

56-F-202C

HWY # 401 &

C.N.R.

ELIZABETHTOWN

BA-560

RACEY, MACCALLUM AND ASSOCIATES

LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
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H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

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HEAD OFFICE
AND
MONTREAL DIVISION
5890 MONKLAND AVENUE

Report No. S 500-505/M 457/1

November 29, 1956.

Department of Highways of Ontario,
c/o C.C. Parker and Associates Limited,
795 Main Street West,
Hamilton, Ont.

Attention: Mr. D.C. Cramer

Re: Foundation Investigation
Proposed Elizabethtown Twp. Bridge No. 8,
near Brockville, Ontario

Dear Sirs:

We have completed the required foundation investigation for the proposed above-mentioned bridge at a crossing of the future highway No. 401 and the C.N.R. railway line west of Brockville, Ont.

Our findings are laid down in the attached report, which we are pleased to submit.

For your convenience, the essentials contained in our report are summarized as follows:

The bridge site being located with its south-east side on the toe of outcropping granite rock, the surface of which dips towards the west, foundations for piers and abutments will have to rest on rock for the western sections of the supporting structures.

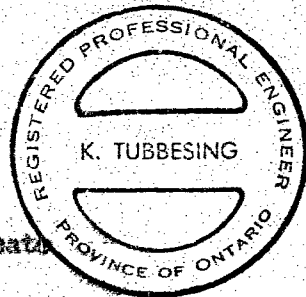
Increasing thickness of clay overburden up to 25 feet towards the west, corresponding to the growing depth to the bedrock, will prohibit the placing of footings on rock for the western sections of the supporting structures. However, it is felt advisable to resort to pile foundations where direct placing of the foundations on rock becomes uneconomical. Foundations partly on clay and partly on rock are not suggest-

Report No. S 500-505/M 457/1

ed in order to avoid the tendency to differential settlement with corresponding stresses in the individual structures.

A block diagram on Enclosure No. 2 of the attached report is prepared in order to present an over-all picture of the subsoil conditions (bedrock indicated by cross symbols).

We trust that the information contained in the report meets your requirements and hope that you will call on us if amplification on any item is felt desirable.



KT:AM.
In Quadruplicate
Att.

Yours very truly,

K. Tubbesing

Karl Tubbesing, P. Eng.,
Divisional Soils Engineer,
RACEY, MACCALLUM AND ASSOCIATES LIMITED

Department of Highways of Ontario,
c/o C.C. Parker and Associates Limited,
795 Main Street West,
Hamilton, Ont.

FOUNDATION INVESTIGATION

PROPOSED ELIZABETHTOWN TWP. BRIDGE NO. 8

near

BRIDGEVILLE, ONTARIO

November 29, 1956

Racey, MacCallum and Associates Limited

Report No. S 500-505/M 457/A

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TORONTO  VANCOUVER
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HEAD OFFICE
AND
MONTREAL DIVISION
5890 MONKLAND AVENUE

Report No. S 500-505/M 457/1

SUBSOIL INVESTIGATION PROPOSED ELIZABETHTOWN TOWNSHIP BRIDGE NO. 8 (HWY. NO. 401 CROSSING CNR TRACKS)

This report covers the results of a subsoil investigation for the proposed above-mentioned bridge.

Description of the Site

The site is located approximately 2 miles west-south-west of the town of Brockville, Ontario, several hundred feet west of the intersection of the country road to the village of Lyn and the C.N.R. tracks (see Enclosure No. 1, above).

The bridge site is located partly at the toe of granitic rock outcrops in the south-east but generally in a fairly level depression zone. The ground surface elevations range from El. 297 to 302.1.

The investigation comprised essentially the drilling, digging or sounding of 13 test holes. The general layout is presented on Enclosure No. 1, below.

The Field Work

Work in the field was carried out from September 28 to October 23, 1956, with two weeks of interruption due to illness of personnel. Standard core drilling equipment was employed; sampling was carried out with the 2-inch diameter split spoon and 2-inch diameter thin-walled tube samplers. The work was permanently supervised by a field engineer.

The elevations of the test holes were determined by levelling

Report No. S 500-505/M 157/1

2.

The Field Work (Cont'd)

referring to the given elevation of the top of the rails at the intersection of the center lines of the railway tracks and the proposed highway.

Description of the Subsoil

The location of this site at the toe of outcropping granitic rock results in the occurrence of a westward sloping bedrock surface which shows bedrock practically at the ground surface in the east (test holes Nos. 5 and 6), while the greatest depths were encountered in the west, with a maximum depth-to-bedrock of 25 feet in test hole No. 11. The elevations of the ground and bedrock surface are entered in the layout sketch, on Enclosure No. 1, below.

Contrary to the granitic outcrops at the surface, bedrock, as recovered with 90% to 100% of the core drilled in boreholes Nos. 1, 11 and 12, is composed of a variety of rock types. These obviously represent a faulty zone which, after being faulted and cracked at various geological times, was later well cemented and now is considered to form a solid mass consisting of metamorphically changed red solid clay shale, argillaceous dolomitic limestone, quartz veins and other mineral components which, conceivably, were preserved or formed in a geological "Graben".

The overburden, consisting of clay soil, increases in thickness as the bedrock dips down in a westward direction. Desiccation has caused stiff and medium consistency of the surface near clay. The clay exhibits variation in composition ranging from gravelly clay and silty clay to clay of high plasticity. Clayey silt and gravel, sometimes embedded in silty clay, were met overlying the bedrock in places.

Individual subsoil profiles, as far as disclosed by the drilling and sampling method, are shown on the attached Engineering Data Sheets (Enclosures Nos. 3 to 8). Several laboratory tests served to classify and appraise the properties of the clay.

An attempt was made to present the subsoil conditions (using the same symbols and vertical scale as employed on the Engineering Data Sheets) with greater clearness on Enclosure No. 2, which shows a perspective non-distorted block-diagram with the subsoil sections drawn along the center lines of the anticipated bridge piers and abutments. The figures entered beside the profiles give the elevation of bedrock (cross symbols).

Report No. S 500-505/M 457/1

Conclusions and Recommendations

The presence of bedrock in places near the ground surface necessitates that the foundations of piers and abutments in the easterly part of the bridge site be placed on the surface of the bedrock. Economical considerations will govern the westward extension of direct founding on rock as the depth to rock increases towards the west. The elevations of the bedrock surface are entered in the layout sketch (Enclosure No. 1, below) and in the block-diagram (Enclosure No. 2).

Rock outcrops are evident only 2 feet south of test hole No. 5 where the elevation of the rock surface is El. 302. From here to the east, the railway tracks are located in a rock cut. The rocky hill extends and rises considerably towards the south across the road adjacent and parallel to the railway line.

Some soundings by hand with rods were performed beside the test holes indicated in order to obtain some data on the slope of the rock surface perpendicular to the center line of the piers. The following data were obtained:

Two feet closer to the rails from test hole No. 6, the rock surface dips 1.5 feet, possibly due to irregularities of the shape of the cut blasted into the rock. At test hole No. 3 (bedrock surface El. 292.5), the bedrock surface dips northward by about 1 in 6 as estimated from hand soundings with rods on either side of point No. 3. A hand sounding with rods near test hole No. 4 penetrated to more than 10 feet, while the test pit dug at this location revealed bedrock at only 4.5 foot depth. This appears to indicate the occurrence of cracks in the rock, possibly from the blasting of the rock cut. Whether grouting of such conceivable cracks is advisable may be decided after the completion of the foundation excavation.

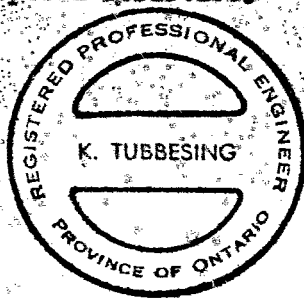
We believe that the foundation of a bridge-supporting structure, placed partly on rock and partly on clay overburden of which the maximal thickness grows to 25 feet (test hole No. 11), is not recommendable due to the variation in composition, thickness and consistency of the clay soil strata. The tendency to differential settlement between the sections over rock and over clay and corresponding stresses within the structures are unavoidable.

It is, therefore, suggested that the structures be supported by piles where the depth to rock makes direct founding on rock uneconomical.

Report No. S 500-505/M 457/1

Conclusions and Recommendations (Cont'd)

The type of piles to be chosen is a structural consideration solely, as the bearing capacity of the type of bedrock is practically unlimited for the proposed structure.

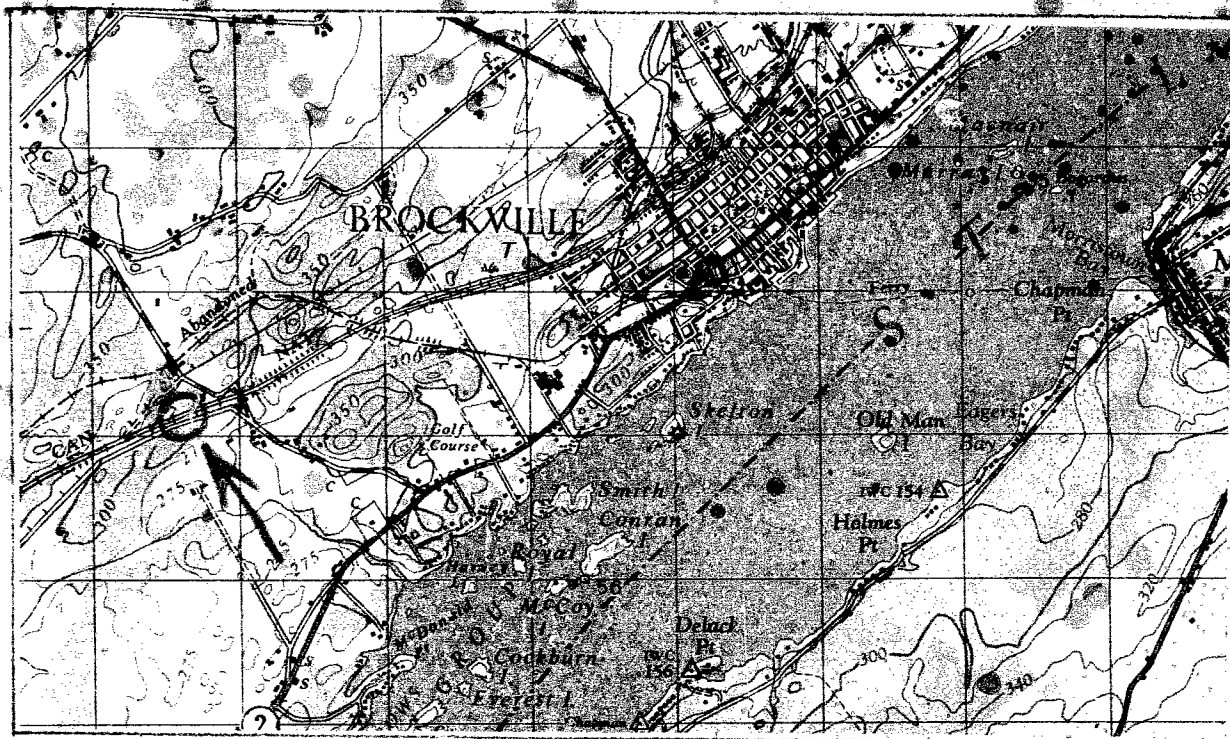


KT:AEW.

K. Tubbesing

Karl Tubbesing, P. Eng.,
Divisional Soils Engineer,
RACEY, MACCALLUM AND ASSOCIATES LIMITED

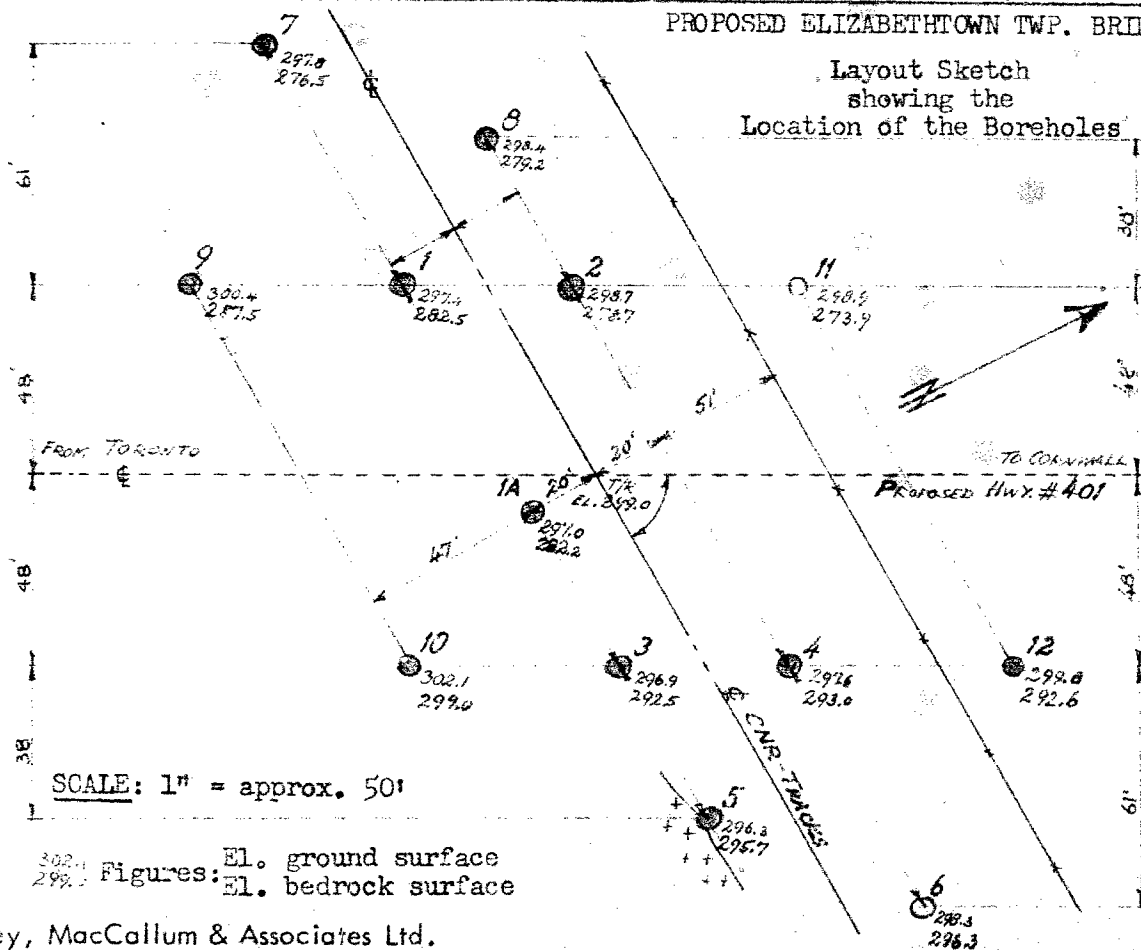
Prep. By E.T.



Topographical Map Section
showing the
Location of the Proposed Bridge Site

PROPOSED ELIZABETHTOWN TWP. BRIDGE #8

Layout Sketch
showing the
Location of the Boreholes



PROPOSED ELIZABETHTOWN TWP. BRIDGE #8

PROPOSED ELIZABETHTOWN TWP. BRD

Layout Sketch
showing the
Location of the Boreholes.

FROM TOWN TO

Proposed Hwy. #401

CNR TRACES

SCALE: 1" = approx. 50'

Figures: El. ground surface
El. bedrock surface

MacCallum & Associates Ltd.

Racey, MacCallum & Associates Ltd.

Block Diagram
showing
Subsoil Sections Along Centre Lines
of Piers and Abutments

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Foundation Engineering Division

Engineering Data Sheet for Borehole: No. 1

Project: Proposed CNR Overhead Elizabethtown Twp. Bridge #8 Field Supervisor: E. Butts
 Location: As shown on Enclosure No. 1, above Driller: E. Bovay
 Hole Location As shown on Enclosure No. 1, below Prep.: D. Bishop, K.T.
 Hole Elevation and Datum: 297.4 (T/R El. 298.98) Checked: K. Tubbesing
 Field Work Begun October 15, 1956 Ended October 15, 1956

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Casing

Casing

Strength

Unconfined compression (Q_u)

Vane test (C) and sensitivity (S)

Consistency

Natural moisture and



Liquidity Index (LI)

Liquid limit

Plastic limit



| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | | | |
|--------|--|---------------|---------------|-------------------------------------|-----|-----|-----|-----|-----------|
| | | | | Q_u | 1.0 | 1.5 | 2.0 | 2.5 | PSF |
| | | | | | | | | | BLOWS/FT. |
| | | 297.4 | 0 | | 20 | 40 | 60 | 80 | 100 |
| | silty clay, light brown | | 5 | | | | | | |
| | clay of high plasticity, grey, slightly calcareous | | 10 | | | | | | |
| 14.9 | refusal on apparent bedrock | 282.5 | 15 | | | | | | |
| | | | 20 | | | | | | |
| | | | 25 | | | | | | |
| | | | 30 | | | | | | |

| CONSISTENCY | | | | | SAMPLE | NATURAL UNIT WT P.C.F. |
|---|----|----|----|----|--------|------------------------------|
| MOISTURE CONTENT | | | | | | |
| 10 | 20 | 30 | 40 | 50 | % | |
|  | | | | | | 1 |
|  | | | | | | 2 |
| | | | | | | 116 |

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Foundation Engineering Division

Engineering Data Sheet for Borehole: No. 2

Project: Proposed CNR Overhead Elizabethtown Twp. Bridge #8 Field Supervision: P. Arsenault

Location: As shown on Enclosure No. 1, above

Driller: E. Povay

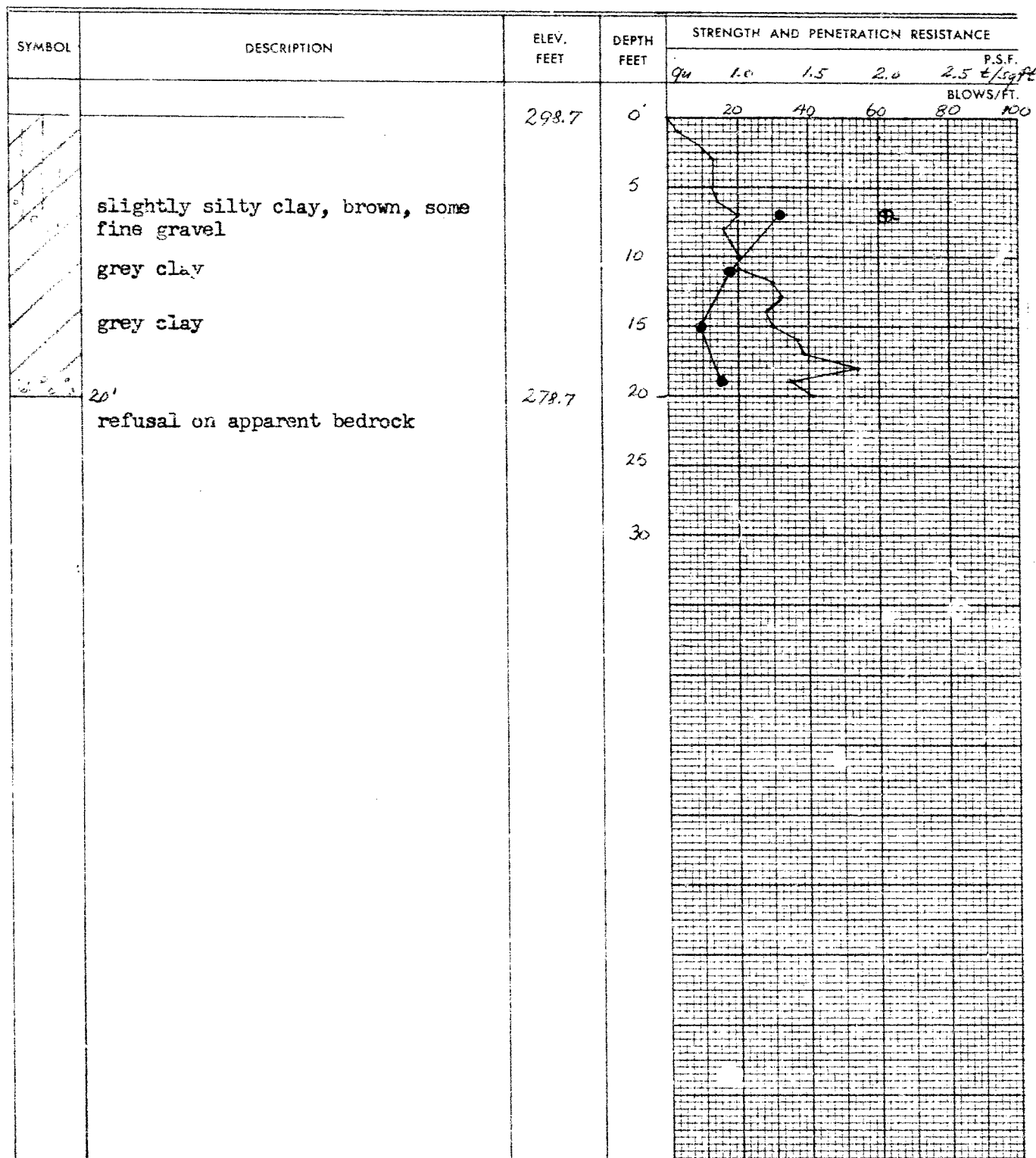
Hole Location As shown on Enclosure No. 1, below

Prep.: D. Bishop, K.T.

Hole Elevation and Datum: 298.7 (T/R El. 298.98)

Checked: K. Tubbesing

Field Work Begun September 29, 1956 Ended Sept. 30, 1956 Date:

**LEGEND****Sampling Method**

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube Shelby Tube

Dia. Cone

Casing

StrengthUnconfined compression (q_u)

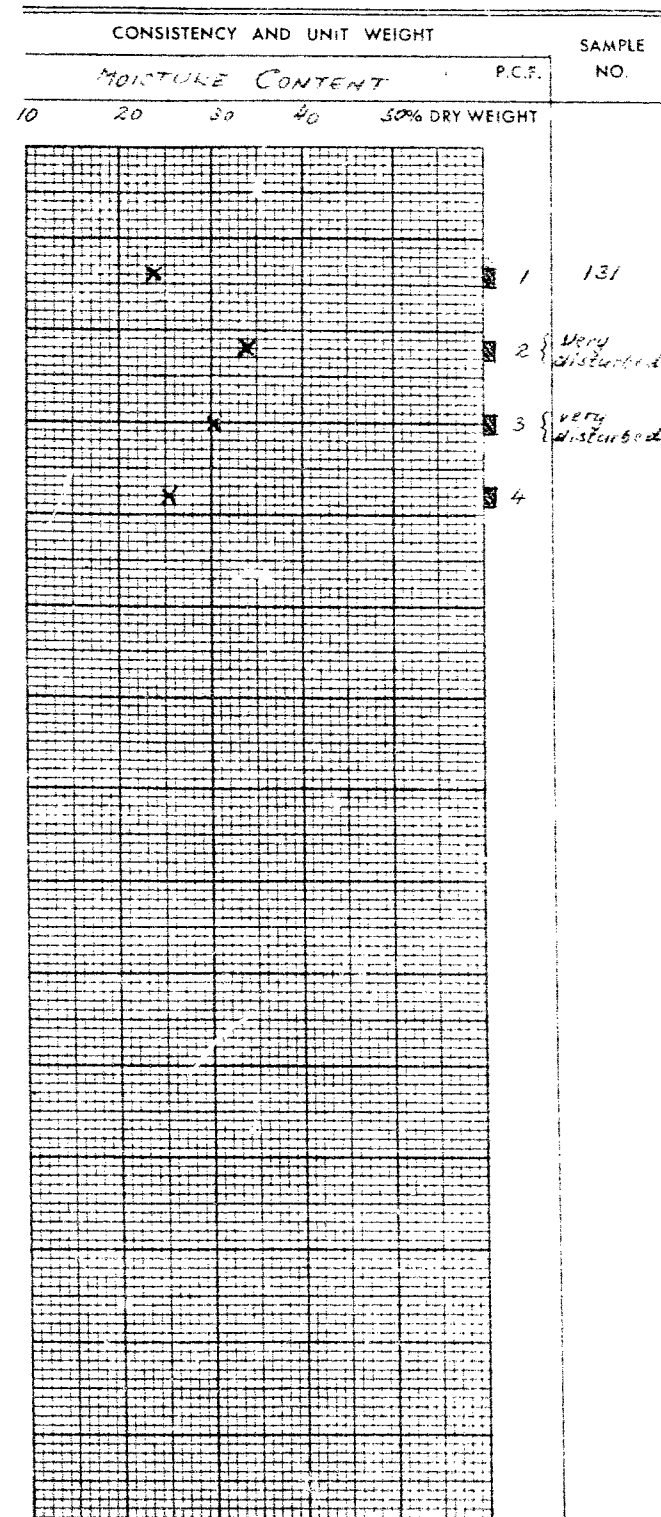
None test and consistency

Consistency

Natural moisture

Liquid limit

Plastic limit

Natural Unit Weight

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Foundation Engineering Division

Engineering Data Sheet for Borehole: No. 7

Project: Proposed CNR Overhead Elizabethtown Twp. Bridge #8 Field Supervisor: E. Butts
Location: As shown on Enclosure No. 1, above Driller: E. Bovay
Hole Location As shown on Enclosure No. 1, below Prep.: D. Bishop, K.T.
Hole Elevation and Datum: 297.8 (T/R El. 298.98) Checked: K. Tubbesing
Field Work Begun October 17, 1956 Ended October 17, 1956

Field Supervisor: E. Butts

Driller: E. Bovay

Prep.: D. Bishop, K.T.

Checked: K. Tubbesing

Ended October 17, 1956

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2-510-6772

Casing

Strength

Unconfined compression (Q_u)

Vane test (C) and sensitivity (S)

Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic lining



| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | | | |
|--------|---------------------------------|---------------|---------------|-------------------------------------|-----|-----|-----|-----|---------------------|
| | | | | Qu | 1.0 | 1.5 | 2.0 | 2.5 | P.S.F. BLOWS/FT. |
| | | 297.8 | 0 | | | | | | |
| | brown clay of medium plasticity | | 5 | | | | | | |
| | grey clay, slightly calcareous | | 10 | | | | | | |
| | grey clay, slightly calcareous | | 15 | | | | | | |
| | gravel | 276.5 | 20 | | | | | | |
| | 27.3 | | 25 | | | | | | |
| | bedrock 90% recovery | | 30 | | | | | | |

[illegible]

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Foundation Engineering Division

Engineering Data Sheet for Borehole: No. 8

Project: Proposed CNR Overhead Elizabethtown Twp. Bridge #8
 Location: As shown on Enclosure No. 1, above
 Hole Location As shown on Enclosure No. 1, below
 Hole Elevation and Datum: 298.4 (T/R El. 298.98)
 Field Work Begun September 28, 1956 Ended Sept. 28, 1956

Field Supervisor: P. Arsenault

Driller: E. Bovay

Prep.: D. Bishop, K.T.

Checked: K. Tubbesing

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

~~2" Dia. Cone~~

Casing

Strength

Unconfined compression (Q_u)Vane test (C_v and sensitivity (S))

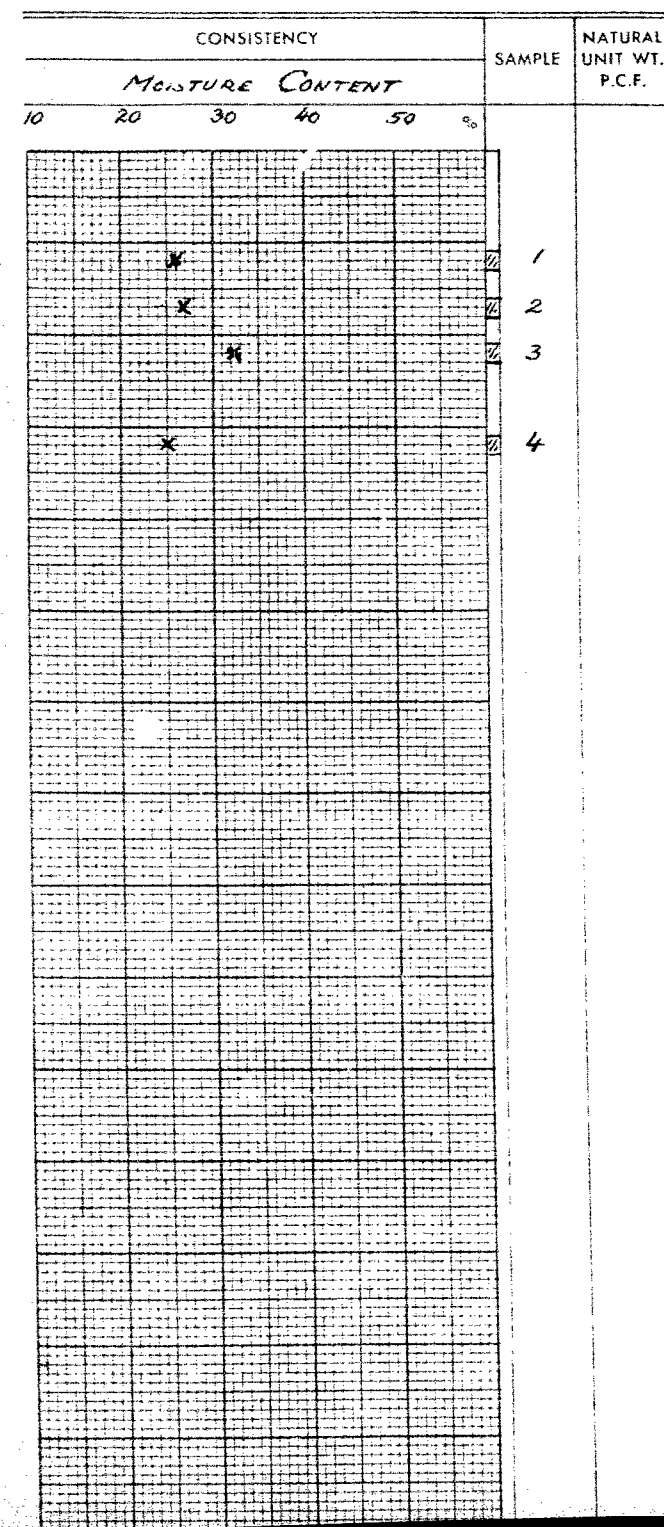
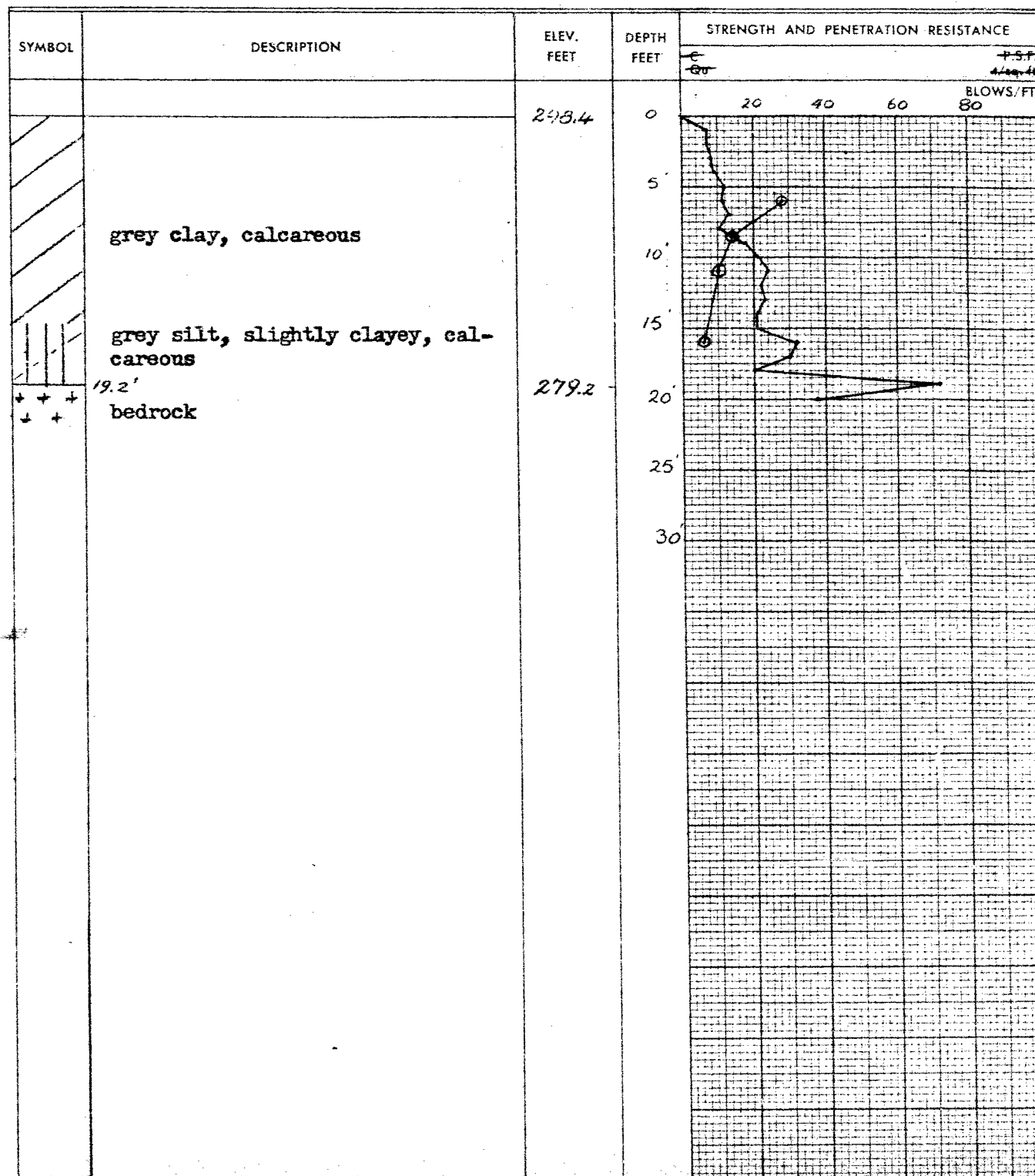
Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic limit



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Foundation Engineering Division

Engineering Data Sheet for Borehole: No. 11

Project: Proposed CNR Overhead Elizabethtown Twp. Bridge #8 Field Supervisor: E. Butts

Location: As shown on Enclosure No. 1, above Driller: E. Bovay

Hole Location As shown on Enclosure No. 1, below Prep.: D. Bishop, K.T.

Hole Elevation and Datum: 298.9 (T/R El. 298.98) Checked: K. Tubbesing

Field Work Begun October 20, 1956 Ended October 20, 1956

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

~~2" Dia. Cone~~

Casing

Strength

Unconfined compression (Qu)

Vane test (C) and sensitivity (S)

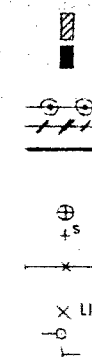
Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic limit



| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | | | | | |
|--------|---|---------------|---------------|-------------------------------------|-----|-----|-----|-----|----------------------------------|
| | | | | Qu | 1.0 | 1.5 | 2.0 | 2.5 | P.S.T. 1/sq. ft. BLOWS/FT. |
| | | 298.9 | 0 | | 20 | 40 | 60 | 80 | 160 |
| | brown clay with some fine gravel | | 5 | | | | | | |
| | brown clay with some fine gravel | | 10 | | | | | | |
| | grey silt with thin clayey interbeds | | 15 | | | | | | |
| | graded gravel embedded in grey silty clay | | 20 | | | | | | |
| | 25% Bedrock | 273.9 | 25 | | | | | | |
| | 100% recovery | | 30 | | | | | | |

| CONSISTENCY | | | | | | SAMPLE | NATURAL UNIT WT. P.C.F. |
|------------------|----|----|----|----|---|--------|-------------------------------|
| MOISTURE CONTENT | | | | | | | |
| 10 | 20 | 30 | 40 | 50 | % | | |
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Foundation Engineering Division

Engineering Data Sheet for Borehole: No. 12

Project: Proposed CNR Overhead Elizabethtown Twp. Bridge #8 Field Supervisor: E. Butts

Location: As shown on Enclosure No. 1, above Driller: E. Bovay

Hole Location As shown on Enclosure No. 1, below Prep.: D. Bishop, K.T.

Hole Elevation and Datum: 299.8 (T/R El. 298.98) Checked: K. Tubbesing

Field Work Begun October 12, 1956 Ended October 12, 1956

LEGEND

Sampling Method

2" Dia. split tube

2" Shelby tube

Penetration Resistance

2" Split tube

2" Dia. Cone

Casing

Strength

Unconfined compression (Qu)

Vane test (C) and sensitivity (S)

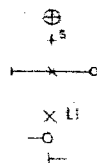
Consistency

Natural moisture and

Liquidity Index (LI)

Liquid limit

Plastic limit



| SYMBOL | DESCRIPTION | ELEV. FEET | DEPTH FEET | STRENGTH AND PENETRATION RESISTANCE | |
|--------|--|---------------|---------------|-------------------------------------|---------------------|
| | | | | C Qu | P.S.F. t/sq. ft. |
| | brownish silty clay with fine to medium gravel | 299.8 | 0 | | |
| | | 292.3 | 7.5 | | |
| | Bedrock | | 10 | | |
| | 100% recovery | | | | |

| CONSISTENCY | SAMPLE | NATURAL UNIT WT. P.C.F. |
|-------------|--------|-------------------------------|
| | 1 | |
| | 2 | |