00175

GEOTECHNICAL EXPLORATION
ACADEMIC, HEALTH & PHYSICAL
EDUCATION CENTER
NORTHERN KENTUCKY UNIVERSITY
HIGHLAND HEIGHTS, KENTUCKY

CIVIL ENGINEERS

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00176

March 7, 1980

Commonwealth of Kentucky
Bureau of Facilities Management
New Capital Annex
Frankfort, Kentucky 40601

Attn: Mr. Clayton Farmer, Project Architect

Re: Geotechnical Exploration
Academic, Health & Physical
Education Center
Northern Kentucky University
Highland Heights, Kentucky

Gentlemen:

Presented herein is our report of the geotechnical exploration made at the site of the proposed Academic, Health & Physical Education Center to be located on the grounds of the Northern Kentucky University, Highland Heights, Kentucky. This work was requested through Edward J. Beiting, Jr., PSC, Architects for the project. Our estimate of work was outlined on our proposal-agreement dated July 6, 1979. The work was authorized by letter dated January 15, 1980 from Mr. Clayton N. Farmer, Division of Engineering, Commonwealth of Kentucky. Authorization for additional work to complete the project because of surface and

and subsurface conditions was authorized by Mr. Clayton Farmer in a verbal conversation with our Mr. J. Dale Proffitt on February 14, 1980.

SCOPE

The purpose of this exploration was to determine the general subsurface profile at the location of the proposed Academic, Health & Physical Education Center. From our engineering review of the subsurface conditions, we were charged with the responsibility of making specific recommendations for foundation design and site development.

PROJECT CHARACTERISTICS

It is our understand that the proposed Academic, Health & Physical Education Center will be located immediately west of the existing Regents Hall in accordance with the floor plans prepared by Edward J. Beiting, Jr., PSC, Architects and Associated Engineers. The Center will be comprised of four areas extending westwardly approximately 423 feet from Regents Hall and extending approximately 240 feet in a north-south direction. That building area immediately adjacent to Regents Hall will be the proposed boiler room and receiving area, part of Unit A. This area will be two-stories in height consisting of concrete columns and beams and concrete pan floor

and roof systems. The locker area to the immediate west (north-central portion of the Center) will be the remainder of Unit A. This section will be three-stories in height and will also have construction with concrete columns and beams and concrete pan upper floor and roof systems. The south-central portion of the building, Unit B, will enclose a pool and the racquetball courts. This area will be a one-story steel-frame having a 28 foot roof height. Roof trusses will span in a north-south direction. The pool will range from approximately 4 to 13 feet in depth below finished floor level. The fourth building area will be the main activity area, Unit C. This building area will also be a steel-frame, one-story in height. Long span roof trusses will span the short dimension, east-west.

The details as to the building dimensions, interior walls and column locations are indicated by the preliminary first floor plans prepared by Edward J. Beiting, Jr., PSC. The entire Center will have a first floor concrete slab-on-grade at El. 850.0 The exterior facade of the entire Center will consist of pre-cast concrete panels.

At the present time only preliminary loading information is available. We understand that the heaviest building area will be the three-story A unit area where maximum column loads

will be 620 kips per column. The adjacent boiler room and receiving two-story area will have maximum column loads of 400 to 500 kips per column. The steel-frame sections, Units B and C, will have maximum column loads of 150 to 200 kips per column.

Exterior grades to the south of the Center will vary from El. 863 to El. 866. Grades along the west wall line of the main activities area, Unit C, will range from El. 866 to the south to El. 850 to the north. The south, east and west walls of the Center will therefore be designed as retaining walls. Proposed grades along the north side of the Center will be near El. 850. The presently depressed area along Simon Kenton Drive will be raised with Simon Kenton Drive re-routed just west of the proposed main activity area. A service drive will parallel the north wall of the Center providing access to the loading dock and receiving area.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the proposed construction as outlined by the Project Characteristics of this report, an engineering reconnaissance of the site, the results of the test borings and laboratory tests, a visual examination of the samples, and our experience as Civil (Geotechnical) Engineers in the

Northern Kentucky - Greater Cincinnati Area, we have reached the following conclusions and provide the following recommendations.

If any significant changes are made in the proposed building design or location, we recommend that our firm be notified accordingly in order that we may review such changes in light of this report prior to the letting of the contract documents.

1. If any conditions are encountered during construction which substantially vary from the facts of this report, we recommend that our office be contacted immediately in order that we may examine such field conditions and make the appropriate recommendations.

2. The general subsurface profile at the location of the proposed Center varies considerably from location to location. There have been substantial man-made changes in the topography of the site. The 1963 Northern Kentucky Area Planning Commission Topography Map indicates a drainage swale through the central portion of the proposed Center. This swale has been filled along with the slopes adjacent to Regents Hall and in the northern portion of parking lot G. In light of these

conditions, the general subsurface profile at the site consists of clayey fill underlain by relatively stiff glacial and residual clays, and then the bedrock formation, a system of shale and thinly bedded limestone. Through the lower portion of the buried drainage swale there is a thick deposit of sediment.

3. Ground water was encountered at this site within the existing fill, the low density sediment and as seepage through the bedrock. Excavations deep into the profile and drilled shafts can expect some ground water seepage. The contractor and sub-contractors should be appriased of this condition. Utility excavations can be cut from lower elevations upward allowing the pipe or completed excavation to drain off accumulated ground water. Discussion of ground water in drilled shafts is outlined by Item 8.

4. We recommend that the two and three-story sections of the proposed Unit A be supported on a system of drilled shafts and grade beams, the drilled shafts socketed a minimum of 2.0 feet into the parent bedrock, the gray (unweathered) shale and thinly bedded limestone, proportioning the shafts for a maximum net bearing

pressure of 80 kips per square foot, full dead and full live load. The bearing shale should have a moisture content less than 8 percent.

5. All shafts should be drilled plumb and straight (without belling) obtaining a relatively level bearing surface. All shafts should be free of loose and wet materials prior to placing concrete.

6. If the drilling of shafts terminates on a limestone layer, we recommend that the limestone layer be penetrated to expose the shale portion of the bedrock, unless it can be shown from probe holes or from visual examination of bottoms of surrounding shafts to the judgement of the Geotechnical Engineer that there is no softening of the shale beneath the limestone layers.

7. We recommend that a unit price be included in the contract documents for drilling a 4-inch diameter probe hole to a depth equal to twice the diameter of the shaft in the bottoms of any shafts selected by the Geotechnical Engineer or his representative. The purpose of the probe holes is to determine the quality of the shale below the visually examined bearing level. The unit price for the exploratory holes should be

lump sum per hole with an estimated 10 to 20 percent of the shafts probed. The contract documents should also provide for a probe rod 8 feet in length with a pointed 2-inch L-shaped end for checking the probe holes.

8. The results of the test borings indicate some ground water seepage should be anticipated in drilled shafts, particularly within the bedrock formation. Where ground water seepage occurs, the shafts should be cleaned, examined and concrete placed as soon as possible in order to prevent water from accumulating and from saturating the bearing surface.

9. Soft pockets of fill and sediment were observed in several of the test borings. Although, in general, the clayey subsoils will maintain open shafts, some localized caving, constricting or excessive seepage may occur, warrent casing. Casing may also be needed for protection of personel in examining probe holes. We recommend that an item be included in the contract documents for casing any shaft as directed by the Project Geotechnical Engineer. Payment should be on a per cased shaft basis.

10. We recommend that the drilling of shafts be witnessed by a Geotechnical Engineer from our office or his representative to report that the project specifications are met.

11. We recommend that the drilling contract be based upon a lump sum cost for drilling of shafts using the total accumulated footage estimated from the test boring data. The contract should also include add and deduct items for drilling over or under the total estimated footage, the items being on a per foot of shaft basis with two price schedules. The first price schedule should be for drilling through the fill, overburden clays and the two weathered zones of bedrock. The second schedule should be for drilling the 2 foot socket into the parent bedrock, the gray shale and thinly bedded limestone.

12. Test borings 12, 13, and 15 indicate that the clayey fill in the boiler room and the receiving area of Unit A is clean and stiff. It is our opinion that the fill is adequate to support the proposed floor concrete slab-on-grade. It is our opinion that partition walls can also be supported on the slab, however, the

bearing pressure should not exceed 2000 pounds per square foot, full dead and full live load. Control joints should be provided where the partition walls abutt any walls supported by the structural frame.

13. The clayey fill and sediment encountered in the locker area, the three-story section of Unit A, contains low density strata which are compressible. It is our opinion that the bearing capacity of the existing fill is low and that floor slabs and partitions supported on the fill would be subject to significant differential settlement. For this reason, we recommend one of two alternatives be accomplished. The first alternative is to undercut all existing fill and low density undisturbed soils and replace them with new compacted fill. The undercutting should be accomplished within the three-story area plus 10 feet all around. The floor slab and partition walls can then be supported on grade. An allowable bearing capacity of 4000 pounds per square foot can be utilized for the compacted fill. The second alternative is to construct the floor slab as a structural slab supported by the deep foundation system and locate the interior partition walls on the structural slab.

14. Because of the existing pool and numerous walls of

the racquetball courts, we recommend that the existing fill of Unit B be undercut and replaced with new compacted fill from within the Unit B limits plus 5 feet around plus a slope of 2 horizontal to 1 vertical to firm undisturbed soils. The south and east foundation walls can be designed as retaining walls supported on spread footings on the compacted fill, proportioning the wall footings for a maximum net bearing pressure of 4000 pounds per square foot, full dead and full live load. The steel frame columns can be supported on top of the wall utilizing the reinforced concrete wall to distribute the load along the length of the wall. The pool and interior partition walls can then be supported on undisturbed soils or new compacted fill, proportioning those foundations also for a maximum net bearing pressure of 4000 pounds per square foot, full dead and full live load. We recommend that the west wall of Unit B be supported by drilled shafts and grade beams as outlined in Item 4. A control joint should be provided at the southwest corner of Unit B. The Unit B floor slab can be constructed as a concrete slab-on-grade.

15. We recommend that the south wall of the main activity area (Unit C), the 25 foot east wall return, and the

southern 200 feet of the west wall be supported on spread footings on the weathered zone (olive brown moist soft weathered shale and thinly bedded limestone) or unweathered zone (gray moist soft to moderately tough shale and thinly bedded limestone) of bedrock, proportioning the footings for a maximum net bearing pressure of 12,000 pounds per square foot, full dead and full live load. The columns can be supported on top of the foundation retaining wall. The weight-training room partition wall at the southwest corner can also be supported on strip footings as discussed above. The northernmost portion of the west wall may require stepping down in order to maintain the recommended bearing material. The northern 40 feet of the west wall line, the north wall line, the remainder of the east wall line and the partition walls at the northwest and northeast corners of Unit C should all be supported on drilled shafts proportioned as discussed by Item 4 of this report. Control joints should be provided at walls of adjacent foundation schemes. It is our opinion that the existing fill and undisturbed profile of Unit C are satisfactory for the support of the main activity area floor slab-on-grade. We recommend that the floor slab, however, not be tied to the foundations, but be designed as a floating slab.

16. We recommend that footing excavations be cut to uniform lines and grades placing concrete directly against the soil without forming. Wherever footings are supported at building or pool excavation level, the footings should be formed to maintain uniform dimensions.

17. Wherever moderately plastic to plastic clays or shales are exposed in the bottom of footing excavations, we recommend that concrete be placed as soon as possible in order to maintain these soils and shales at their natural moisture content. If a saturated or crusted surface develops subsequent to excavating, the surface should be reskimmed immediately prior to placing steel and concrete.

18. Footing excavations into the undisturbed bedrock should expose shaley material at bearing level. If limestone slabs are encountered at bearing level, we recommend that the limestone be penetrated to the underlying shale.

19. All foundations around the perimeter of the proposed building should be supported at a sufficient depth for protection from frost, accepted as 30 inches below exterior grades in the Northern Kentucky - Greater Cincinnati Area.

20. We recommend that all footing excavations be examined by a Geotechnical Engineer from our office or his representative prior to placing concrete in order to assure you that the bearing soils and surfaces are consistent with the recommendations outlined herein.

21. We recommend that a footing drain system be installed behind all foundation and retaining walls extending above 2 feet above floor line and at the loading dock. Outlined on Plate I enclosed herewith are our recommendations for footing drain installation and backfilling criteria. A positive discharge outlet should be provided into a storm sewer system.

22. It is our opinion that foundation walls and retaining walls backfilled in accordance with Item 21 can be designed to resist an equivalent fluid weight of 40 pounds per cubic foot plus any surcharge.

23. We recommend that all earthwork at this site be accomplished under controlled conditions. We recommend that any earthwork accomplished in Unit A and that work accomplished in Unit B be undertaken in stages so as to minimize handling of the soils. For example, the northernmost portion of the building to be undercut

Purpose:
To relieve Hydrostatic Pressures On Foundation Walls And From Under Floor Slabs.

Note:
All Backfill Material To Be Compacted To 95% (ASTM-698) Or 90% (ASTM-1557). No Backfill To Be Flushed To Obtain Compaction.

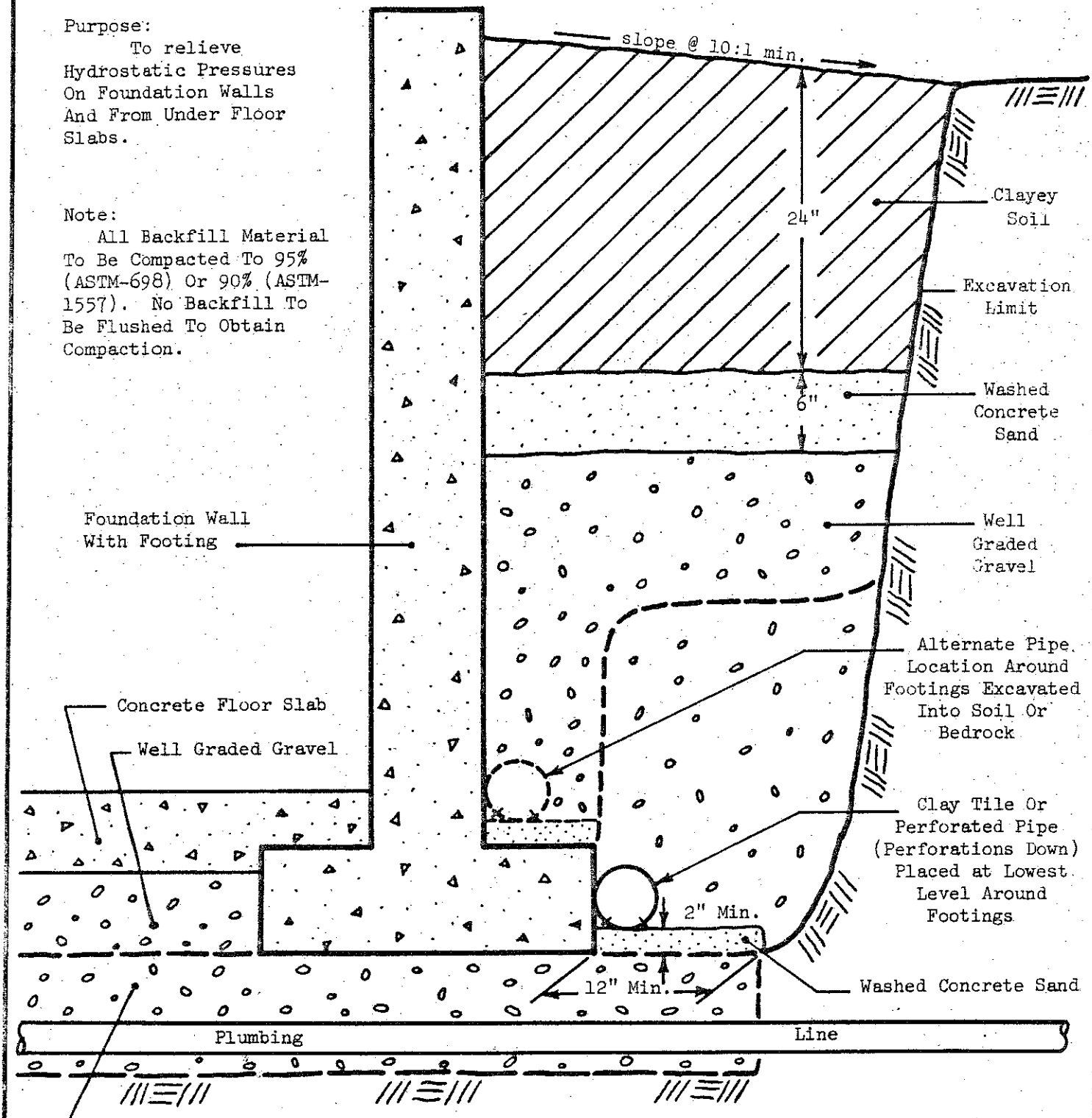

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PLATE I

Footing Drains and Footing And Foundation Excavation Backfill Criteria

can have the fill excavated and placed directly as compacted fill in the presently depressed area north of the proposed Academic, Health & Physical Education Center. After that area has been undercut, excavated soils from an undercut area in the southern portion of the building can be placed directly as compacted fill in that area to the north. Once the southern area has been undercut, the proposed cut in the main activity area and boiler room and receiving area can be used for borrow in filling the southern undercut area. The volumes of soil handled in the staged process should be coordinated accordingly.

24. During undercutting, any clean clayey soils should be placed directly as new compacted fill. Existing clayey fill containing concentrations of topsoil or organic matter, existing topsoil and sediment should be wasted. The test borings indicate that the majority of the clayey fill is acceptable for re-use as compacted fill.

25. The undercutting should be accomplished to expose firm undisturbed soils. Upon completion, the exposed surface should be proofrolled with a heavy piece of on-site equipment under the review of a Geotechnical Engineer

from our office or his representative. Should proof-rolling indicate localized soft or yielding areas, they should be further undercut. The surface of the proposed fill area should then be compacted to at least 95 percent of maximum density as determined by the standard Proctor moisture-density test, ASTM D698.

26. We recommend that all fill placed as part of this development be accomplished with approved soils placed in uniform level layers, 6 to 8 inches in thickness, and compacted near optimum moisture content with an appropriate type of compaction equipment, such as a sheepsfoot roller for clayey soils. Fill placed within the proposed building areas should be compacted to at least 98 percent of maximum density as determined by the standard Proctor moisture-density test, ASTM D698. Fill placed beyond proposed building limits should be compacted under a specification of 95 percent of maximum density, ASTM D698.

27. We recommend that the top 6 inches of subgrade in all proposed building areas and in all proposed pavement areas be compacted to at least 100 percent of maximum density, ASTM D698, immediately prior to placing the floor slab or pavement.

28 Laboratory tests on samples of clayey fill indicate that the fill has moisture contents scattered through the twenties. The undisturbed clayey soils similarly have moisture contents in the twenties. We anticipate that in order to re-use these soils as compacted fill, some aerating and drying will be required in order to reduce their moisture content to near optimum moisture content in order that the recommended degree of compaction can be more expeditiously obtained. We recommend that cut and fill areas as large as possible be worked in order to expose as much soil as possible to the sun and wind to promote drying. The weathered and highly weathered shales have natural moisture contents nearer optimum and will require a lesser amount of drying time. The parent shale has natural moisture contents generally less than 10 percent and it may be necessary to add water to these soils to assist the compacting process. Mixing of the drier and wetter soils by cutting across the profile will minimize the effects of moisture differences.

29. It is our opinion that limestone floaters and slabs can be incorporated into the compacted fill provided they do not nest or retard compaction. If in the

opinion of the Geotechnical Engineer the amount of limestone becomes excessive, measures will have to be taken by the contractor to break up the slabs or better disperse them through the fill area. In addition, larger limestone slabs should be restricted from the fill area as such slabs will retard advancing drilled shafts for foundation installation.

30. We recommend that the contract documents include items for undercutting and replacing with compacted fill on a per cubic yard of in-place compacted fill basis.

31. We recommend that field density tests be run continuously during the filling operation by engineering technicians from our firm to assure you that the compaction specifications outlined herein are properly implemented.

32. Experience has shown that the two weathered zones of bedrock can readily be excavated with conventional track-mounted equipment. The parent bedrock, the gray shale and thinly bedded limestone, can also be excavated with track-mounted equipment, but requires more time and more effort. The difficulty is increased when confined to narrow trench excavations.

33. As part of construction of the Academic, Health & Physical Education Center, we recommend that the existing storm sewers within the proposed building area be abandoned and sealed unless they are removed as part of the earthwork. Their flow should be rerouted.

34. We recommend that all foundation, sewer and utility excavations at this site be backfilled with approved on-site clayey soils or approved borrow placed in uniform level layers, 6 to 8 inches in thickness, and compacted with an appropriate type of compaction equipment, near optimum moisture content, to at least 95 percent of maximum density, ASTM D698. Under no conditions should any backfill be flushed to obtain compaction.

35. We recommend that new fill slopes at this site be constructed not steeper than 2.5 horizontal to 1 vertical. Shallower slopes should be used for easier maintenance. Cut slopes through undisturbed soils should be graded no steeper than 2 horizontal to 1 vertical. Regrading existing slopes containing fill should be to no steeper than 3 horizontal to 1 vertical.

36. During construction good surface drainage should be maintained. Ponding of surface water in fill and foundation areas should be prohibited. Following the completion of the building,grades around the structure should be set so as to direct surface water away from the building and into natural drainage or storm sewers. Surface water should also be directed away from the edges of pavement. Water falling on paved surfaces should be collected in storm sewers.

37. Normal design pavement thicknesses for automobile traffic in the Northern Kentucky - Greater Cincinnati Area consists of 2 inches of surface asphalt over 6 inches of crushed stone on a compacted subgrade. Pavement subjected to truck traffic should be increased proportionately for their expected axle loads, frequency of loading and properties of the subgrade. In all cases, we recommend consideration be given to using a full depth asphalt design for flexible pavement. The rule-of-thumb is to substitute 1 inch of asphaltic base for each 2 inches of crushed stone. Verification of subgrade properties for use in formal pavement design should be accomplished by field CBR tests or correlation of field densities to laboratory CBR tests.

38. If any portions of construction are undertaken during the winter or spring months of the year, we recommend that under no conditions should any concrete, pavement or fill be placed over frozen or saturated soils. In addition, frozen soils should not be used as compacted fill or backfill.

GENERAL SITE CONDITIONS

The location of the proposed Academic, Health & Physical Education Center will be immediately west of existing Regents Hall, Northern Kentucky University, Highland Heights, Kentucky. The proposed building area encompasses several sloping yard areas, portions of Daniel Boone Drive, Albert Gallatin Drive, Simon Kenton Drive, a service drive, the eastern portion of parking lot G, and several temporary academic building areas. Elevations within the proposed building area vary from El. 868 to the southwest to El. 844 to the north-central portion of the proposed building. Presently there are several existing active storm sewers through the proposed building area. In addition, there is an 8-inch water line which terminates near the north wall of the proposed boiler room and receiving area.

Present drainage at the site is fair to good.

The general subsurface profile at the site is exemplified by the

test boring logs and cross sections illustrated on the enclosed boring plan and cross section sheet. We have enclosed herewith a copy of a portion of sheet K3C41 of the 1963 Edition of the Northern Kentucky Area Planning Commission Topographic Maps upon which we have approximately superimposed existing Regents Hall and the proposed Academic, Health & Physical Education Center. As can be seen from that topographic map, a major drainage tributary extended through the central portion of the site. This drainage tributary has been partially filled and a fill embankment has been constructed at the north end of the main activity area, existing parking lot G. The clayey fill encountered in the test borings consists of overburden clays, shale and limestone floaters native of the area. In the central and western portions of the site, the fill was typically medium stiff in consistency whereas to the east adjacent to Regents Hall, the fill was relatively stiff. Natural moisture content tests on the fill are scattered through the twenties and N-values ranged from 6 to 22 blows per foot, a median of 12 blows per foot. Two undisturbed Shelby tube samples of the clayey fill resulted in natural dry densities of 96.4 and 100.9 pounds per cubic foot. One sample tested for unconfined compressive strength resulted in a strength of 740 pounds per square foot, the soft range.

Below the fill in several of the test borings there was encountered

undisturbed topsoil or sediment. The sediment is a low density soil accumulated through the lower portion of the original drainage valley. This soil was soft to medium stiff in consistency with N-values recorded at 2 to 7 blows per foot. This soil classifies ML according to the Unified Soil Classification System (USCS) with a liquid limit of 34 and a plasticity index of 9. Natural moisture contents range from the plastic to liquid limit.

The undisturbed profile consists of a low density undisturbed surface soil, stiff to very stiff overburden clays, and then the bedrock formation, a system of shale and thinly bedded limestone. The uppermost stratum is described as a brown moist medium stiff silty clay. This soil has been subjected to the seasonal variations of wetting and drying, freezing and thawing. This soil classifies ML (USCS) with a liquid limit of 32 and a plasticity index of 8. Natural moisture contents are in the middle twenties. N-values are less than 10 blows per foot.

Two types of overburden clays were encountered. The first soil type are glacial clays described as silty clay on the test boring logs. These soils classify CL or CL-ML (USCS) with a liquid limit of 40 to 47 and plasticity indicies of 16 to 22. Natural moisture contents are in the low twenties and N-values range from 10 to

30 blows per foot. The second soil type is a residual clay which has developed from the extreme weathering of the underlying bedrock formation. This soil classifies CH (USCS) with a liquid limit of 53 and a plasticity index of 26. Natural moisture contents are in the twenties. N-values vary from 10 to 30 blows per foot, the higher N-values a result of limestone floaters.

The above described overburden clays are underlain by the bedrock formation, a system of shale and thinly bedded limestone. We characterize the bedrock into three basic zones; an upper zone of brown and gray very soft highly weathered shale and thinly bedded limestone, an intermediate zone of olive brown weathered shale and thinly bedded limestone, and the parent bedrock, the gray (unweathered) shale and thinly bedded limestone. As a result of variations in weathering and erosion, either or both of the weathered zones may be absent at a particular location. Natural moisture contents of the highly weathered shale are in the upper teens. The weathered shale has natural moisture contents scattered through the teens and the parent gray shale has natural moisture contents ranging from 4 to 8 percent. Selected samples of rock core were tested for unconfined compressive strength and the gray shale resulted in strengths of 24.0 to 31.8 tons per square foot at natural dry densities of 148.4 to 148.7 pounds per cubic foot.

The bedrock formation of the Greater Cincinnati Area has been generally correlated by USGS elevations. Enclosed herewith is a copy of the Geologic Column outlining the bedrock classification. The bedrock within the range of influence of the proposed Academic, Health & Physical Education Center is the Corryville and Mt. Auburn members of the McMillan formation. Some correlation has been observed between the concentrations of limestone of the various members of the bedrock and their classification. Experience has shown that the bedrock within the Greater Cincinnati Area contains limestone layers varying in thickness from less than 1 inch to 12 inches. Thicker layers or concentrations of layers are occasionally encountered. The bedrock cores obtained at this site indicate limestone layers varying in thickness from less than 1 inch to 4½ inches. Limestone concentrations varied from approximately 39 to 73 percent. The limestone layers are fossiliferous and jointed on a random pattern of approximately 5 to 10 feet in any direction.

Ground water readings were obtained in the majority of the test borings. The depths and times of the ground water readings are noted at the bottoms of the test boring logs. Ground water was first noted at random depths in the clayey fill, within the sediment, at the surface of the bedrock, and within the bedrock. Because the profile is primarily clayey, ground water

movement is typically minor. Experience has shown, however, that some significant flow can occur through the low density sedimentary soils and along layers of limestone within the bedrock.

FIELD EXPLORATION

Our scheduled scope of work was reduced from sixteen to fifteen test borings because of the depth of fill encountered at the site. The locations are illustrated on the boring plan included in the Appendix to this report. The test borings were staked in the field with respect to the southwestern corner of the existing Regents Hall. The ground surface elevation at each test boring location was determined by our survey crew with respect to the finished floor elevation of the gymnasium level of Regents Hall, El. 864.0.

The test borings were made with a truck-mounted drill rig advancing continuous flight augers and sampling ahead of the augers with a 2-inch O.D. split spoon driven with a 140-pound weight falling 30 inches. This procedure is described as the standard drive sample method and results in the standard penetration test. As each split spoon sample was obtained, a representative portion was selected and placed in a glass jar, the jar sealed and marked for proper identification. As the

test borings proceeded, the drilling technician prepared a field log of the subsurface profile noting the soil and bedrock descriptions, stratifications, ground water, penetration resistance and other pertinent data.

In addition to the standard split spoon samples, three 3-inch O. D. undisturbed Shelby tube samples were obtained at the depths indicated on the test boring logs. These samples were sealed in their tubes and the tubes marked for proper identification.

Each of the test borings were extended to refusal conditions in the parent bedrock. Test borings 4, 8, 12 and 14 were extended into the bedrock by coring with an NXM-size double tube core barrel with a diamond bit. A 2-inch diameter rock core was recovered and placed in wooden boxes and appropriately marked for identification. The drilling technician selected representative samples of the rock core, wrapped them in plastic, sealed them in jars and appropriately identified them.

A John Deere 450 dozer was provided by our firm to assist moving the drill rig on the snow covered sloping terrain.

LABORATORY REVIEW

After the test borings were completed, all samples obtained therein were returned to our Soil Mechanics Laboratory where

they were examined and visually classified by our Project Geotechnical Engineer. As the Engineer reviewed the samples with the field logs, representative samples were selected for general soil classification tests including natural moisture content tests, Atterberg limits tests, unconfined compression tests and natural density tests. The tabulated results of all laboratory tests are included in the Appendix to this report. We have also included in the Appendix the unconfined compression test forms.

Based upon a visual examination of the samples, the laboratory tests, and the drilling technician's field logs, our Project Geotechnical Engineer prepared the final test boring logs. Copies of the finalized logs are included in the Appendix to this report together with a Soil Classification Sheet which outlines the terms and symbols used on the test boring logs. We have also prepared three cross sections through the proposed building area. The ground surface was obtained from a preliminary copy of the surveyor's topographic plan. The cross sections are illustrated on the boring plan and cross section sheet included in the Appendix to this report.

We appreciate the opportunity of being your geotechnical consultants for the subject project. If you have any questions concerning the findings, conclusions, or recommendations

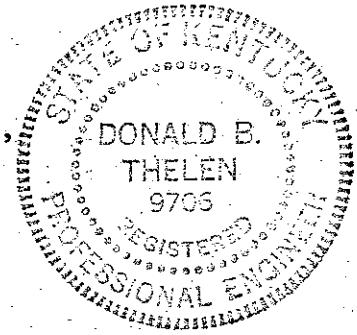
contained herein, or if we may be of any additional service to you, please do not hesitate to contact us.

Respectfully submitted,

G. J. THELEN, PSC

Donald B. Thelen

Donald B. Thelen, P.E.
Civil (Geotechnical) Engineer



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Copies submitted:

2 - Client

3 - Edward J. Beiting, Jr., PSC

1 - White, Walker & McReynolds

APPENDIX

Geologic Column

NKAPC Topographic Plan

Tabulation of Laboratory Tests

Unconfined Compression Test Forms

Test Boring Logs

Soil Classification Sheet

Boring Plan and Cross Sections (See Drawings)

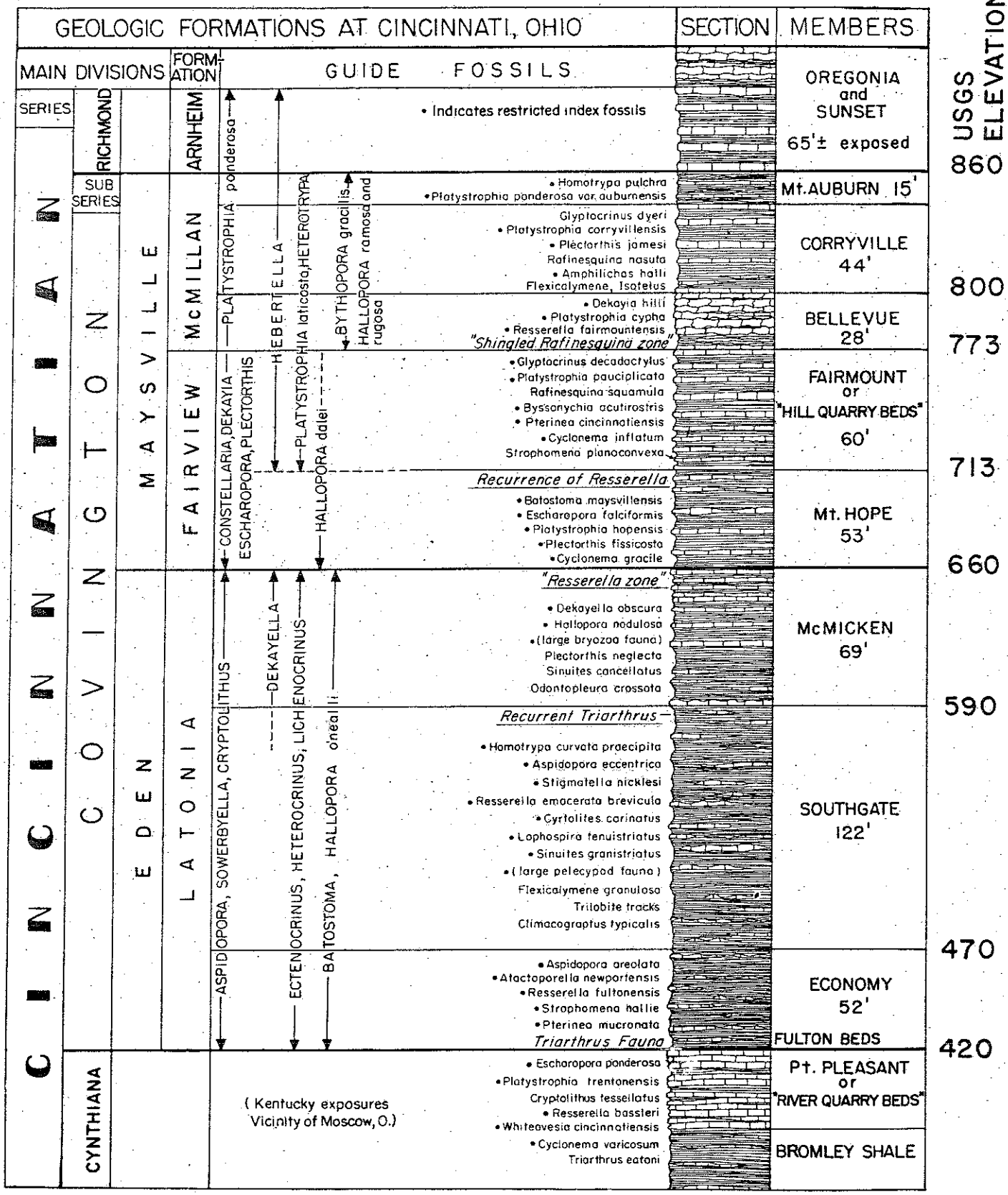
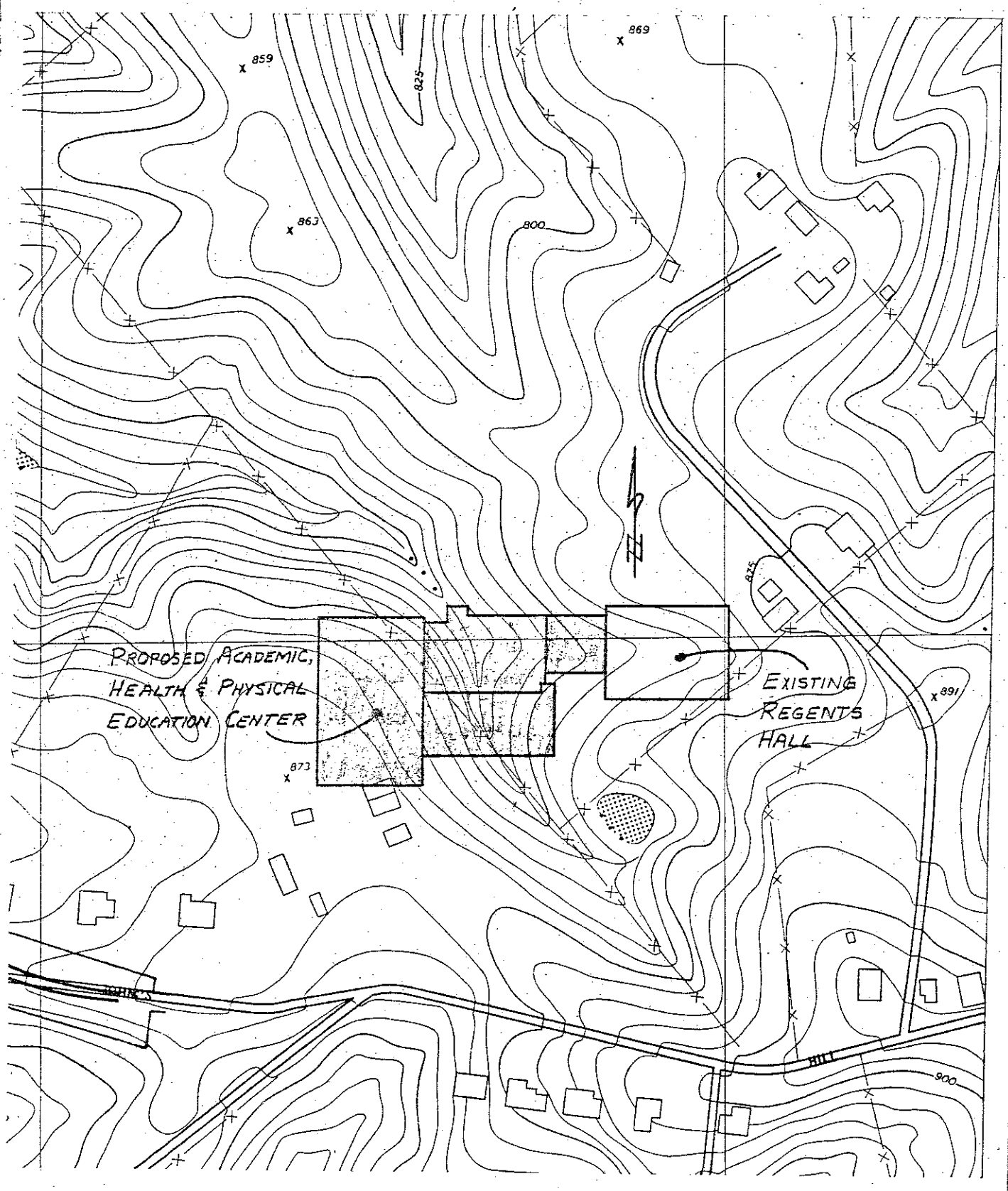


Fig. 3

GEOLOGIC[12] COLUMN

Prepared from a publication of the Cincinnati Museum of Natural History, "Fossils and Strata of the Ordovician" by Caster, Dalve and Pope, 1961.



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NKAPC
Topographic Map
Scale: 1" = 200'

Geotechnical Exploration
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GEOTECHNICAL EXPLORATION
NKU HEALTH & PHYSICAL EDUCATION CENTER
HIGHLAND HEIGHTS, KENTUCKY

80026E

TABULATION OF LABORATORY TESTS

Boring Number	Sample Number	Depth, ft.	Moisture Content, %	Atterberg Limits LL	PL	PI	Natural Dry Density, Pcf	Unconfined Compression Strength, Psf	USCS Classification
2	7	14.0-14.5	9.2						
3	3	5.0- 5.3	6.6						
4	1B	0.9- 1.5	22.4	32	24	8			ML
	2	2.5- 4.0	25.3	46	27	19			CL-ML
	3	5.0- 6.5	25.0						
	4	7.5- 9.0	24.9						
	5	10.0-10.5	18.3						
	6	12.5-13.0	7.5						
	RC-7A	15.5-15.6	6.3						
	RC-7B	17.0-17.5	4.9				148.7	63,510	
	RC-7C	17.7-17.8	6.8						
	RC-8A	19.0-19.5	5.1				148.7	55,260	
	RC-8B	19.5-19.6	5.9						
	RC-8C	20.3-20.4	3.0						
6	1	1.0- 1.5	25.5						
	2	3.0- 4.5	20.0	53	27	26			CH
	3	5.0- 6.5	19.1						
	7	15.0-15.3	2.5						
7	7	15.0-15.5	5.3						

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GEOTECHNICAL EXPLORATION
NKU HEALTH & PHYSICAL EDUCATION CENTER
HIGHLAND HEIGHTS, KENTUCKY

80026E

TABULATION OF LABORATORY TESTS

Boring Number	Sample Number	Depth, Ft.	Moisture Content, %	Atterberg Limits LL	PL	PI	Natural Dry Density, Pcf	Unconfined Compression Strength, Psf	USCS Classification
8	9	20.0-21.5	19.0						
	10	22.5-24.0	18.7						
	11	25.0-26.2	16.8						
	RC-13A	30.0-30.1	4.0						
	RC-13B	31.0-31.1	3.7						
	RC-13C	31.5-31.6	7.9						
	RC-13D	32.0-32.1	4.7						
	RC-14A	32.5-32.6	4.8						
	RC-14B	35.0-35.1	5.8						
	RC-14C	35.4-35.8	4.6				148.4	48,070	
10	9	22.5-22.8	9.3						
11	1	0.0- 1.5	23.2						
	2	2.5- 4.0	26.2						
	3	5.0- 6.5	21.5						
	4	7.5- 9.0	20.0						
	5B	10.5-11.5	25.2						
	6	12.5-14.0	31.9	34	25	9			ML
	7	15.0-16.5	26.9						
	8	17.5-19.0	21.2	40	24	16			CL
	9	20.0-20.5	13.1						
	10	22.5-22.7	5.2						
12	PT-A1	3.1- 3.6	29.4				96.4	740	
	PT-A2	3.7- 4.1	25.2				100.9		
	3B	8.0- 9.0	20.2	46	24	22			CL
	4	10.0-11.0	30.0						

00210

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80026E

TABULATION OF LABORATORY TESTS

Boring Number	Sample Number	Depth, Ft.	Moisture Content, %	Atterberg Limits LL	PL	PI	Natural Dry Density, Pcf	Unconfined Compression Strength, Psf	USCS Classification
12	6	15.0-15.5	5.3						
	7	17.0-17.2	7.6						
	RC-8A	17.8-17.9	8.2						
	RC-8C	19.5-19.6	5.7						
	RC-8D	21.0-21.1	4.8						
	RC-9A	23.8-23.9	7.2						
	RC-9B	24.2-24.3	6.6						
14	RC-12A	26.5-26.6	4.1						
	RC-12B	27.0-27.1	4.4						
	RC-12C	28.5-28.6	5.9						
	RC-13A	30.4-30.5	5.1						
	RC-13B	33.0-33.1	5.1						
	RC-13C	34.7-34.8	5.7						

CIVIL ENGINEERS

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00212

UNCONFINED COMPRESSION TEST

Unit Weight and Natural Moisture

Client Commonwealth of Kentucky Project Number 80026E

Project Geotechnical Exploration, NKU Health & Physical Education Center

Boring Number 4 Sample Number RC-7B Depth, Ft. 17.0-17.5 Lab Number 80453

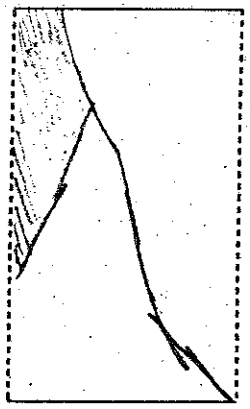
Sample Description Gray moist moderately tough SHALE.
X Rock Core

Sample Obtained By: ☐ Spoon ☐ Tube Sides: ☐ Trimmed ☒ Untrimmed Date 2/22/80

NATURAL UNIT WEIGHT

Diameter - Av. (in.)	2.12
Area - Av. (Sq. cm.)	22.76
Height (in.)	5.81
Volume (cu. cm.)	335.88
Weight - Wet (Gm.)	839.50
Weight - Dry (Gm.)	800.28
Density - Dry (Lbs./cu. ft.)	148.7

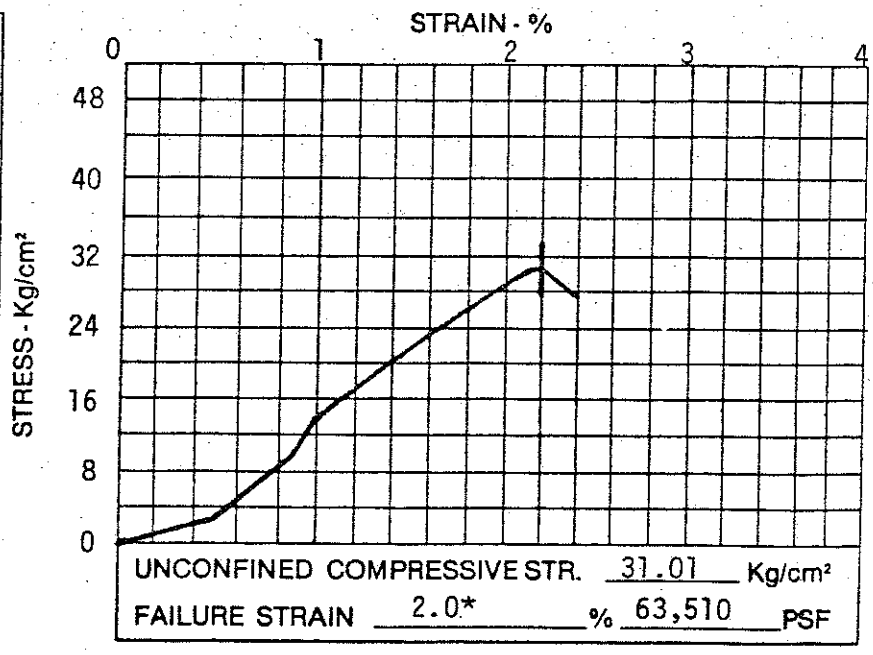
FAILURE SHAPE



WATER CONTENT

Can No.	AF
Weight - Wet (Gm.)	858.55
Weight - Dry (Gm.)	826.53
Weight Water (Gm.)	32.02
Weight Can (Gm.)	169.00
Weight Solids (Gm.)	657.53
Moisture (%)	4.9

DEFORM DIAL (in. x 10-3)	LOAD DIAL (in. x 10-4)	LOAD (Kg.)	STRAIN (%)	CORR. AREA (cm²)	STRESS (Kg./cm²)
10	7	18.6	.2	22.80	.82
20	17	45.3	.3	22.83	1.98
30	32	85.3	.5	22.87	3.73
50	88	234.3	.9	22.97	10.20
60	120	319.6	1.0	22.99	13.90
70	146	388.8	1.2	23.04	16.88
80	172	458.0	1.4	23.08	19.84
90	195	519.3	1.5	23.11	22.47
100	215	572.5	1.7	23.15	24.73
110	237	631.1	1.9	23.20	27.20
120	257	684.4	2.1	23.25	29.44
130	271	721.7	2.2	23.27	31.01
140	245	652.4	2.4	23.32	27.98



REMARKS: Unconfined compressive strength 31.8 TSF

*Corrected strain

00213

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UNCONFINED COMPRESSION TEST

Unit Weight and Natural Moisture

Client Commonwealth of Kentucky Project Number 80026E

Project Geotechnical Exploration, NKU Health & Physical Education Center

Boring Number 4 Sample Number RC-8A Depth, Ft. 19.0-19.5 Lab Number 80455

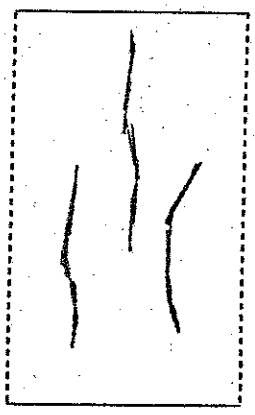
Sample Description Gray moist moderately tough SHALE.

Sample Obtained By: X Rock Core ☐ Spoon ☐ Tube Sides: ☐ Trimmed ☒ Untrimmed Date 2/22/80

NATURAL UNIT WEIGHT

Diameter - Av. (in.)	2.13
Area - Av. (Sq. cm.)	22.98
Height (in.)	5.45
Volume (cu. cm.)	318.11
Weight - Wet (Gm.)	796.71
Weight - Dry (Gm.)	758.05
Density - Dry (Lbs./cu. ft.)	148.7

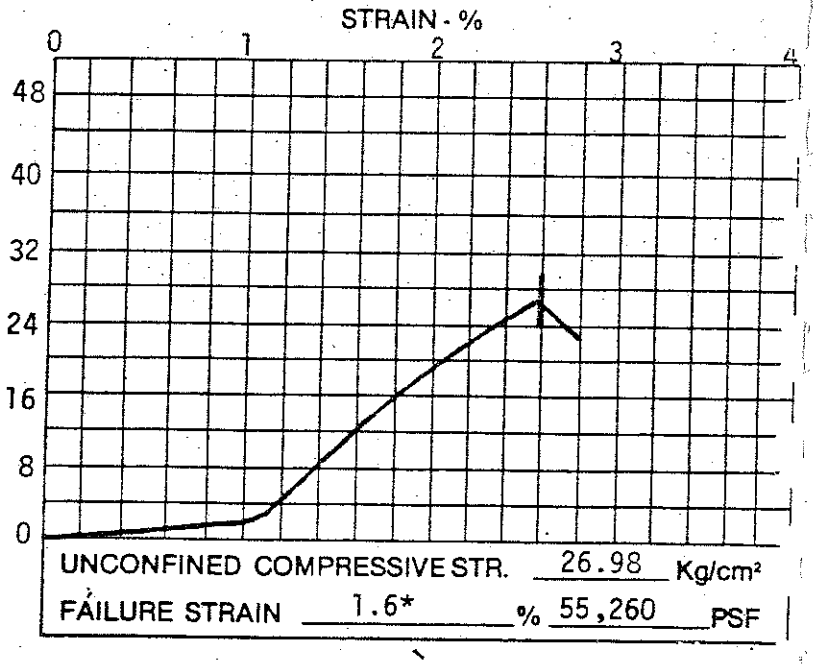
FAILURE SHAPE



WATER CONTENT

Can No.	16
Weight - Wet (Gm.)	922.24
Weight - Dry (Gm.)	885.51
Weight Water (Gm.)	37.43
Weight Can (Gm.)	155.39
Weight Solids (Gm.)	730.12
Moisture (%)	5.1

DEFORM DIAL (in. x 10-3)	LOAD DIAL (in. x 10-4)	LOAD (Kg.)	STRAIN (%)	CORR. AREA (cm²)	STRESS (Kg./cm²)
20	4.1	10.9	.4	23.07	.47
30	6.5	17.3	.6	23.12	.75
40	11.2	29.8	.7	23.14	1.29
50	20.0	53.3	.9	23.19	2.30
60	33.0	87.9	1.1	23.24	3.78
70	53.0	141.1	1.3	23.28	6.06
80	79.8	212.5	1.5	23.33	9.11
90	111.0	295.6	1.6	23.25	12.66
100	143.0	380.8	1.8	23.40	16.27
120	202.0	537.9	2.2	23.50	22.89
130	222.0	591.2	2.4	23.54	25.11
140	239.0	636.5	2.6	23.59	26.98
150	210.0	559.2	2.8	23.64	23.65



UNCONFINED COMPRESSIVE STR. 26.98 Kg/cm²

FAILURE STRAIN 1.6* % 55,260 PSF

REMARKS: *Corrected strain.

Unconfined compressive strength 27.6 TSF

CIVIL ENGINEERS

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00214

UNCONFINED COMPRESSION TEST

Unit Weight and Natural Moisture

Client Commonwealth of Kentucky Project Number 80026E

Project Geotechnical Exploration, NKU Health & Physical Education Center

Boring Number 8 Sample Number RC-14C Depth, Ft. 35.4-35.8 Lab Number 80473

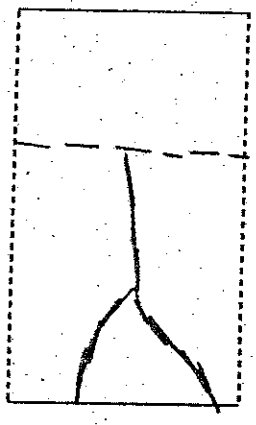
Sample Description Gray moist moderately tough SHALE
X Rock Core

Sample Obtained By: ☐ Spoon ☐ Tube Sides: ☐ Trimmed ☒ Untrimmed Date 2/22/80

NATURAL UNIT WEIGHT

Diameter - Av. (in.)	2.14
Area - Av. (Sq. cm.)	23.19
Height (in.)	4.51
Volume (cu. cm.)	265.65
Weight - Wet (Gm.)	660.92
Weight - Dry (Gm.)	631.85
Density - Dry (Lbs./cu. ft.)	148.4

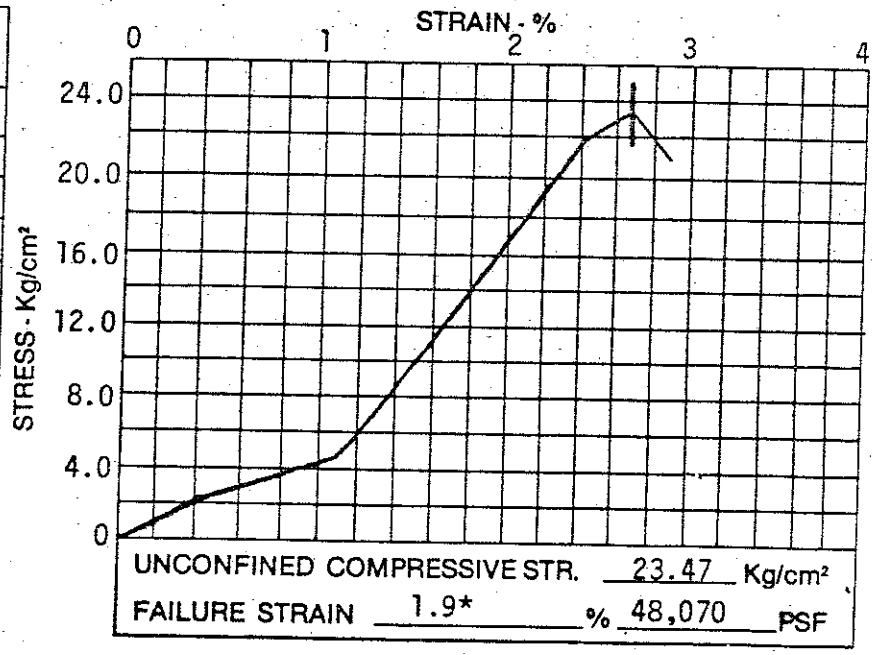
FAILURE SHAPE



WATER CONTENT

Can No.	FF
Weight - Wet (Gm.)	780.25
Weight - Dry (Gm.)	753.26
Weight Water (Gm.)	26.99
Weight Can (Gm.)	170.32
Weight Solids (Gm.)	582.94
Moisture (%)	4.6

DEFORM DIAL (in. x 10-3)	LOAD DIAL (in. x 10-4)	LOAD (Kg.)	STRAIN (%)	CORR. AREA (cm^2)	STRESS ($Kg./cm^2$)
10	9	24.0	.2	23.24	1.03
20	19	50.6	.4	23.28	2.17
30	31	82.6	.7	23.35	3.54
40	31	82.6	.9	23.40	3.53
50	37	98.5	1.1	23.45	4.20
60	61	162.4	1.3	23.50	6.91
70	89	237.0	1.6	23.57	10.06
80	117	311.6	1.8	23.62	13.19
90	143	380.8	2.0	23.67	16.09
100	170	452.7	2.2	23.71	19.09
110	195	519.3	2.4	23.76	21.86
120	210	559.2	2.7	23.83	23.47
130	195	519.3	2.9	23.88	21.75



UNCONFINED COMPRESSIVE STR. 23.47 Kg/cm^2

FAILURE STRAIN 1.9* % 48,070 PSF

REMARKS: Unconfined compressive strength 24.0 TSF

*Corrected strain

CIVIL ENGINEERS

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00215

UNCONFINED COMPRESSION TEST

Unit Weight and Natural Moisture

Client Commonwealth of Kentucky Project Number 80026E

Project Geotechnical Exploration, NKU Health & Physical Education Center

Boring Number 12 Sample Number PT-A1 Depth, Ft. 3.1-3.6 Lab Number 80495

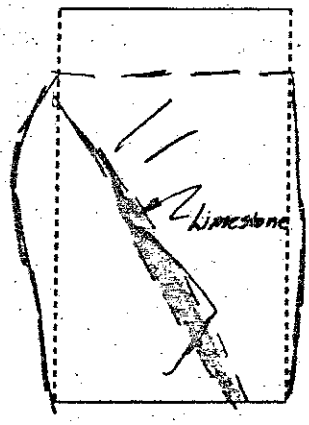
Sample Description Brown moist medium stiff FILL, shale with silty clay and limestone floaters

Sample Obtained By: ☐ Spoon ☒ Tube Sides: ☐ Trimmed ☒ Untrimmed Date 2/22/80

NATURAL UNIT WEIGHT

Diameter - Av. (in.)	2.80
Area - Av. (Sq. cm.)	39.7
Height (in.)	5.60
Volume (cu. cm.)	564.69
Weight - Wet (Gm.)	1128.66
Weight - Dry (Gm.)	872.23
Density - Dry (Lbs./cu. ft.)	96.4

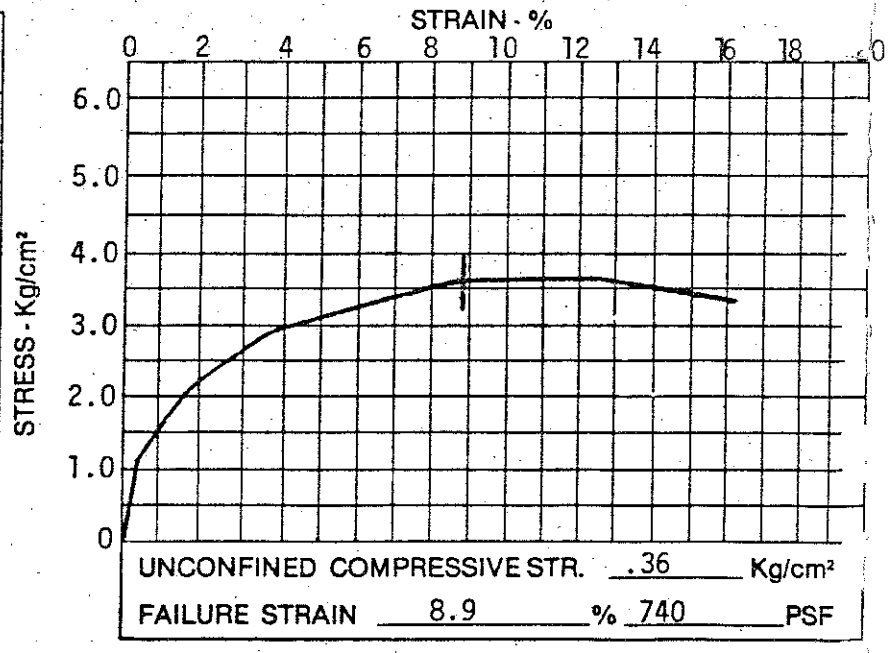
FAILURE SHAPE



WATER CONTENT

Can No.	14
Weight - Wet (Gm.)	1133.01
Weight - Dry (Gm.)	915.02
Weight Water (Gm.)	217.99
Weight Can (Gm.)	173.82
Weight Solids (Gm.)	741.20
Moisture (%)	29.4

DEFORM DIAL (in. x 10-3)	LOAD DIAL (in. x 10-4)	LOAD (Kg.)	STRAIN (%)	CORR. AREA (cm²)	STRESS (Kg./cm²)
20	32	4.3	.4	39.8	.11
40	44	5.9	.7	40.0	.15
60	51	6.8	1.1	40.1	.17
80	59	7.9	1.4	40.3	.20
100	66	8.8	1.8	40.4	.22
200	87	11.6	3.6	41.2	.28
300	101	13.5	5.4	42.0	.32
400	110	14.7	7.1	42.7	.34
500	117	15.7	8.9	43.6	.36
600	120	16.1	10.7	44.5	.36
700	123	16.5	12.5	45.4	.36
800	122	16.3	14.3	46.3	.35
900	118	15.8	16.1	47.3	.33



UNCONFINED COMPRESSIVE STR. .36 Kg/cm²

FAILURE STRAIN 8.9 % 740 PSF

REMARKS: Pocket penetrometer readings: .70, .75, .80, 1.05 TSF

Torvane Readings: .34 Kg/Cm²

Note: The shear took place at the same angle as the rock was in the sample

CIVIL ENGINEERS

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00216

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky BORING # 1
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec
855.4	SURFACE	0.5						
854.9	ASPHALT.	1.0						
854.4	GRANULAR BASE			I	2/3/3	1	DS	7
	Mixed brown, trace dark gray moist medium stiff FILL, silty clay with clay and shale, some limestone floaters and hairlike roots.		5	U		A	PT	8"
				I	3/4/5	2	DS	6"
				I	3/7/4	3	DS	14"
			10	I	2/3/7	4	DS	8"
843.4		12.0						
	Brown to olive brown moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).			I	15/26/35	5	DS	18
			15	I	50/6"	6	DS	6
837.9		17.5						
	Olive brown with seams of gray moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).	19.5		I	23/25/6"	7	DS	12
835.9		20.7	20	D	50/3"	8	DS	3
834.7	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).							
	Refusal and bottom of test boring at 20.7 feet.		25					

Datum USGS
Surf. Elev. 955.4 Ft.
Date Started 2/13/80

Hammer Wt. 140 Lbs.
Hammer Drop 30 In.
Pipe Size O.D.2 In.

Hole Diameter 5"
Rock Core Dia. -
Boring Method CFA

Foreman J.M.
Engineer D.B.T.
Date Completed 2/13/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 12.0 FT.
AT COMPLETION — FT.
AFTER 24 HRS 15.7 FT.
BACKFILLED 24 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 # HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS

CIVIL ENGINEERS

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00217

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 2

PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E

LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Typ.
855.9	SURFACE	0.3					
855.6	ASPHALT.	0.5		I	25/40/6"	1	DS
855.4	GRANULAR BASE.			I	35/6"	2	DS
850.9	Brown moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).	5.0	5	I	50/6"	3	DS
	Olive brown, trace gray seams, moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).			I	20/46/6"	4	DS
			10	D	25/2"	5	DS
				I	50/6"	6	DS
842.4		13.5					
	Gray moist soft to moderately tough SHALE and thinly bedded LIMESTONE	14.5	15	I	60/6"	7	DS
841.4	(bedrock).						
	Refusal and bottom of test boring at 14.5 feet.						

Datum USGS — Hammer Wt. 140 Lbs. — Hole Diameter 5" — Foreman J.M.

Surf. Elev. 855.9 Ft. — Hammer Drop 30 In. — Rock Core Dia. - — Engineer D.B.T.

Date Started 2/14/80 — Pipe Size O.D.2 In. — Boring Method CFA — Date Completed 2/14/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION Dry FT.
AFTER 24 HRS. Dry FT.
BACKFILLED 24 HRS

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Au
DC – Driving Casing
MD – Mud Drilling

CIVIL ENGINEERS

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00218

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 3

PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E

LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec
857.0	SURFACE	0.0						
	SHALEY CRUSHED STONE FILL with some silty clay.			D	6/5/5	1	DS	10"
853.5		3.5		D	6/5/6"	2	DS	4"
851.7	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).	5.3	5	D	50/3"	3	DS	2"
	Refusal and bottom of test boring at 5.3 feet.		10					

Datum USGS — Surf. Elev. 857.0 Ft. — Date Started 2/14/80

Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.

Hole Diameter 5" — Rock Core Dia. - — Boring Method CFA

Foreman J.M. — Engineer D.B.T. — Date Completed 2/14/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 1.0 FT.
AT COMPLETION Dry FT.
AFTER 24 HRS. 2.5 FT.
BACKFILLED 24 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

CIVIL ENGINEERS

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00219

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky BORING # 4
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	
867.5	SURFACE							
866.6	TOPSOIL.	0.9		I	7/5/4	1A 1B	DS	12"
865.5	Brown moist medium stiff SILTY CLAY. (ML)	2.0		I	4/5/6	2	DS	18"
863.0	Mottled brown and gray moist medium stiff to stiff SILTY CLAY. (CL-ML)	4.5	5	I	5/7/11	3	DS	18"
860.5	Mottled brown and gray moist stiff SILTY CLAY with silt or siltstone fragments.	7.0		I	9/9/11	4	DS	18"
858.0	Mottled brown and gray moist very stiff SILTY CLAY with shale fragments, limestone floaters and iron oxide stains.	9.5	10	I	20/6"	5	DS	6"
856.5	Olive brown with seams of gray moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).	11.0		I	50/6"	6	DS	6"
854.5	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).	13.0	15			7	RC	40" 22"
844.5	Gray moist moderately tough SHALE and thinly bedded LIMESTONE. Limestone is fossiliferous and jointed with beds of 1/4 to 4 1/2 inches. 61% Shale and 39% Limestone assuming lost core is shale (bedrock).	23.0	20			8	RC	40" 7"
	Bottom of test boring at 23.0 feet.		25					

Datum USGS
Surf. Elev. 867.5 Ft.
Date Started 2/14/80

Hammer Wt. 140 Lbs.
Hammer Drop 30 In.
Pipe Size O.D.2 In.

Hole Diameter 5"
Rock Core Dia. NXM-2"
Boring Method CFA

Foreman J.M.
Engineer D.B.T.
Date Completed 2/14/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 9.5 FT.
AT COMPLETION 3.4 FT.
AFTER 2/20 HRS. 7.2 FT.
BACKFILLED 2/20/80 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Auger
DC – Driving Casing
MD – Mud Drilling

GJT CIVIL ENGINEERS
G. J. Thelen, PSC
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00220

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 5
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Re
844.0	SURFACE	0.0						
842.0	Dark brown moist medium stiff FILL, silty clay with hairlike roots.	2.0		I	5/2/8	1	DS	6
837.0	Mixed brown, trace gray moist medium stiff to stiff FILL, sitly clay and shale with limestone floaters.		5	I	5/6/5	2	DS	15
833.5	Brown, dark brown and dark gray moist medium stiff FILL, silty clay with shale.	7.0		I	5/6/6	3	DS	18
833.0	Dark gray moist medium stiff SILTY CLAY with hairlike roots (topsoil).	10.5		I	4/4/4	4	DS	16
831.5	Brown, trace gray moist medium stiff to stiff CLAY with limestone floaters.	11.0 12.5	10	I	4/4/5	5A 5B	DS	18'
829.0	Dark brown and brown moist stiff SILTY CLAY with limestone floaters and iron oxide stains.	15.0		I	5/6/9	6	DS	18'
827.0	Brown moist stiff SILTY CLAY with limestone floaters, iron oxide stains and concretions, trace bedding planes.	17.0 19.0	15	I	10/8/9	7	DS	18'
825.0	Brown, trace gray moist soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).	20.2		I	28/35/2"	8	DS	7'
823.8	Olive brown and gray moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).	22.7	20	I	38/6"	9	DS	6'
821.3	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).			D	30/3"	10	DS	3'
	Refusal and bottom of test boring at 22.7 feet.		25					

Datum USGS — Surf. Elev. 844.0 Ft. — Date Started 2/13/80
Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.
Hole Diameter 5" — Rock Core Dia. - - — Boring Method CFA
Foreman J.M. — Engineer D.B.T. — Date Completed 2/13/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION Dry FT.
AFTER 2/20 HRS. Surf FT.
BACKFILLED 2/20/80 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 #. HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS

CIVIL ENGINEERS

G. J. Thelen, PSC

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00221

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 6

PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E

LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type
849.9	SURFACE	0.5					
849.4	ASPHALT.	1.0					
		2.5		I	5/6/7	1	DS
848.9	GRANULAR BASE.						
		4.5		I	15/9/12	2	DS
847.4	Brown moist stiff CLAY.		5				
845.4	Brown moist stiff CLAY with limestone floaters, trace bedding planes. (CH)			I	10/15/18	3	DS
	Brown, trace gray moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).	9.5		I	19/28/33	4	DS
840.4			10				
	Olive brown moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).			I	38/50/3"	5	DS
				I	15/31/6"	6	DS
835.4		14.5					
		15.3	15				
834.6	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).			I	50/3"	7	DS
	Refusal and bottom of test boring at 15.3 feet.		20				

Datum USGS — Surf. Elev. 849.9 Ft. — Date Started 2/13/80

Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.

Hole Diameter 5" — Rock Core Dia. - — Boring Method CFA

Foreman J.M. — Engineer D.R.T. — Date Completed 2/13/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION Dry FT.
AFTER 24 HRS. Dry FT.
BACKFILLED 24 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augr
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" O.D. SAMPLER 4' WITH 140 lb. HAMMER FALLING 30" COUNT MADE AT CHANGES OF

CIVIL ENGINEERS

G. J. Thelen, PSC

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00222

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 7
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Re
861.1	SURFACE	0.4						
860.7	TOPSOIL.			I	5/5/6	1A 1B	DS	18
858.6	Brown moist medium stiff CLAY.	2.5		I	12/6/9	2	DS	16
	Brown, trace gray moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).		5	I	10/10/15	3	DS	17
				I	10/14/15	4	DS	18
851.6		9.5						
	Olive brown moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).		10	I	8/25/31	5	DS	10'
848.1		13.0		I	50/6"	6	DS	6'
845.6	Gray moist soft to moderately tough SHALE and thinly bedded LIMESTONE (bedrock).	15.5	15	I	55/6"	7	DS	6'
	Refusal and bottom of test boring at 15.5 feet.		20					

Datum USGS — Surf. Elev. 861.1 Ft. — Date Started 2/13/80
Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.
Hole Diameter 5" — Rock Core Dia. - — Boring Method CFA
Foreman J.M. — Engineer D.B.T. — Date Completed 2/13/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION Dry FT.
AFTER 2/20 HRS. 2.0 FT.
BACKFILLED 2/20/80 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 #. HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS

00223

CIVIL ENGINEERS

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LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 8 (1/2)
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Typ	R
847.7	SURFACE	0.0						
	Mixed brown, trace gray with dark brown moist medium stiff to stiff FILL, silty clay with shale and limestone floaters.			I	3/3/4	1	DS	5
				I	8/10/9	2	DS	17
842.7		5.0	5	I	7/4/15	3	DS	8
	Brown, trace dark brown moist stiff FILL, shale with silty clay and limestone.			I	4/7/9	4	DS	16
			10	I	4/5/8	5	DS	14
835.7		12.0						
	Brown moist very stiff FILL, silty clay.			I	10/12/17	6	DS	15
831.7		16.0	15	I	20/12/10	7	DS	15
		17.0						
830.7	Grayish brown moist medium stiff SILTY CLAY (sediment).			I	10/12/21	8	DS	11
827.7	Brown moist stiff SILTY CLAY with shale fragments and limestone floaters.	20.0	20	I	5/9/6	9	DS	16
	Brown moist very soft highly weathered SHALE and thinly bedded LIMESTONE with clay seams in sample 11 (bedrock).			I	12/18/25	10	DS	16
821.5			25	I	11/29/12 /2"	11	DS	12
	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).	26.2		D	30/2"	12	DS	2

Datum USGS — Surf. Elev. 847.7 Ft. — Date Started 2/20/80
Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.
Hole Diameter 5" — Rock Core Dia. NXM-2" — Boring Method CFA
Foreman J.M. — Engineer D.R.T. — Date Completed 2/20/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION 8.0 FT.
AFTER ____ HRS. ____ FT.
BACKFILLED Immed. HRS

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Au
DC – Driving Casing
MD – Mud Drilling

CIVIL ENGINEERS

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00224

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, /Highland Heights, Ky
LOCATION OF BORING As shown on boring plan
BORING # 8 (2/2)
JOB # 80026F

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec
		27.5						
820.2	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).		30			13	RC	36" / 60"
	Gray moist moderately tough SHALE and thinly bedded LIMESTONE. Limestone is fossiliferous and jointed in 1/4 to 3 inch beds. 56% shale and 44% limestone assuming lost core is shale. (bedrock).		35			14	RC	45" / 48"
811.2		36.5						
	Bottom of test boring at 36.5 feet.		40					

Datum USGS
Surf. Elev. 847.7 Ft.
Date Started 2/20/80

Hammer Wt. 140 Lbs.
Hammer Drop 30 In.
Pipe Size O.D.2 In.

Hole Diameter 5"
Rock Core Dia. NXM-2"
Boring Method CFA

Foreman J.M.
Engineer D.B.T.
Date Completed 2/20/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION 8.0 FT.
AFTER ____ HRS. ____ FT.
BACKFILLED Immed. HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING PILOT SAMPLER WITH

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00225

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 9
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Re
846.3	SURFACE	0.5						
845.8	ASPHALT.	2.3		D	30/10/5	1	DS	5
844.0	GRANULAR BASE.	4.0		I	5/6/8	2	DS	10
842.3	Mixed brown moist medium stiff to soft FILL, silty clay with shale and limestone floaters.	7.0	5	I	12/17/25	3	DS	2
839.3	Mixed brown and gray moist very stiff FILL, shale with limestone floaters.			I	4/15/8	4	DS	4
	Mixed olive brown, brown and gray moist medium stiff to soft FILL, shale with silty clay and limestone floaters.		10	I	4/7/4	5	DS	1
833.5		12.8		I	3/3/4	6	DS	7'
831.8	Dark brown moist medium stiff SILTY CLAY (sediment).	14.5	15	I	2/2/2	7	DS	8'
826.8	Dark gray moist soft to medium stiff SILTY CLAY with organic matter (sediment).	19.5		I	2/1/1	8	DS	8'
824.3	Brown, trace gray moist medium stiff SILTY CLAY with limestone floaters.	22.0	20	I	7/5/5	9	DS	4'
822.3	Brown moist very soft highly weathered SHALE and thinly bedded LIMESTONE(bedrock).	24.0		I	25/6"	10	DS	6'
821.1	Gray moist soft SHALE and thinly bedded LIMESTONE (bedrock).	25.2	25	L/D	50/2"	11	DS CA	0'
	Refusal and bottom of test boring at 25.2 feet.							

Datum USGS — Surf. Elev. 846.3 Ft. — Date Started 2/12/80
Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.
Hole Diameter 5" — Rock Core Dia. - — Boring Method CFA
Foreman J.M. — Engineer D.B.T. — Date Completed 2/12/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 9.0 FT.
AT COMPLETION 20.2 FT.
AFTER 24 HRS. 8.7 FT.
BACKFILLED 24 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 #, HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS

CIVIL ENGINEERS

G. J. Thelen, PSC

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00226

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky BORING # 10
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, JOB # 80026F
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Re
846.6	SURFACE	0.5						
846.1	ASPHALT.	1.0						
		3.0		I	20/24/12	1	DS	15
845.6	GRANULAR BASE.							
				U		A	PT	11
843.6	Gray moist dense FILL, limestone floaters and fragments and shale.		5					
		7.0		I	16/8/16	2	DS	10
839.6	Mixed gray and brown moist medium stiff to very stiff FILL, shale and silty clay and limestone floaters.			I	50/15/15	3	DS	7'
		11.0	10					
835.6	Mixed brown and gray moist medium stiff FILL, shale and silty clay with limestone floaters.	12.0		I	4/4/3	4A 4B	DS	15'
834.6	Dark gray moist medium stiff to soft SILTY CLAY with organic matter (sediment).			I	2/2/2	5	DS	18"
			15					
829.6	Gray and brown moist soft SILTY CLAY, trace organic matter (sediment).	17.0		I	1/1/1	4	DS	18"
				I	3/4/7	5	DS	18"
827.1	Brown moist stiff SILTY CLAY with iron oxide stains and concretions and shale fragments.	19.5						
		21.0	20	I	17/28/6"	8	DS	10"
825.6	Brown and gray moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).	22.8		D	50/4"	9	DS	4"
823.8	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).		25					
	Refusal and bottom of test boring at 22.8 feet.							

Datum USGS
Surf. Elev. 846.6 Ft.
Date Started 2/14/80

Hammer Wt. 140 Lbs.
Hammer Drop 30 In.
Pipe Size O.D.2 In.

Hole Diameter 5"
Rock Core Dia. -
Boring Method CFA

Foreman J.M.
Engineer D.B.T.
Date Completed 2/14/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 5.5&19.5 FT.
AT COMPLETION 14.0 FT.
AFTER 2/20 HRS. 1.3 FT.
BACKFILLED 2/20/80 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

CIVIL ENGINEERS

G. J. Thelen, PSC

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00227

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 11
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	
851.3	SURFACE	0.0						
849.3	Brown moist stiff FILL, silty clay with roots.	2.0		I	6/5/6	1	DS	15'
846.8	Mixed brown moist stiff FILL, silty clay with shale and limestone floaters.	4.5		I	5/6/8	2	DS	10'
	Brown, little gray moist stiff to medium stiff FILL, shale and silty clay with limestone floaters.		5	I	5/6/7	3	DS	14'
841.8		9.5		I	5/5/5	4	DS	6'
840.8	TOPSOIL.	10.5	10	I	4/3/4	5A 5B	DS	18'
839.3	Brownish gray moist medium stiff SILTY CLAY (sediment)	12.0		I	2/2/2	6	DS	18'
836.3	Dark gray moist soft SILTY CLAY with organic matter and iron oxide stains (sediment). (ML)	15.0 17.0	15	I	2/1/2	7	DS	18'
834.3	Brown, trace gray moist soft SILTY CLAY.			I	4/5/6	8	DS	18'
831.8	Brown, trace gray moist stiff SILTY CLAY with iron oxide stains and concretions and shale fragments.(CL)	19.5 21.5	20	I	35/6"	9	DS	5"
829.8	Brown and gray moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).	22.7		L/D	50/2"	10	DS CA	0"
828.6	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).		25					
	Refusal and bottom of test boring at 22.7 feet.							

Datum USGS — Hammer Wt. 140 Lbs. — Hole Diameter 5" — Foreman J.M.
Surf. Elev. 851.3 Ft. — Hammer Drop 30 In. — Rock Core Dia. - — Engineer D.B.T.
Date Started 2/11/80 — Pipe Size O.D.2 In. — Boring Method CFA — Date Completed 2/11/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 14.5 FT.
AT COMPLETION 17.8 FT.
AFTER 24 HRS. 2.3 FT.
BACKFILLED 24 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Aug
DC – Driving Casing
MD – Mud Drilling

CIVIL ENGINEERS

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00228

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 12
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	R
848.6	SURFACE	0.0						
	Mixed brown, trace gray moist medium stiff FILL, silty clay with shale and limestone floaters.	2.5		I	8/5/3"	1	DS	9
846.1	Mixed brown moist stiff FILL, silty clay and shale with limestone floaters.			U		A	PT	15
			5	I	7/8/12	2	DS	16
841.6		7.0						
840.6	Brown moist stiff FILL, clay.	8.0						
		9.5		I	6/8/10	3A 3B	DS	18
839.1	Brown moist very stiff SILTY CLAY with iron oxide stains.		10	I	14/20/6"	4	DS	8
	Brown, trace gray moist stiff CLAY with limestone floaters.	13.5		I	38/6"	5	DS	6
835.1								
832.6	Olive brown moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).	16.0	15	I	50/6"	6	DS	6
		17.5		D	50/2"	7	DS	2
831.1	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).							
	Gray moist tough SHALE and thinly bedded LIMESTONE. Limestone is highly fossiliferous and jointed in 1/4 to 3½ inch beds. 27% shale and 73% limestone. (bedrock).		20			8	RC	60' 60'
821.1								
			25			9	RC	60' 60"
	Bottom of test boring at 27.5 feet.	27.5						

Datum USGS — Hammer Wt. 140 Lbs. — Hole Diameter 5" — Foreman J.M.
Surf. Elev. 848.6 Ft. — Hammer Drop 30 In. — Rock Core Dia. NXM-2" — Engineer D.B.T.
Date Started 2/19/80 — Pipe Size O.D.2 In. — Boring Method CFA — Date Completed 2/19/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION 4.5 FT.
AFTER 24 HRS 5.5 FT.
BACKFILLED 24 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

00229

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LOG OF TEST BORING

CLIENT Commonwealth of Kentucky BORING # 13
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, JOB # 80026
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Ty
847.6	SURFACE	0.0					
	Mixed brown, trace gray moist stiff FILL, silty clay, little shale with limestone floaters.			I	9/6/9	1	DS
				I	4/4/6	2	DS
			5	I	3/4/4	3	DS
835.6		9.5		I	12/8/14	4	DS
	Brown moist very stiff CLAY with iron oxide stains		10	I	10/8/7	5	DS
843.1		13.5		I	6/8/13	6A 6B	DS
	Brown moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).		15	I	11/23/6"	7	DS
838.1		17.0					
835.6	Olive brown moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).	19.5		I	55/6"	8	DS
	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).	20.5	20	D	50/2"	9	DS
834.6							
	Refusal and bottom of test boring at 20.5 feet.		25				

Datum USGS — Hammer Wt. 140 lbs. — Hole Diameter 5" — Foreman J.M.
Surf. Elev. 834.6 ft. — Hammer Drop 30 in. — Rock Core Dia. - — Engineer D.B.T.
Date Started 2/19/80 — Pipe Size O.D.2 in. — Boring Method CFA — Date Completed 2/19/80

SAMPLE CONDITIONS: D – DISINTEGRATED; I – INTACT; U – UNDISTURBED; L – LOST

SAMPLER TYPE: DS – DRIVEN SPLIT SPOON; PT – PRESSED SHELBY TUBE; CA – CONTINUOUS FLIGHT AUGER; RC – ROCK CORE

GROUND WATER DEPTH: FIRST NOTED None FT.; AT COMPLETION Dry FT.; AFTER 24 HRS. 4.5 FT.; BACKFILLED 24 HRS.

BORING METHOD: HSA – Hollow Stem Auger; CFA – Continous Flight Auger; DC – Driving Casing; MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 #, HAMMER FALLING 30"; COUNT MADE AT 6" INTERVAL

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00230

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 14(1/2)
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec
860.3	SURFACE	0.0						
858.3	Mixed brown and grayish brown moist stiff FILL, silty clay, trace organic matter with iron oxide stains.	2.0		I	4/3/3	1	DS	16
				I	3/3/3	2	DS	18
854.8	Mixed brown, dark gray and olive gray moist medium stiff FILL, silty clay, trace organic matter.	5.5	5	I	3/5/8	3A 3B	DS	18
	Mixed brown moist stiff FILL, silty clay with shale, limestone floaters and concrete chunks.			I	10/13/9	4	DS	14
848.3		12.0	10	I	6/8/14	5	DS	16
845.8	Brown, trace gray moist stiff CLAY with limestone floaters.	14.5		I	6/12/16	6	DS	10
840.8	Brown, trace gray moist very soft highly weathered SHALE and thinly bedded LIMESTONE (bedrock).		15	I	26/35/6"	7	DS	10"
836.8	Olive brown with seams of gray moist soft weathered SAHLE and thinly bedded LIMESTONE (bedrock).	19.5		I	15/3/6"	8	DS	3"
835.3	Gray moist soft to moderately tough SHALE and thinly bedded LIMESTONE (bedrock).		20	I	19/28/3"	9	DS	6"
	Gray moist moderately tough SHALE and thinly bedded LIMESTONE. Limestone is fossiliferous and jointed in 1/4 to 3 inch beds. 50% shale and 50% limestone assuming lost core is shale (bedrock).	23.5		I	25/31/37	10	DS	11"
		25.0	25	L/D		11	DS CA	0"

Datum USGS — Surf. Elev. 860.3 Ft. — Date Started 2/19/80
Hammer Wt. 140 Lbs. — Hammer Drop 30 In. — Pipe Size O.D.2 In.
Hole Diameter 5" — Rock Core Dia. NXM-2" — Boring Method CFA
Foreman J.M. — Engineer D.B.T. — Date Completed 2/19/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 3.5 FT.
AT COMPLETION 1.9 FT.
AFTER ____ HRS. ____ FT.
BACKFILLED * ____ HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 # HAMMER FALLING 30" COUNT MADE AT INTERVALS

CIVIL ENGINEERS

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00231

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 14(2/2)
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan. /Highland Heights, Ky.

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	
	Gray moist moderately tough SHALE and thinly bedded LIMESTONE. Limestone is fossiliferous and jointed in 1/4 to 3 inch beds. 50% shale and 50% limestone assuming lost core is shale (bedrock).		30			12	RC	2' 60'
						13	RC	2'
825.3		35.0	35					
	Bottom of test boring at 35.0 feet.							
	*Covered by dozer							

Datum USGS — Hammer Wt. 140 Lbs. — Hole Diameter 5" — Foreman J.M.
Surf. Elev. 860.3 Ft. — Hammer Drop 30 In. — Rock Core Dia. NXM-2" — Engineer D.B.T.
Date Started 2/19/80 — Pipe Size O.D.2 In. — Boring Method CFA — Date Completed 2/19/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST.

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED 3.5 FT.
AT COMPLETION 1.9 FT.
AFTER ____ HRS. ____ FT.
BACKFILLED * HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Contigous Flight Auger
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 #, HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS

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00232

LOG OF TEST BORING

CLIENT Commonwealth of Kentucky — BORING # 15
PROJECT Geotechnical Exploration, NKU Health & Physical Education Center, — JOB # 80026E
LOCATION OF BORING As shown on boring plan /Highland Heights, Ky

ELEV.	SOIL DESCRIPTION COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS	STRA. DEPTH	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Re
861.8	SURFACE	0.0						
	Mixed brown with gray moist stiff FILL, silty clay and clay with shale, trace gravel and roots.			I	11/6/5	1	DS	14
857.3		4.5		I	4/6/7	2	DS	18
	Mixed brown moist stiff to very stiff FILL, silty clay with shale and limestone floaters.		5	I	15/4"	3	DS	4
				I	5/7/8	4	DS	18
				I	7/3/5	5	DS	10
849.8		12.0	10	I	6/6/8	6	DS	18
846.8	Mixed brown moist very stiff FILL, shale with silty clay and limestone floaters.	15.0		I	5/6/8	7	DS	18'
	Brown moist very stiff FILL, silty clay with shale fragments and limestone floaters.		15	I	5/6/12	8	DS	15'
842.3				I	6/7/10	9	DS	14'
839.8	Brown moist very stiff CLAY with iron oxide stains.	19.5						
	Brown moist very stiff CLAY with iron oxide stains and concretions and shale fragments.	22.0	20	I	5/6/8	10	DS	18"
837.8		24.0		I	8/31/6"	11	DS	10"
835.8	Brown and olive brown moist soft weathered SHALE and thinly bedded LIMESTONE (bedrock).	26.5	25	I	75/6"	12	DS	6"
834.2	Gray moist moderately tough SHALE and thinly bedded LIMESTONE (bedrock).	27.6		D	50/2"	13	DS	2"
	Refusal and bottom of test boring at 27.6 feet.							

Datum USGS — Hammer Wt. 140 Lbs. — Hole Diameter 5" — Foreman J.M.
Surf. Elev. 861.8 Ft. — Hammer Drop 30 In. — Rock Core Dia. - — Engineer D.R.T.
Date Started 2/18/80 — Pipe Size O.D.2 In. — Boring Method CFA — Date Completed 2/18/80

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

GROUND WATER DEPTH
FIRST NOTED None FT.
AT COMPLETION Dry FT.
AFTER 48 HRS. 8.0 FT.
BACKFILLED 48 HRS.

BORING METHOD
HSA – Hollow Stem Augers
CFA – Continous Flight Augers
DC – Driving Casing
MD – Mud Drilling

*STANDARD PENETRATION TEST – DRIVING 2" OD SAMPLER 1' WITH 140 #, HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS

CIVIL ENGINEERS

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FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON COHESIVE SOILS

(Silt, Sand, Gravel and Combinations)

Density

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	-11 to 30 blows/ft.
Dense	-31 to 50 blows/ft.
Very Dense	-51 blows/ft. or more

Relative Proportions

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification

Boulders	–8 inch diameter or more	
Cobbles	–3 to 8 inch diameter	
Gravel	–Coarse	–¾ to 3 inches
	Fine	–3/16 to ¾ inches
Sand	–Coarse	–2mm to 5mm (dia. of pencil lead)
	Medium	–0.45mm to 2mm (dia. of broom straw)
	Fine	–0.075mm to 0.45mm (dia. of human hair)
Silt		–0.005mm to 0.075mm (Cannot see particles)

COHESIVE SOILS

(Clay, Silt and Combinations)

Consistency	Field Indentification	Unconfined Compressive Strength (tons/sq. ft.)
Very soft	Easily penetrated several inches by fist	Less than 0.25
Soft	Easily penetrated several inches by thumb	0.25 – 0.5
Medium	Can be penetrated several inches by thumb with moderate effort	0.5 – 1.0
Stiff	Readily indented by thumb but penetrated only with great effort	1.0 – 2.0
Very Stiff	Readily indented by thumbnail	2.0 – 4.0
Hard	Indented with difficulty by thumbnail	Over 4.0

Classification on logs are made by visual inspection.

Standard Penetration Test—Driving a 2.0" O. D., 1⅜" I. D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary for GJT to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6.0 inches of penetration on the drill log (Example—6/8/9). The standard penetration test results can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). Refusal is defined as greater than 50 blows for 6 inches or less penetration.

Strata Changes—In the column "Soil Descriptions" on the drill log the horizontal lines represent strata changes. A solid line (———) represents an actually observed change, a dashed line (— — —) represents an estimated change.

Ground Water observations were made at the times indicated. Porosity of soil strata, weather conditions,