∴ I_2 = 0.475 x 2 = 0.95

USING 125 pcf FOR EMBANKMENT SOILS
& 250 psf SURCHARGE

① $\Delta P = (125)(36) + I_1(250) = 4745$ pcf & $P_{o_1} = (11.5)(115) = 1322.5$ pcf
② $\Delta P = (125)(36) + I_2(250) = 4737.5$ pcf & $P_{o_2} = (23)(120) = 2760$ pcf

USING: $\Delta H_T = \frac{H_o(12in.)}{1.85}\left(C_r \log \frac{P_F}{P_{o_1}}\right)_{①} + \frac{H_o(12in.)}{1.85}\left(C_r \log \frac{P_F}{P_{o_2}}\right)_{②}$

$\Delta H_T = \frac{15(12)}{1.85}\left(.015 \log \frac{4745 + 1322.5}{1322.5}\right) + \frac{10(12)}{1.85}\left(.042 \log \frac{4737.5 + 2,760}{2760}\right)$

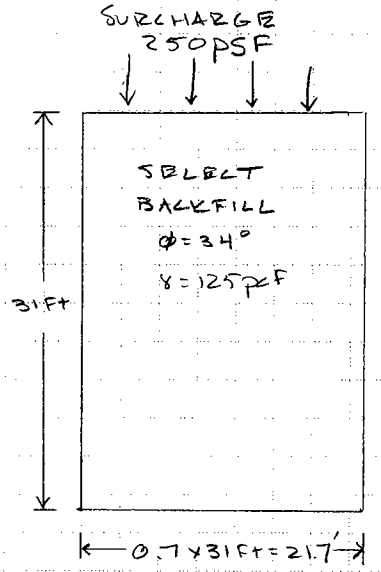
$= 0.96 + 1.18 = \boxed{1.13 \text{ in.}}$

$t = \frac{T(\frac{1}{2}H_o)^2}{C_v}$ $C_v = 0.033$ in²/min (From Terzaghi & Peck)
$t_{50} = 0.05(\frac{25}{2} \times 12)^2 / .033 = 34,000$ min. $= 0.8$m. $t_{90} = 4.5$ mo

Project: Hamilton Boulevard			
EEI Proj. No.: 1-04-132	Date: 10/5/05	By: CRB	Rev. By: SJL

MSE Abutment Wall Analysis

BORING TB-1
STA: 59+25, 23FT LT "A"



SUBGRADE - SILTY CLAY LOAM
$C = 1{,}750$ psf, $\gamma_s = 115$pcf
$K = 0.33$

VERTICAL LOADS	V_K	ARM Ft	MOMENT (Ft·K)
SELECT BACKFILL - (31Ft)(21.7Ft)(.125 KSF) =	84.1	10.8	908.3
SURCHARGE - (.250 KSF)(21.7Ft) =	5.4	10.8	58.3
	89.5		966.6

HORIZONTAL LOADS	H_K	ARM Ft	MOMENT (Ft·K)
SELECT BACKFILL - $\frac{1}{2}(0.33)(.125\text{KSF})(31)^2$ =	19.8	10.3	203.9
SURCHARGE - (31Ft)(.250psf)(0.33) =	2.6	15.5	40.3
	22.4		244.2

OVERTURNING

$$FS = \frac{M_V}{M_H} = \frac{966.6}{244.2} = 3.9 > 2 \text{ ok}$$

NOTE: THIS WAS PERFORMED BEFORE CHANGE IN SCOPE AND THIS IS NO LONGER APPLICABLE BASED ON THE CURRENT SCOPE

SLIDING

$$\text{RESISTANCE} = (21.7\text{ft})(1\text{ft})(1.75\text{ksf}) = 38.0\text{ k}$$

$$FS = \frac{\text{RESISTANCE}}{H} = \frac{38.0}{22.4} = 1.7 > 1.5 \text{ ok}$$

CONTACT PRESSURE

$$e = \frac{L}{2} - \frac{M_V - M_H}{V} = \frac{21.7}{2} - \frac{966.6 - 244.2}{89.5} = 2.78$$

$$= 2.78 < \frac{L}{6} = \frac{21.7}{6} = 3.6 \text{ ok}$$

$$q_v = \frac{V}{L - 2e} = \frac{89.5}{21.7 - 2(2.78)} = 5.54 \text{ ksf} = 5,540 \text{psf}$$

BEARING CAPACITY

FROM NAVFAC

$$q_{ult} = (5.53)(1,750) + (41)(115) =$$

$$= 10,138 \text{psf}$$

$$q_{all} = 10,138 / 2.5 = 4,055 < 5,540 \text{psf}$$

THEREFORE SUBGRADE IMPROVEMENT WILL BE REQUIRED

HOWEVER, SINCE THE EMBANKMENT IN THE AREA OF THE ABUTMENTS WILL BE SUPPORTED ON DRILLED SHAFTS WITH 3 LAYER OF GEOGRID (SEPERATED) BY 12" OF NO.53 AGGREGATE EACH THE BEARING CAPACITY IS NOT AN ISSUE.