

## ภาคผนวก 1-3

หนังสือแจ้งผลการพิจารณาการขอเปลี่ยนแปลง  
รายละเอียดโครงการในรายงานการประเมินผลกระทบสิ่งแวดล้อม  
โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรม  
ภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ 1)

ปธ. รับที่ 490 วันที่ 13 ธ.ค. 64

บริษัท ปตท. จำกัด (มหาชน)  
เลขรับที่ 1406  
วันที่ 21 / 12 / 64  
เวลา 17.17 น.



ที่ ทส ๑๐๑๐.๗/ ๘ ๔ ๗ ๕

สำนักงานนโยบายและแผน วันที่ 21 / 12 / 64  
สนย.รับที่ 2426 เวลา 15:21 น.  
สว.รับที่ 1406

ทรัพยากรธรรมชาติและสิ่งแวดล้อม  
๑๑๘/๑ อาคารทิปโก้ ๒ ถนนพระรามที่ ๖  
แขวงพญาไท เขตพญาไท กรุงเทพฯ ๑๐๕๐๐

๑๕ มิถุนายน ๒๕๖๔

เรื่อง แจ้งผลการพิจารณาการขอเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม  
โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ ๑)  
ของบริษัท ปตท. จำกัด (มหาชน)

เรียน กรรมการผู้จัดการใหญ่บริษัท ปตท. จำกัด (มหาชน)

สิ่งที่ส่งมาด้วย สำเนาหนังสือสำนักงานคณะกรรมการกำกับกิจการพลังงาน ที่ สกพ ๕๕๐๒/๔๘๒๙  
ลงวันที่ ๖ พฤษภาคม ๒๕๖๔

ด้วย สำนักงานคณะกรรมการกำกับกิจการพลังงาน (สำนักงาน กกพ.) ได้แจ้งสำนักงานนโยบาย  
และแผนทรัพยากรธรรมชาติและสิ่งแวดล้อม ว่าบริษัท ปตท. จำกัด (มหาชน) ได้แจ้งความประสงค์ขอ  
เปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม (รายงาน EIA) โครงการท่อส่ง  
ก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ ๑) ในประเด็นการ  
เปลี่ยนแปลง ดังนี้ (๑) การเปลี่ยนแปลงแนววางท่อในเขตทางหลวงหมายเลข ๓๓๑ ตอนแปลงยาว-เขาหินซ้อน  
ด้านซ้ายทางของถนนไปยังนิคมอุตสาหกรรมเกตเวย์ ซิตี้ โดยให้ปรับจุดศูนย์กลางแนววางท่อส่งก๊าซธรรมชาติ  
อยู่ที่ระยะ ๕ เมตร จากเขตทางหลวง และ (๒) ปรับตำแหน่งบ่อรับ/บ่อส่ง ช่วงวางท่อส่งก๊าซธรรมชาติ ตลอด  
ถนนทางหลวงหมายเลข ๓๓๑ บริเวณกิโลเมตรที่ ๐+๐๕๘ และ ๐+๑๓๓ ทั้งนี้ คณะกรรมการกำกับกิจการ  
พลังงาน (กกพ.) ในการประชุมครั้งที่ ๑๓/๒๕๖๔ (ครั้งที่ ๗๒๒) เมื่อวันที่ ๒๔ มีนาคม ๒๕๖๔ มีความเห็นว่  
การเปลี่ยนแปลงรายละเอียดโครงการดังกล่าวเป็นการเปลี่ยนแปลงที่ไม่กระทบต่อการประเมินผลกระทบ  
สิ่งแวดล้อมในรายงาน EIA ที่ได้รับความเห็นชอบไว้แล้ว สำนักงาน กกพ. จึงขอส่งเรื่องการขอเปลี่ยนแปลง  
ดังกล่าวให้สำนักงานนโยบายฯ เพื่อเสนอคณะกรรมการผู้ชำนาญการพิจารณารายงานการวิเคราะห์ผลกระทบ  
สิ่งแวดล้อมเพื่อทราบต่อไป รายละเอียดตามสิ่งที่ส่งมาด้วย

สำนักงานนโยบายและแผนทรัพยากรธรรมชาติและสิ่งแวดล้อม ได้นำเรื่องการขอเปลี่ยนแปลง  
รายละเอียดโครงการดังกล่าว เสนอคณะกรรมการผู้ชำนาญการพิจารณารายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม  
โครงการโรงไฟฟ้าพลังความร้อน ในการประชุมครั้งที่ ๒๒/๒๕๖๔ เมื่อวันที่ ๒๗ พฤษภาคม ๒๕๖๔ ซึ่งคณะ  
กรรมการผู้ชำนาญการฯ มีมติรับทราบ โดยมีข้อสังเกตเกี่ยวกับมาตรการที่เสนอเพิ่มเติมไว้ในระยะก่อสร้าง

เกี่ยวกับ...

เกี่ยวกับการสำรวจชั้นดินและทดสอบ Soil Consolidation เพื่อวิเคราะห์ Pipeline Settlement และ Stress Analysis ของท่อขนาด ๖ นิ้ว และ ๔๒ นิ้ว ตามมาตรฐานของ ASME B31.8 และรับรองโดยวิศวกรตามข้อบังคับสภาวิศวกรว่าด้วยหลักเกณฑ์และคุณสมบัติของผู้ประกอบการของผู้ประกอบวิชาชีพวิศวกรรมควบคุมแต่ละระดับ สาขาวิศวกรรมโยธา และเครื่องกล ปี พ.ศ. ๒๕๕๑ ในการขอเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมโครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ซิตี้ (ครั้งที่ ๑) ของบริษัท ปตท. จำกัด (มหาชน) ตั้งอยู่ที่ตำบลหัวสำโรง อำเภอบางพลี จังหวัดฉะเชิงเทรา ยังไม่ได้มีการระบุไว้เป็นมาตรการของโครงการ จึงขอให้สำนักงานคณะกรรมการกำกับกิจการพลังงาน พิจารณาตรวจสอบมาตรการของโครงการดังกล่าวต่อไป ทั้งนี้ สำนักงานนโยบายฯ ได้มีหนังสือแจ้งสำนักงานคณะกรรมการกำกับกิจการพลังงาน และกรมธุรกิจพลังงาน เพื่อทราบด้วยแล้ว

จึงเรียนมาเพื่อโปรดทราบ

๕) วิชา วิชา/วิชา  
วิชาวิชา วิชาวิชา  
24/6/64

ขอแสดงความนับถือ

รองเลขาธิการ ปฏิบัติราชการแทน

เลขาธิการสำนักงานนโยบายและแผนทรัพยากรธรรมชาติและสิ่งแวดล้อม

๑) เรียน ปตท.

เพื่อโปรดพิจารณา:

วิ.ผจ.สผญ.

21/5/64

กองวิเคราะห์ผลกระทบสิ่งแวดล้อม

โทรศัพท์ ๐ ๒๒๖๕ ๖๕๐๐ ต่อ ๖๘๒๕

โทรสาร ๐ ๒๒๖๕ ๖๖๑๖

ไปรษณีย์อิเล็กทรอนิกส์ sarabun@onep.go.th



สำนักงานนโยบายและแผน  
ทรัพยากรธรรมชาติและสิ่งแวดล้อม  
เลขที่ ๗162 - ๖ พ.ศ. ๒๕๖๔  
เวลา 16.22

ที่ สกพ ๕๕๐๒/๔๔๒๗

สำนักงานคณะกรรมการกำกับกิจการพลังงาน  
๓๑๙ อาคารจัตุรัสจามจุรี ชั้น ๑๙ ถนนพญาไท  
แขวงปทุมวัน เขตปทุมวัน กรุงเทพฯ ๑๐๓๓๐

๖ พฤษภาคม ๒๕๖๔

เรื่อง แจ้งผลการพิจารณาการขอเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม โครงการก่อสร้างท่าเรือขนถ่ายสินค้าไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ ๑) ของบริษัท ปตท. จำกัด (มหาชน)

เรียน เลขาธิการสำนักงานนโยบายและแผนทรัพยากรธรรมชาติและสิ่งแวดล้อม

สิ่งที่ส่งมาด้วย เอกสารการเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมโครงการก่อสร้างท่าเรือขนถ่ายสินค้าไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ ๑) จำนวน ๑๕ ชุด

ด้วยบริษัท ปตท. จำกัด (มหาชน) (บริษัทฯ) ได้แจ้งความประสงค์ขอเปลี่ยนแปลงรายละเอียดโครงการในรายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อม (รายงาน EIA) โครงการก่อสร้างท่าเรือขนถ่ายสินค้าไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ ๑) ต่อสำนักงานคณะกรรมการกำกับกิจการพลังงาน (สำนักงาน กกพ.) ในฐานะหน่วยงานอนุญาตตามพระราชบัญญัติการประกอบกิจการพลังงาน พ.ศ. ๒๕๕๐ ในประเด็นการขอเปลี่ยนแปลงแนววางท่อในเขตทางหลวงหมายเลข ๓๓๑ และปรับตำแหน่งบ่อรับ-บ่อส่ง ช่วงวางท่อส่งก๊าซธรรมชาติ ลอดใต้ถนนทางหลวงหมายเลข ๓๓๑

สำนักงาน กกพ. ในฐานะเลขานุการของคณะกรรมการกำกับกิจการพลังงาน (กกพ.) ขอเรียนว่า กกพ. ในการประชุมครั้งที่ ๑๓/๒๕๖๔ (ครั้งที่ ๗๒๒) เมื่อวันที่ ๒๔ มีนาคม ๒๕๖๔ ได้พิจารณาเรื่องดังกล่าวแล้ว มีมติเห็นชอบการขอเปลี่ยนแปลงรายละเอียดโครงการในรายงาน EIA โครงการก่อสร้างท่าเรือขนถ่ายสินค้าไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ (ครั้งที่ ๑) ดังนี้ (๑) การเปลี่ยนแปลงแนววางท่อในเขตทางหลวงหมายเลข ๓๓๑ ตอนแปลงยาว-เขาหินซ้อน ด้านซ้ายทางของถนน ไปยังนิคมอุตสาหกรรมเกตเวย์ ซิตี้ โดยให้ปรับจุดศูนย์กลางแนววางท่อส่งก๊าซธรรมชาติ อยู่ในระยะ ๕ เมตร จากเขตทางหลวง และ (๒) ปรับตำแหน่งบ่อรับ-บ่อส่ง ช่วงวางท่อส่งก๊าซธรรมชาติ ลอดใต้ถนนทางหลวงหมายเลข ๓๓๑ บริเวณกิโลเมตรที่ ๐+๐๕๘ และ ๐+๑๓๓ โดยเห็นว่าเป็นการเปลี่ยนแปลงที่ไม่กระทบต่อการประเมินผลกระทบสิ่งแวดล้อมในรายงาน EIA ที่ได้รับความเห็นชอบไว้แล้ว ทั้งนี้ สำนักงาน กกพ. ได้แนบเอกสารการขอเปลี่ยนแปลง ดังกล่าวมาพร้อมนี้ (รายละเอียดตามสิ่งที่ส่งมาด้วย) เพื่อที่สำนักงานนโยบายและแผนทรัพยากรธรรมชาติและสิ่งแวดล้อมจะได้ดำเนินการเสนอคณะกรรมการผู้ชำนาญการพิจารณารายงานการวิเคราะห์ผลกระทบสิ่งแวดล้อมเพื่อทราบต่อไป

จึงเรียนมาเพื่อโปรดทราบและดำเนินการในส่วนที่เกี่ยวข้องต่อไปด้วย จะขอบคุณยิ่ง

เอกสารแนบ.....15.....กล่อง,เล่ม  
เอกสารแนบ.....ชุด CD.....แผ่น

ขอแสดงความนับถือ

สำเนาถูกต้อง

ฝ่ายตรวจสอบกิจการพลังงาน  
โทร. ๐ ๒๒๐๗ ๓๕๔๔ ต่อ ๗๘๒  
โทรสาร ๐ ๒๒๐๗ ๓๕๐๖

ผู้ช่วยเลขาธิการ ปฏิบัติการแทน  
เลขาธิการสำนักงานคณะกรรมการกำกับกิจการพลังงาน

เจ้าพนักงานธุรการอาวุโส



ภาคผนวก 1-4  
รายงานผลการสำรวจทางธรณีวิทยา ลักษณะของดิน  
และผลการทดสอบดินจากห้องปฏิบัติการ



# SOIL SURVEY REPORT



PTT GAS PIPELINE FOR GATEWAY CITY INDUSTRIAL ESTATE PROJECT

[Job No. 2113]

HUASAMRONG, PLANGYAO, CHACHOENGSAO, THAILAND

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May 05, 2021

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## Content

	Page
Executive Summary	1
1. Introduction	1
2. Purpose and Scope of Work	3
2.1 Part 1 (Boring Survey)	3
3. Part 1 (Boring Survey)	3
3.1 Boring Survey	3
4. Load capacity of foundation soil	21
4.1 Driven Pile	21
4.1 Bored Pile	27
5. List of References	30
Appendix A (Soil Investigation)	
Appendix B (Soil Classification)	
Appendix C (Laboratory Testing Procedures)	
Appendix D (Boring Logs)	
Appendix E (Summary of Laboratory Tests)	
Appendix F (Pile Design)	
Appendix G (Driven Pile)	
Appendix H (Bored Pile)	
Appendix I (Pictures of Field)	

**Content of Figures**

	Page
Figure 1-1 Location of the investigated area	2
Figure 3-1 Soil Stratigraphy of BH-1	6
Figure 3-2 Soil Stratigraphy of BH-2	7
Figure 3-3 Soil Stratigraphy of BH-3	8
Figure 3-4 Soil Stratigraphy of BH-4	9
Figure 3-5 Soil Stratigraphy of BH-5	10
Figure 3-6 Soil Stratigraphy of BH-6	11
Figure 3-7 Soil Stratigraphy of BH-7	12
Figure 3-8 Soil Stratigraphy of BH-8	14
Figure 3-9 Soil Stratigraphy of BH-9	15
Figure 3-10 Soil Stratigraphy of BH-10	17
Figure 3-11 Summary of Standard Penetration Test for all Boreholes	18
Figure 3-12 Summary of Water Content for all Boreholes	19
Figure 3-13 Summary of Total Unit Weight for all Boreholes	20

**Content of Tables**

	Page
Table 2-1 Quantity of borings and the tests	3
Table 3-1 Borehole Detail	4
Table 3-2 Borehole Co-ordinate (UTM/ WGS84 /Zone 47N)	4
Table 3-3 Soil Stratigraphy of BH-1	5
Table 3-4 Soil Stratigraphy of BH-2	7
Table 3-5 Soil Stratigraphy of BH-3	8
Table 3-6 Soil Stratigraphy of BH-4	9
Table 3-7 Soil Stratigraphy of BH-5	10
Table 3-8 Soil Stratigraphy of BH-6	11
Table 3-9 Soil Stratigraphy of BH-7	12
Table 3-10 Soil Stratigraphy of BH-8	13
Table 3-11 Soil Stratigraphy of BH-9	15
Table 3-12 Soil Stratigraphy of BH-10	16
Table 4-1 Safe load capacity of square concrete hammer pile	21
Table 4-2 Safe load capacity of I section driven pile	24
Table 4-2 Safe load capacity of Circular Bored pile	27

**Executive Summary**

Naovaratt Surveying Co., Ltd. has carried out geotechnical investigation for PTT gas pipeline for gateway city industrial estate project in order to grasp the characteristics of soils along the site and to utilize the results as basic information for foundation design. The survey was conducted at Plaeng Yao District, Chachoengsao Province. The soil investigation commenced on the 4<sup>th</sup> of May 2021 and was completed on the following days.

Boring survey was conducted to inspect the ground characteristics for the utilization of excavated soil properties for foundations design. In order to survey the soil profiles, borehole investigation along with screw driving sounding test was performed up to a depth of 7.95 to 24.00m below ground surface. Basic physical tests were conducted at every 1.50 m intervals of the boring survey.

This geotechnical investigation report contains the presentation of the location of boring, sampling, soil stratification, detailed explanation of geology and soil characteristics, laboratory test results, and report of boring soil.

**1. Introduction**

PTT Thailand assigned Naovaratt Surveying Co., Ltd. to carry out a geotechnical investigation program for the PTT gas pipeline for gateway city industrial estate project. The geotechnical investigation commenced on the 4<sup>th</sup> of May 2020 and was completed on the following days. The details of the investigation are as follows.

Soil boring and the soil investigation drilling was carried out for ten boreholes by wash boring process using drilling machine. The drilling process is then set to commence immediately upon arriving, including checking the water depth. The ten continuous standard penetration test (SPT) borehole was drilled continuously up to rock layers.

The details of the boring process and field tests illustrated on the **Appendix A**. The procedure of soil classification according to the Unified Soil Classification System (USCS) are given in **Appendix B**. The laboratory tests were performed in accordance to ASTM standards. Details on tests procedure for each test are provided in **Appendix C**.



Figure 1-1 Location of the investigated area

## 2. Purpose and Scope of Work

This survey is conducted to grasp the characteristics of soil along the planned “PTT gas pipeline for gateway city industrial estate project” and to utilize the results as basic information for foundations design. The following part of the report elaborates on the boring survey.

### 2.1 Part 1 (Boring Survey)

#### Boring Survey

Borings were conducted at Chachoengsao Province to survey the soil profiles. The depth of boring ranged from 7.95 to 24.00m. The standard penetration tests (SPT) was conducted for this boring. Basic physical tests include water content, unit weight, sieve analysis, and Atterberg's limits were conducted for the soil from selected samples along the depth of boring. The quantity of borings and the tests are summarized in the **Table 2-1**.

The details of boring process are illustrated on the **Appendix A**. The method of soil classification is given in **Appendix B**. Details on laboratory tests procedure for each test are provided in **Appendix C**. The tests were performed in accordance to ASTM standards.

Table 2-1 Quantity of borings and the tests

No.	Laboratory testing	Method	BH-1	BH-2	BH-3	BH-4	BH-5	BH-6	BH-7	BH-8	BH-9	BH-10
1	Soil Boring	ASTM D420, ASTM D1452, ASTM D1586, ASTM D1587	1	1	1	1	1	1	1	1	1	1
2	Standard Penetration Tests (SPT)	ASTM D1586	16	7	10	5	7	7	7	16	7	12
3	Grain Size Distribution by Sieve Analysis	ASTM D422	10	7	4	3	3	5	6	9	7	4
4	Atterberg's Limits	ASTM D4318	8	7	4	3	3	5	6	3	4	4
5	Water Content	ASTM D2216	16	7	7	4	3	5	7	11	7	10

### 3. Part 1 (Boring Survey)

#### 3.1 Boring Survey

Soil borings were conducted at Chachoengsao Province for ten boreholes namely BH-1 to BH-10. They were carried out to take the undisturbed core samples for the laboratory tests. The borehole details are summarized in **Table 3-1**. Actual co-ordinates at each borehole location are summarized and tabulated in **Table 3-2**. A more detailed positioning summary presenting the geodetic parameters used in the system for the each borehole location are presented in **Appendix E** of this report.

**Table 3-1 Borehole Detail**

No.	Borehole	Borehole Detail	Final Penetration (m)
1	BH-1	Continuous SPT and Sampling	24.15
2	BH-2	Continuous SPT and Sampling	10.65
3	BH-3	Continuous SPT and Sampling	15.45
4	BH-4	Continuous SPT and Sampling	7.95
5	BH-5	Continuous SPT and Sampling	10.50
6	BH-6	Continuous SPT and Sampling	10.50
7	BH-7	Continuous SPT and Sampling	10.65
8	BH-8	Continuous SPT and Sampling	24.00
9	BH-9	Continuous SPT and Sampling	10.65
10	BH-10	Continuous SPT and Sampling	18.45

**Table 3-2 Borehole Co-ordinate (UTM/ WGS84 /Zone 47N)**

No.	Borehole	Location	UTM Co-ordinates	
			Easting (m)	Northing (m)
1	BH-1	S.A. Road	750,896.288	1,508,015.120
2	BH-2	S.A. Road	752,193.121	1,507,165.701
3	BH-3	Gate Station	753,225.757	1,506,121.383
4	BH-4	Gate Station	753,265.598	1,506,071.618
5	BH-5	Telephone Exchange Gateway	752,851.656	1,505,489.967
6	BH-6	Gateway City Primary Road	753,357.284	1,505,081.799
7	BH-7	Gateway City Road Soi 7	753,740.757	1,505,354.272
8	BH-8	Gateway City Road Soi 9	754,000.404	1,505,006.507
9	BH-9	Gateway City Road Soi 9	753,799.765	1,504,713.971
10	BH-10	Gateway City Road Soi 10	753,269.569	1,504,079.049

Note: The geodetic parameters used were in reference to:

*Datum: WGS 84 datum / Zone 47N*

*Projection: Universal Transverse Mercator (UTM)*

### 3.1.1 Soil Stratigraphy of BH-1

Generally, the soil profile for BH-1 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 1.50 m from ground surface. **Table 3-3** summarizes the descriptions of soil stratigraphy from BH-1 and the soil profile of BH-1 is shown in **Figure 3-1**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 6.35% to 32.30%.

**Table 3-3 Soil Stratigraphy of BH-1**

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	6.00	- <b>CLAYEY SAND</b> (SC), dense to very dense. - N <sub>SPT</sub> 31 to 50/6" blows/inch, W <sub>n</sub> 6.35 to 13.08%, LL 51.25 to 56.29 %, PL 25.60 to 26.59 %, and PI 25.65 to 29.70 %, γ <sub>t</sub> 2.16 t/m <sup>3</sup>
2	6.00	9.00	- <b>CLAY</b> (CL), very stiff to hard, low plasticity - N <sub>SPT</sub> 29 to 50/6" blows/inch, W <sub>n</sub> 18.93 to 32.30 %, LL 48.36%, PL 26.13%, and PI 22.23%.
3	9.00	16.50	- <b>CLAYEY SAND</b> (SC), very dense - N <sub>SPT</sub> 50 to 50/6" blows/inch, W <sub>n</sub> 12.15 to 18.35%, LL 39.85 to 48.75%, PL 17.44 to 22.09%, and PI 22.41 to 26.98%.
4	16.50	19.50	- <b>CLAY</b> (CL), hard, low plasticity. - N <sub>SPT</sub> 50/6" blows/inch, W <sub>n</sub> 16.95 to 17.22%, LL 42.89%, PL 17.24 %, and PI 25.65%.
5	19.50	24.00	- <b>CLAYEY SAND</b> (SC), very dense - N <sub>SPT</sub> 50/6" to 50/4" blows/inch, W <sub>n</sub> 14.03 to 15.47%, LL 39.85%, PL 20.49 %, and PI 19.36%.
6	24.00	24.15	- <b>ROCK</b> .

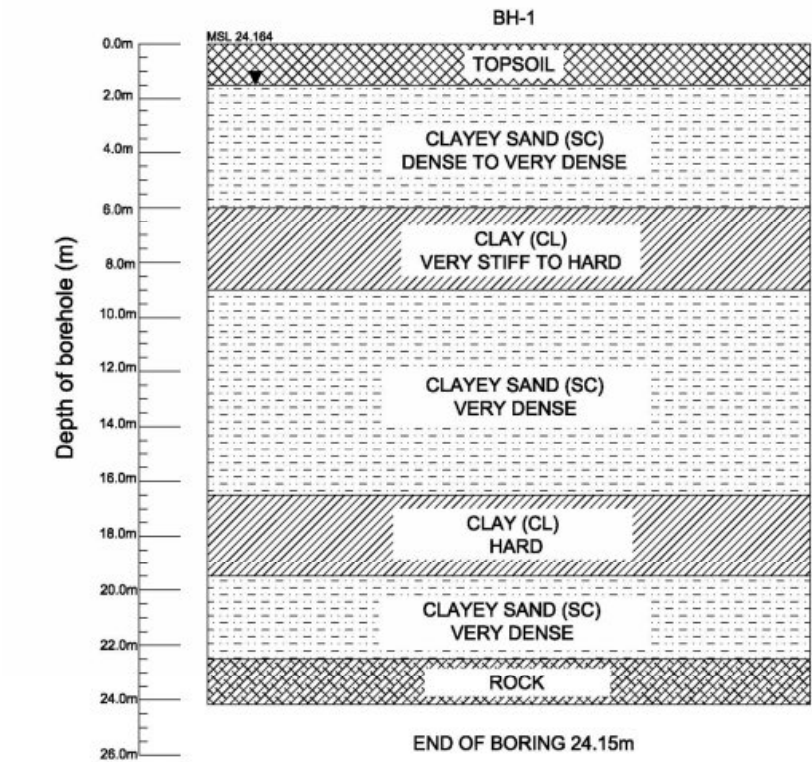


Figure 3-1 Soil Stratigraphy of BH-1

3.1.2 Soil Stratigraphy of BH-2

Generally, the soil profile for BH-2 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 1.20 m from ground surface. **Table 3-4** summarizes the descriptions of soil stratigraphy from BH-2 and the soil profile of BH-2 is shown in **Figure 3-2**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 4.44% to 11.37%.

Table 3-4 Soil Stratigraphy of BH-2

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	3.00	- CLAY (CL), very stiff, low plasticity. - N <sub>SPT</sub> 26 blows/inch, W <sub>n</sub> 4.44%, LL 37.42%, PL 17.57%, and PI 19.85%
2	3.00	4.50	- GRAVEL WITH CLAY (GC), very dense - N <sub>SPT</sub> 85 blows/inch, W <sub>n</sub> 11.37%, LL 31.49%, PL 16.69%, and PI 14.80%
3	4.50	6.00	- CLAY (CL), hard, low plasticity. - N <sub>SPT</sub> 82 blows/inch, W <sub>n</sub> 10.63%, LL 40.25%, PL 21.84%, and PI 18.41%
4	6.00	10.65	- CLAYEY SAND (SC), very dense - N <sub>SPT</sub> 50/6" blows/inch, W <sub>n</sub> 6.74 to 8.93%, LL 37.41 to 47.37%, PL 20.32 to 21.89%, and PI 15.53 to 20.34%.

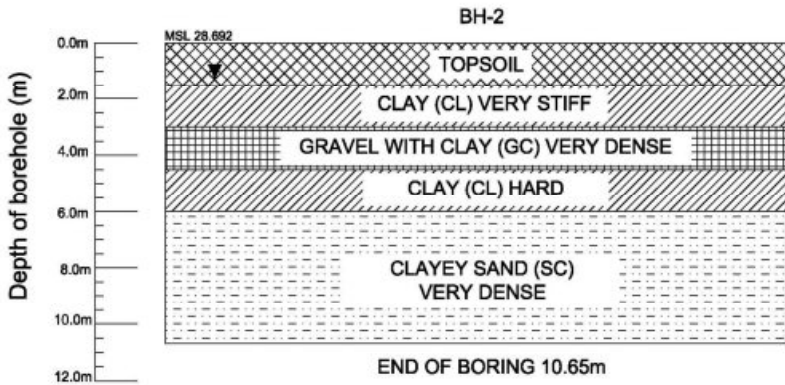


Figure 3-2 Soil Stratigraphy of BH-2

3.1.3 Soil Stratigraphy of BH-3

Generally, the soil profile for BH-3 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 0.30 m from ground surface. **Table 3-5** summarizes the descriptions of soil stratigraphy from BH-3 and the soil profile of BH-3 is shown in **Figure 3-3**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 9.81% to 22.20%.

Table 3-5 Soil Stratigraphy of BH-3

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	4.50	- <b>CLAYEY SAND (SC)</b> , very dense - N <sub>SPT</sub> 47 to 50/4" blows/inch, W <sub>n</sub> 9.81 to 12.04%, LL 25.15%, PL. 18.36%, and PI 6.79%.
2	4.50	10.50	- <b>CLAY (CL)</b> , hard, low plasticity. - N <sub>SPT</sub> 75 to 50/1" blows/inch, W <sub>n</sub> 3.38 to 22.29%, LL 33.71 to 40.02%, PL. 23.45 to 28.74%, and PI 10.26 to 11.28%
3	10.50	12.00	- <b>GRAVEL WITH CLAY (GC)</b> , very dense - N <sub>SPT</sub> 50/1" blows/inch, W <sub>n</sub> 13.65%.
4	12.00	15.45	- <b>ROCK</b>

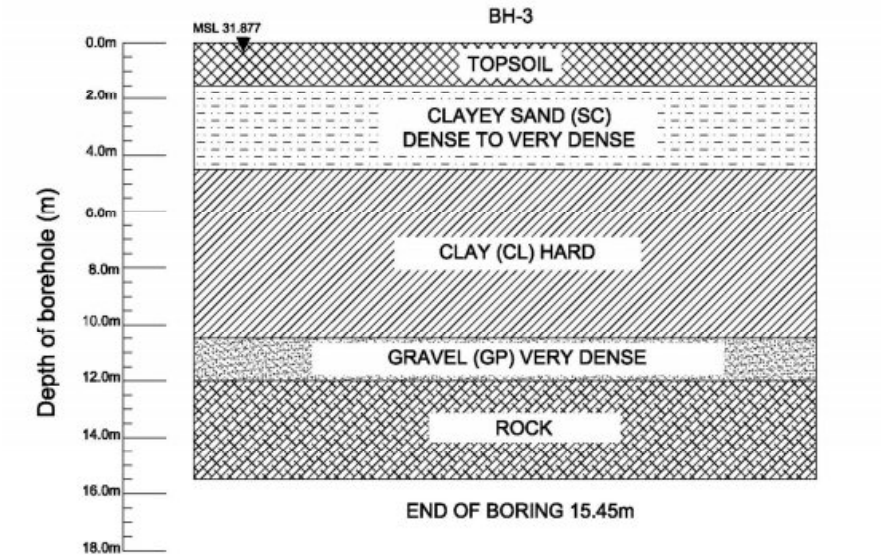


Figure 3-3 Soil Stratigraphy of BH-3

3.1.4 Soil Stratigraphy of BH-4

Generally, the soil profile for BH-4 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 0.30 m from ground surface. **Table 3-6** summarizes the descriptions of soil stratigraphy from BH-4 and the soil profile of BH-4 is shown in **Figure 3-4**.

From the grain size distribution curve, the soil at this location generally clayey sand. Generally the natural water content ranging from 8.64% to 16.57%.

Table 3-6 Soil Stratigraphy of BH-4

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	7.50	- <b>CLAYEY SAND (SC)</b> , dense to very dense - N <sub>SPT</sub> 32 to 50/5" blows/inch, W <sub>n</sub> 8.64 to 16.57%, LL 29.31 to 39.17%, PL. 17.29 to 26.12%, and PI 12.02 to 13.05%.
2	7.50	7.95	- <b>ROCK</b>

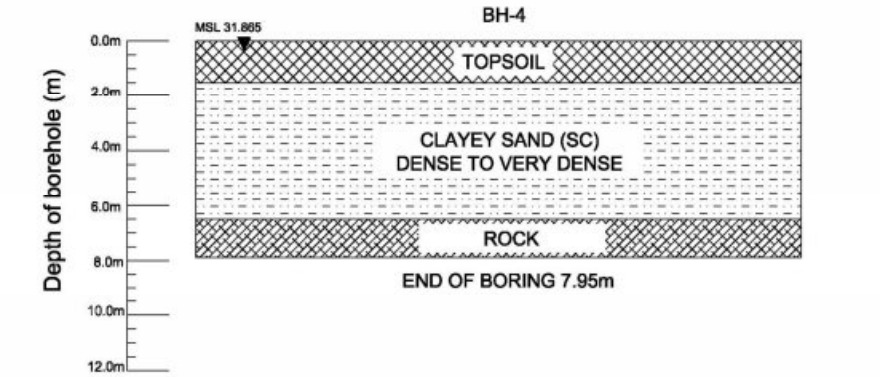


Figure 3-4 Soil Stratigraphy of BH-4

3.1.5 Soil Stratigraphy of BH-5

Generally, the soil profile for BH-5 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 1.00 m from ground surface. **Table 3-7** summarizes the descriptions of soil stratigraphy from BH-5 and the soil profile of BH-5 is shown in **Figure 3-5**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 9.27% to 13.56%.

Table 3-7 Soil Stratigraphy of BH-5

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	4.50	- <b>CLAYEY SAND (SC)</b> , medium dense to dense - N <sub>SPT</sub> 21 to 49 blows/inch, W <sub>n</sub> 9.27 to 13.24%, LL 22.87 to 32.46%, PL 10.87 to 16.29%, and PI 6.58 to 21.59%.
2	4.50	6.00	- <b>CLAY (CL)</b> , hard, low plasticity. - N <sub>SPT</sub> 50/4" blows/inch, W <sub>n</sub> 13.56%, LL 35.42%, PL 19.14%, and PI 16.28%
3	6.00	10.50	- <b>ROCK</b>

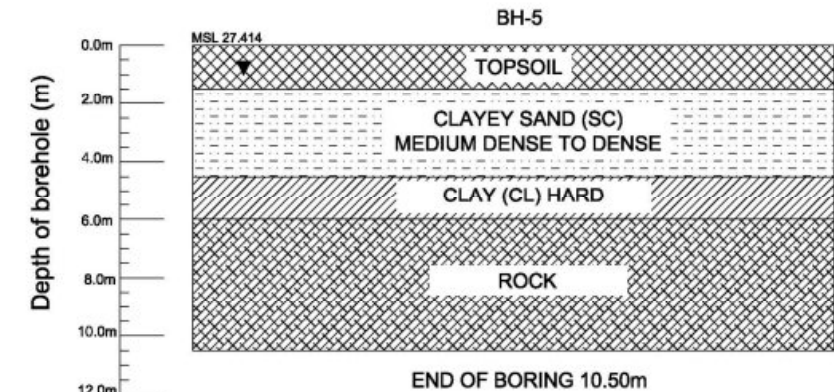


Figure 3-5 Soil Stratigraphy of BH-5

3.1.6 Soil Stratigraphy of BH-6

Generally, the soil profile for BH-6 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 1.00 m from ground surface. **Table 3-8** summarizes the descriptions of soil stratigraphy from BH-6 and the soil profile of BH-6 is shown in **Figure 3-6**.

From the grain size distribution curve, the soil at this location generally clayey sand. Generally the natural water content ranging from 7.74% to 11.71%.

Table 3-8 Soil Stratigraphy of BH-6

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	3.00	- <b>CLAYEY SAND (SC)</b> , loose - N <sub>SPT</sub> 9 blows/inch, W <sub>n</sub> 7.74%, LL 22.63%, PL 14.18%, and PI 8.45%.
2	3.00	9.00	- <b>CLAYEY SAND (SC)</b> , dense to very dense - N <sub>SPT</sub> 39 to 50/6" blows/inch, W <sub>n</sub> 8.01 to 11.71%, LL 25.55 to 41.18%, PL 15.77 to 18.86%, and PI 9.78 to 23.21%, γ <sub>t</sub> 2.13 t/m <sup>3</sup>
3	9.00	10.50	- <b>ROCK</b>

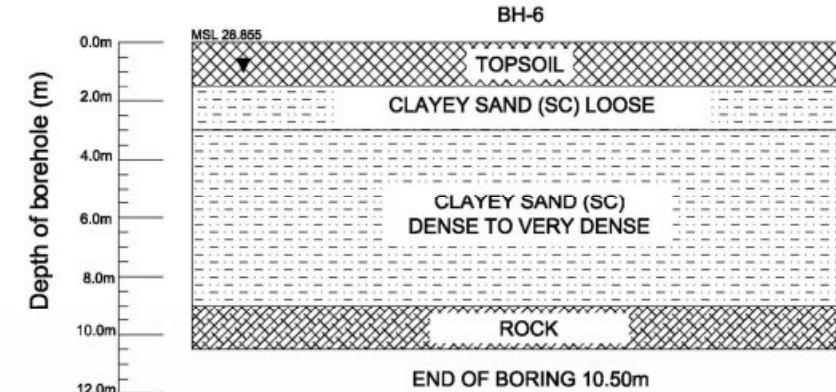


Figure 3-6 Soil Stratigraphy of BH-6

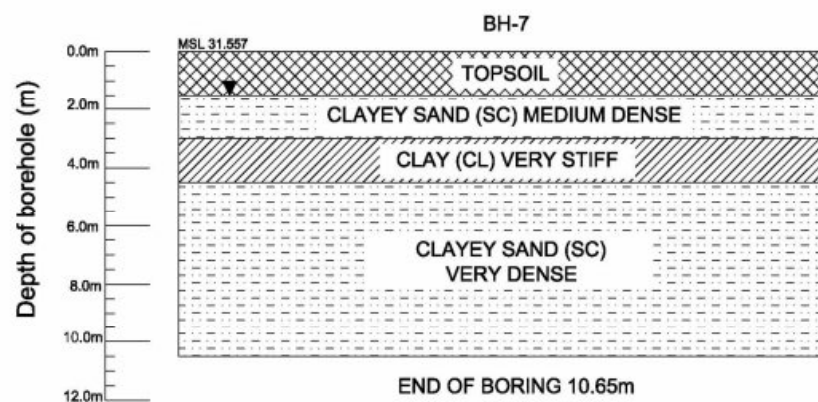
### 3.1.7 Soil Stratigraphy of BH-7

Generally, the soil profile for BH-7 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 1.50 m from ground surface. **Table 3-9** summarizes the descriptions of soil stratigraphy from BH-7 and the soil profile of BH-7 is shown in **Figure 3-7**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 7.84% to 14.30%.

**Table 3-9 Soil Stratigraphy of BH-7**

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	3.00	- <b>CLAYEY SAND (SC)</b> , medium dense - N <sub>SPT</sub> 21 blows/inch, W <sub>n</sub> 7.84%, LL 25.55%, PL. 19.57%, and PI 5.98%.
2	3.00	4.50	- <b>CLAY (CL)</b> , very stiff, low plasticity. - N <sub>SPT</sub> 26 blows/inch, W <sub>n</sub> 14.30%, LL 34.63%, PL. 21.45%, and PI 13.18%, γ <sub>t</sub> 2.15 t/m <sup>3</sup>
3	4.50	10.65	- <b>CLAYEY SAND (SC)</b> , very dense - N <sub>SPT</sub> 85 to 50/6" blows/inch, W <sub>n</sub> 9.09 to 12.30%, LL 27.61 to 36.64%, PL. 12.42 to 24.64%, and PI 12.00 to 22.51%.



**Figure 3-7 Soil Stratigraphy of BH-7**

### 3.1.8 Soil Stratigraphy of BH-8

Generally, the soil profile for BH-8 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 2.50 m from ground surface. **Table 3-10** summarizes the descriptions of soil stratigraphy from BH-8 and the soil profile of BH-8 is shown in **Figure 3-8**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 7.55% to 20.80%.

**Table 3-10 Soil Stratigraphy of BH-8**

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	3.00	- <b>CLAY (CL)</b> , hard, low plasticity. - N <sub>SPT</sub> 40 blows/inch, W <sub>n</sub> 11.25%, LL 40.12%, PL. 22.22%, and PI 17.90%
2	3.00	6.00	- <b>CLAY (CL)</b> , stiff to very stiff, low plasticity. - N <sub>SPT</sub> 11 to 29 blows/inch, W <sub>n</sub> 16.18 to 20.80%, γ <sub>t</sub> 2.00 t/m <sup>3</sup>
3	6.00	15.00	- <b>CLAY (CL)</b> , hard, low plasticity. - N <sub>SPT</sub> 36 to 50/4" blows/inch, W <sub>n</sub> 8.75 to 17.39%, LL 41.71 to 45.48%, PL. 20.19 to 25.11%, and PI 20.37 to 21.52%, γ <sub>t</sub> 2.06 to 2.21 t/m <sup>3</sup>
4	15.00	16.50	- <b>ROCK</b>
5	16.50	18.00	- <b>CLAY (CL)</b> , hard, low plasticity. - N <sub>SPT</sub> 50/4" blows/inch, W <sub>n</sub> 8.43%
6	18.00	21.00	- <b>ROCK</b>
7	21.00	22.50	- <b>CLAYEY SAND (SC)</b> , very dense - N <sub>SPT</sub> 50/2" blows/inch, W <sub>n</sub> 7.55%
8	22.50	24.00	- <b>ROCK</b>

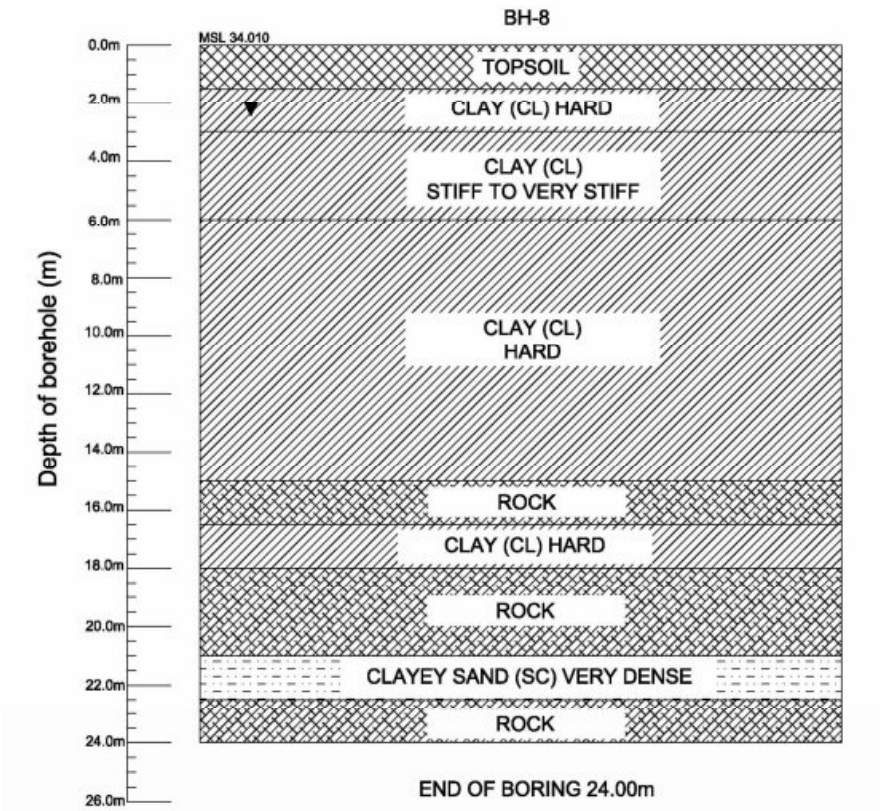


Figure 3-8 Soil Stratigraphy of BH-8

3.1.9 Soil Stratigraphy of BH-9

Generally, the soil profile for BH-9 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 1.50 m from ground surface. **Table 3-11** summarizes the descriptions of soil stratigraphy from BH-9 and the soil profile of BH-9 is shown in **Figure 3-9**.

From the grain size distribution curve, the soil at this location generally Clay. Generally the natural water content ranging from 8.44% to 23.86%.

Table 3-11 Soil Stratigraphy of BH-9

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	10.65	- <b>CLAY (CL)</b> , very stiff to hard, low plasticity. - $N_{SPT}$ 18 to 50/6" blows/inch, $W_n$ 8.44 to 23.86%, LL 36.21 to 48.60%, PL 15.27 to 27.47%, and PI 14.10 to 28.71%

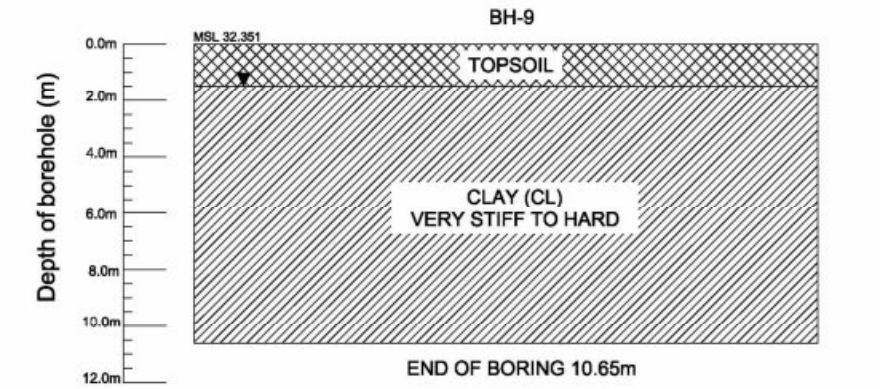


Figure 3-9 Soil Stratigraphy of BH-9

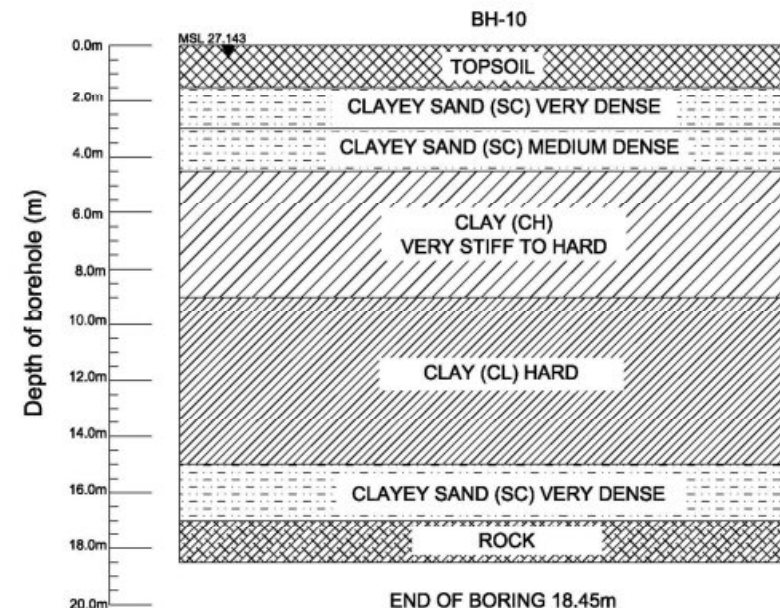
### 3.1.10 Soil Stratigraphy of BH-10

Generally, the soil profile for BH-10 consist of layer of clayey sand and clay with various consistencies. Detailed illustration of the soil profile as presented on the Boring Log and summary of test results of the soil borehole are given in the **Appendix E**. The water table is found at the depth of 0.50 m from ground surface. **Table 3-12** summarizes the descriptions of soil stratigraphy from BH-10 and the soil profile of BH-10 is shown in **Figure 3-10**.

From the grain size distribution curve, the soil at this location generally Clay, and clayey sand. Generally the natural water content ranging from 8.05% to 31.22%.

**Table 3-12 Soil Stratigraphy of BH-10**

Stratum	Depth (m)		Soil Description
	From	To	
1	1.50	3.00	- <b>CLAYEY SAND (SC)</b> , very dense - N <sub>SPT</sub> 71/4" blows/inch, W <sub>n</sub> 9.49%.
2	3.00	4.50	- <b>CLAYEY SAND (SC)</b> , medium dense - N <sub>SPT</sub> 25 blows/inch, W <sub>n</sub> 8.06%.
3	4.50	9.00	- <b>CLAY (CH)</b> , very stiff to hard, high plasticity. - N <sub>SPT</sub> 22 to 46 blows/inch, W <sub>n</sub> 27.07 to 31.22%, LL 65.12%, PL 31.76%, and PI 33.36%
4	9.00	15.00	- <b>CLAY (CL)</b> , hard, low plasticity. - N <sub>SPT</sub> 60 to 74/5" blows/inch, W <sub>n</sub> 10.67 to 21.22%, LL 45.52%, PL 21.58%, and PI 23.94%
5	15.00	17.00	- <b>CLAYEY SAND (SC)</b> , very dense - N <sub>SPT</sub> 50/5" to 50/1" blows/inch, W <sub>n</sub> 10.38%, LL 49.67%, PL 26.59 and PI 23.08%.
6	17.00	18.45	- <b>ROCK</b>



**Figure 3-10 Soil Stratigraphy of BH-10**

### 3.1.13 Standard Penetration Test

Result of Standard Penetration Tests of BH-1 to BH-10 are shown in **Figure 3-11**. The SPT N values of the boring is within a range of 20 to 100 up to the end of boring. Significant increase in the N value is observed at shallow depths of all boreholes with the exception of BH-5.

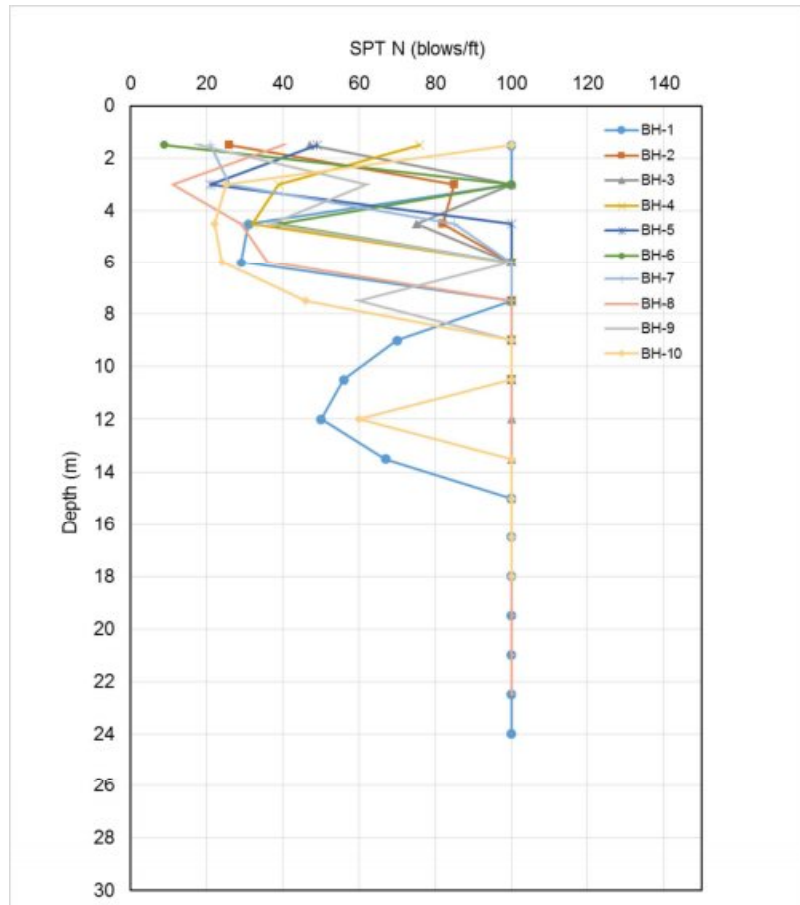


Figure 3-11 Summary of Standard Penetration Test for all Boreholes

### 3.1.14 Water Content

Result of Water Content of BH-1 to BH-10 are shown in **Figure 3-12**. The water content of the boring is observed to decrease gradually with the increase in depth. The highest water content is observed at a depth of approximately 4-6m with a water content of 33% at the highest. After the depth 8m the water content varied within the range of 10 to 20% approximately.

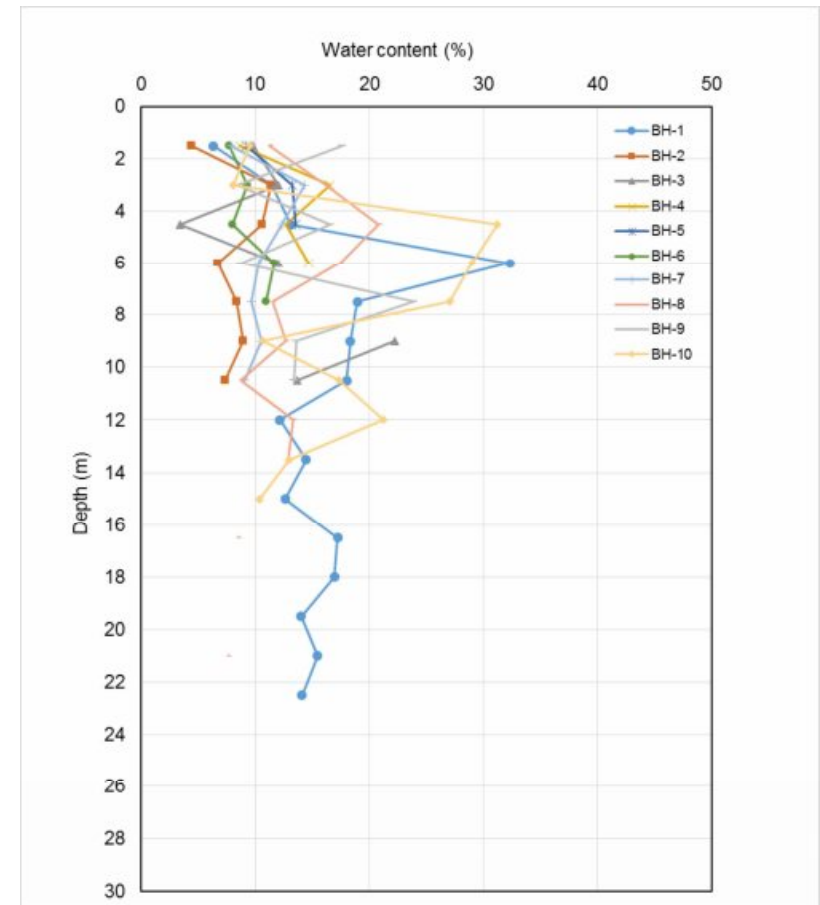
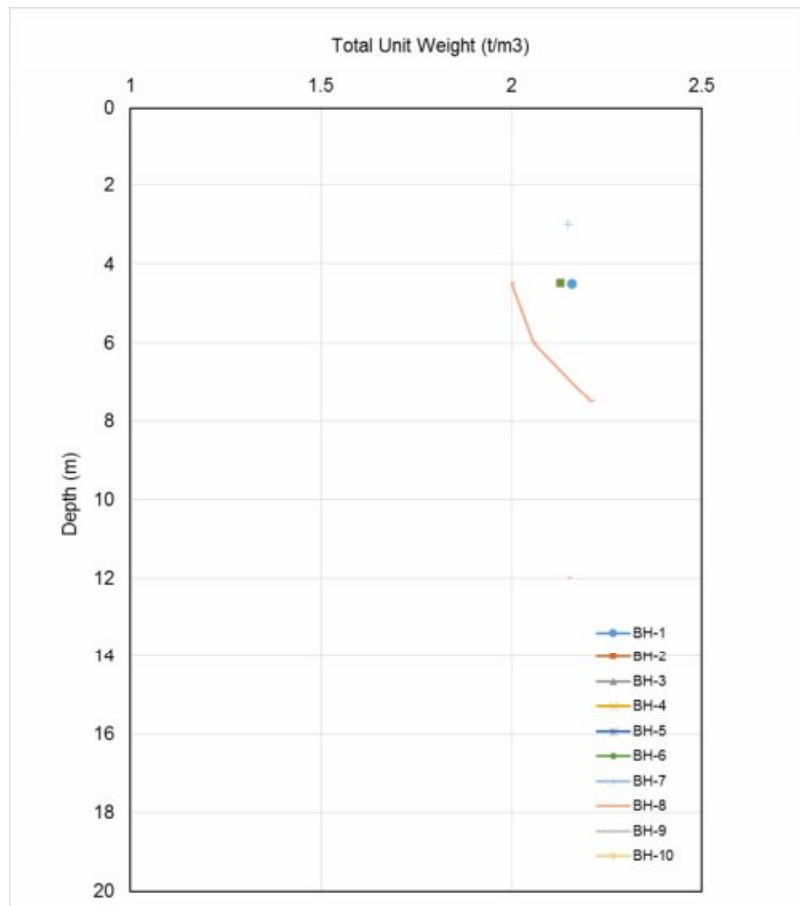


Figure 3-12 Summary of Water Content for all Boreholes

### 3.1.15 Total Unit Weight

Result of total unit weight of BH-1 to BH-10 are shown in **Figure 3-13**. The total unit weight of the samples were within the typical range of 1.5 to 2.5t/m<sup>3</sup>.



**Figure 3-13 Summary of Total Unit Weight for all Boreholes**

## 4. Load capacity of foundation soil

### 4.1 Driven Pile

**Table 4-1 Safe load capacity of square concrete hammer pile**

	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
BH-1	-5.00	11.4	14.2	17.2	21.3	25.8	30.5
	-6.00	13.6	16.7	19.9	24.2	28.7	33.6
	-7.00	31.6	39.7	48.5	60.5	73.6	87.8
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-2	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-2.00	8.0	10.0	12.3	15.3	18.7	22.3
	-3.00	9.1	11.2	13.4	16.3	19.4	22.8
	-4.00	24.3	30.7	37.6	47.2	57.7	69.1
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-3	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-3.00	3.6	4.4	5.3	6.6	7.9	9.4
	-4.00	18.2	23.3	29.0	36.8	45.4	54.9
	-5.00	25.5	31.9	38.8	48.2	58.5	69.6
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-4	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-6.00	9.0	11.2	13.5	16.5	19.8	23.4
	-7.00	12.3	15.1	18.1	22.1	26.4	31.0
	-8.00	15.9	19.4	23.2	28.3	33.7	39.4

BH-5	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-2.00	2.8	3.5	4.3	5.4	6.6	7.9
	-3.00	4.2	5.2	6.4	8.0	9.8	11.7
	-4.00	23.7	30.4	37.8	48.2	59.7	72.3
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-6	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-6.00	13.9	17.3	20.9	25.8	31.1	36.8
	-7.00	18.4	22.7	27.3	33.6	40.2	47.4
	-8.00	23.4	28.7	34.4	42.1	50.2	58.9
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-7	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-6.00	16.8	20.7	24.8	30.4	36.4	42.8
	-7.00	21.3	26.2	31.4	38.3	45.7	53.5
	-8.00	26.4	32.3	38.6	46.9	55.8	65.3
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-8	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-4.00	15.4	18.9	22.5	27.3	32.4	37.8
	-5.00	18.2	22.1	26.2	31.5	37.2	43.2
	-6.00	22.4	27.3	32.3	39.0	46.0	53.3

BH-9	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-3.00	17.1	21.7	26.7	33.7	41.3	49.7
	-4.00	17.7	21.8	26.1	31.8	38.0	44.5
	-5.00	21.3	25.9	30.9	37.3	44.2	51.5
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0
BH-10	Pile Tip (m)	Allowable Pile Load (t)					
		Square Pile Section (m × m)					
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m	□ 0.45 m
	-6.00	11.1	13.6	16.2	19.7	23.4	27.3
	-7.00	18.1	22.4	27.0	33.1	39.7	46.8
	-8.00	22.5	27.6	32.9	40.0	47.6	55.6
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0	100.0

1) Use factor of safety (FS) equal to 2.5

2) Use the Ultimate End Bearing value not more than 600 tons / square meter. For clay, sediment, sand and gravel, and not more than 800 tons / square meter for rock layers

3) The values shown in this table are the values of the allowable carrying capacity of the permissible soil layers which may be greater than the maximum safe load capacity of the concrete used for pile foundation Therefore, the design engineer must consider the maximum load capacity with the safety of the concrete used to make piles.

4) \*\* indicates pile driving in the clay layer or the sediment layer of the hardest And the sand layer or gravel layer is very tight or the rock layer which has NSPT value> 50 times / feet will be very difficult to hammer down Therefore, it is better to use a hammer-driven pile with a pointed steel head to help hammer through the soil in an easier method or may require drilling (Pre Bored) if not hammered down.

5) Allowable Load of Concrete Failure considering  $f'_c = 210 \text{ ksc}$

Table 4-2 Safe load capacity of I section driven pile

BH-1	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-5.00	11.8	14.8	18.1	21.3	25.1
	-6.00	14.8	18.2	22.3	25.5	29.2
	-7.00	31.9	40.1	49.1	58.8	70.1
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-2	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-2.00	8.0	10.1	12.4	14.8	17.7
	-3.00	9.8	12.1	14.8	17.0	19.6
	-4.00	24.2	30.4	37.3	45.1	54.3
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-3	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-3.00	3.7	4.6	5.7	6.7	7.8
	-4.00	17.3	22.1	27.2	33.8	41.5
	-5.00	26.1	32.6	40.0	47.5	56.3
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-4	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-6.00	9.5	11.8	14.5	16.9	19.6
	-7.00	13.1	16.2	19.9	22.9	26.5
	-8.00	17.2	21.1	25.9	29.7	34.1
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-5	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-3.00	4.2	5.2	6.4	7.8	9.3
	-4.00	22.3	28.6	35.1	43.9	54.1
	-5.00	34.0	42.6	52.2	62.2	74.0
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0

BH-6	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-6.00	14.5	18.1	22.1	26.0	30.5
	-7.00	19.5	24.2	29.6	34.4	39.9
	-8.00	25.1	31.0	37.9	43.7	50.4
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-7	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-5.00	13.4	16.6	20.4	23.8	27.7
	-6.00	17.9	22.1	27.1	31.3	36.3
	-7.00	22.9	28.3	34.7	39.8	46.0
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-8	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-4.00	16.9	20.7	25.3	28.8	33.0
	-5.00	20.2	24.7	30.2	34.0	38.6
	-6.00	24.9	30.4	37.3	42.0	47.6
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-9	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-3.00	16.8	21.2	26.0	31.7	38.5
	-4.00	19.1	23.6	28.8	33.1	38.2
	-5.00	23.4	28.7	35.1	39.8	45.4
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-10	Pile Tip (m)	Allowable Pile Load (t)				
		I Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-5.00	9.2	11.4	14.0	16.2	18.7
	-6.00	12.2	15.0	18.3	20.9	23.9
	-7.00	19.2	23.8	29.1	33.8	39.4
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0

- 1) Use factor of safety (FS) equal to 2.5
- 2) Use the Ultimate End Bearing value not more than 600 tons / square meter. For clay, sediment, sand and gravel, and not more than 800 tons / square meter for rock layers
- 3) The values shown in this table are the values of the allowable carrying capacity of the permissible soil layers which may be greater than the maximum safe load capacity of the concrete used for pile foundation Therefore, the design engineer must consider the maximum load capacity with the safety of the concrete used to make piles.
- 4) \*\* indicates pile driving in the clay layer or the sediment layer of the hardest And the sand layer or gravel layer is very tight or the rock layer which has NSPT value > 50 times / feet will be very difficult to hammer down Therefore, it is better to use a hammer-driven pile with a pointed steel head to help hammer through the soil in an easier method or may require drilling (Pre Bored) if not hammered down.
- 5) Allowable Load of Concrete Failure considering  $f_c = 210 \text{ ksc}$

#### 4.2 Bored Pile

**Table 4-3 Safe load capacity of Circular Bored pile**

	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		0.22 m	0.26 m	0.30 m	0.35 m	0.40 m
BH-1	-3.00	15.0	22.1	30.2	39.3	55.0
	-4.00	19.7	29.1	39.8	51.8	72.6
	-5.00	25.0	36.8	50.4	65.6	91.7
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		0.22 m	0.26 m	0.30 m	0.35 m	0.40 m
BH-2	-1.00	21.8	36.6	55.2	77.6	118.2
	-2.00	26.0	41.9	61.5	84.6	126.1
	-3.00	18.4	26.5	35.6	45.7	62.8
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		0.22 m	0.26 m	0.30 m	0.35 m	0.40 m
BH-3	-2.00	3.3	4.7	6.2	7.9	10.7
	-3.00	7.2	10.4	14.0	17.9	24.5
	-4.00	56.1	96.3	147.2	208.7	321.2
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		0.22 m	0.26 m	0.30 m	0.35 m	0.40 m
BH-4	-5.00	14.2	20.6	27.9	36.0	49.8
	-6.00	20.4	29.4	39.5	50.6	69.4
	-7.00	27.5	39.4	52.5	66.9	91.1
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		0.22 m	0.26 m	0.30 m	0.35 m	0.40 m
BH-5	-3.00	8.9	13.3	18.3	24.1	34.1
	-4.00	72.2	125.3	192.8	274.8	425.0
	-5.00	72.9	125.9	193.2	274.8	424.1
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0

BH-6	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-3.00	11.3	17.0	23.8	31.5	45.0
	-4.00	16.2	24.3	33.7	44.4	63.0
	-5.00	21.8	32.4	44.7	58.5	82.5
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-7	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-3.00	23.6	38.4	56.7	78.4	117.6
	-4.00	19.3	28.5	39.1	50.9	71.4
	-5.00	27.1	39.5	53.7	69.5	96.5
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-8	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-4.00	34.4	53.4	76.2	102.7	149.7
	-5.00	38.6	58.7	82.5	109.7	157.6
	-6.00	47.3	72.2	101.6	135.4	194.9
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-9	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-1.00	16.0	26.5	39.5	55.1	83.3
	-2.00	19.8	31.2	45.1	61.3	90.3
	-3.00	52.2	87.4	131.5	184.5	280.7
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0
BH-10	Pile Tip (m)	Allowable Pile Load (t)				
		Circular Concrete Pile Section (m × m)				
		□ 0.22 m	□ 0.26 m	□ 0.30 m	□ 0.35 m	□ 0.40 m
	-3.00	6.9	9.9	13.4	17.2	23.7
	-4.00	22.1	34.9	50.5	68.7	101.2
	-5.00	26.2	40.1	56.5	75.4	108.8
Allowable Load of Concrete Failure		25.0	35.0	45.0	60.0	80.0

1) Use factor of safety (FS) equal to 2.5

2) Use the Ultimate End Bearing value not more than 600 tons / square meter. For clay, sediment, sand and gravel, and not more than 800 tons / square meter for rock layers

3) The values shown in this table are the values of the allowable carrying capacity of the permissible soil layers which may be greater than the maximum safe load capacity of the concrete used for pile foundation Therefore, the design engineer must consider the maximum load capacity with the safety of the concrete used to make piles.

4) \*\* indicates pile driving in the clay layer or the sediment layer of the hardest And the sand layer or gravel layer is very tight or the rock layer which has NSPT value > 50 times / feet will be very difficult to hammer down Therefore, it is better to use a hammer-driven pile with a pointed steel head to help hammer through the soil in an easier method or may require drilling (Pre Bored) if not hammered down.

5) Allowable Load of Concrete Failure considering  $f'c = 210 \text{ ksc}$

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## Appendix A

### Soil Investigation

Content

	Page
Content	A-2
1. Soil Boring	A-3
2. Soil Sampling	A-4
2.1 Undisturbed Sample	A-4
2.2 Disturbed Sample	A-4
3. Standard Penetration Test, SPT	A-5
4. Hand Auger	A-7
5. Pocket Penetrometer	A-8
6. Subsurface Water Level in Borehole	A-8
7. Screw Driving Sounding Test	A-9
8. Spectral Analysis of Surface Waves (SASW) Testing	A-10
9. Cone Penetration Testing	A-12
List of Term Used and Symbols	A-14
List of References	A-15

Content of Figures

	Page
Figure A-1 Schematic diagram of wash boring with motorized cathead and portable tripod. (Sathaporn, 2001)	A-3
Figure A-2 Thin-Walled Tube for Sampling (ASTM D 1587)	A-4
Figure A-3 Split Spoon Sampler (ASTM D 1586)	A-5
Figure A-4 Hammer for Standard Penetration Test (Seed et al., 1985)	A-6
Figure A-5 Standard Penetration Test	A-6
Figure A-6 Equipment of hand auger	A-7
Figure A-7 Types of hand auger	A-7
Figure A-7 Types of hand auger (continuous)	A-8
Figure A-8 Pocket penetrometer devices	A-8
Figure A-9 Screw Driving Sounding devices	A-9
Figure A-10 Test configuration of SASW testing (Bay, 2002)	A-10
Figure A-11 An example of phase spectrum from two receivers (Bay, 2002)	A-11
Figure A-12 An example of shear wave velocity profile (Bay, 2002)	A-11
Figure A-13 Cone Penetration Testing	A-13

Content of Tables

	Page
Table A-1 Approximate relationship among the standard penetration number, the consistency, the unconfined compression strength for cohesive soils and the relative density for cohesionless soils. (Peck, Hanson and Thornburn, 1974)	

1. Soil Boring

The geotechnical investigation has been conducted using wash boring method. In this approach, a casing about 2 to 3 m long is driven into the ground. The soil inside the casing is then removed by using a chopping bit that is attached to drilling rod. Water is forced through the drilling rod, and it goes out at a very high velocity through the holes at the bottom of the chopping bit. The water and the chopped soil particles rise upward in the drill hole and overflow at the top of the casing through a T-connection. The wash water is then collected in a container. The casing can be extended with additional pieces as the borehole progresses; however, such extension is not necessary if the borehole will stay open without caving in. **Figure A-1** shows a schematic diagram of wash boring with motorized cathead and portable tripod.

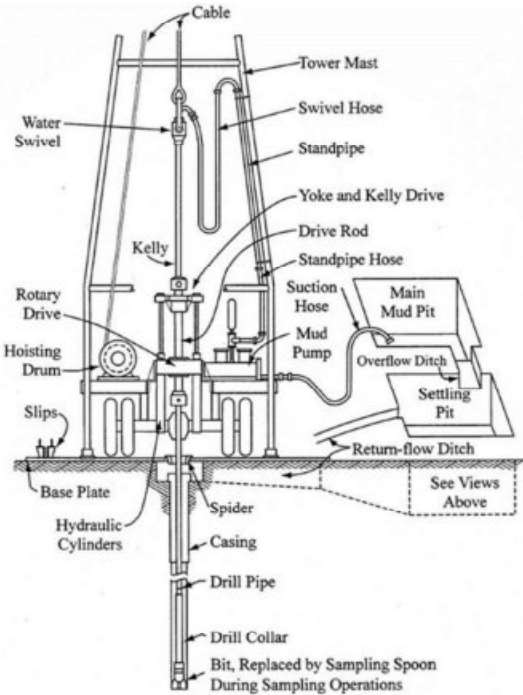
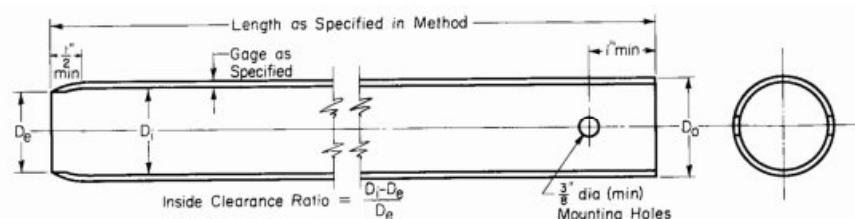


Figure A-1 Schematic diagram of wash boring with Rotary (Sathaporn, 2001)

## 2. Soil Sampling

### 2.1 Undisturbed Sample

The undisturbed sample is obtained by thin wall tube. The tube is made of seamless thin tube and is commonly referred to as Shelby tubes. To collect samples at a given depth in a borehole, one must first remove the drilling tools. The sampler is attached to a drilling rod and lowered to the bottom of the borehole. After this, it is hydraulically pushed into the soil. It is then spun to shear off the base and is pulled out. The sampler with the soil inside is sealed and taken to the laboratory for testing. The tube commonly used for very soft to medium stiff clay. The thin wall tube samplers have outside diameters of 3 in and 29.5 in as shown in **Figure A-2**



Note 1 - Minimum of two mounting holes on opposite sides for  $D_o$  smaller than 4 inches. (101.6 mm).

Note 2 - Minimum of four mounting holes equally spaced for  $D_o$  4 inches. (101.6 mm) alternatively, larger.

Note 3 - Tube held with hardened screws or other suitable means.

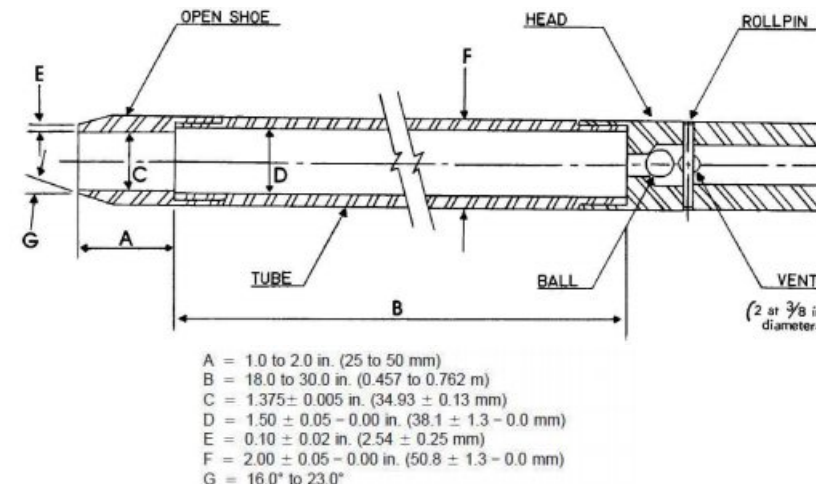
Note 4 - 2-in (50.8 mm) outside diameter tubes are specified with an 18-gage wall thickness to comply with area ratio criteria accepted for undisturbed samples. Users are advised that such tubing was difficult to locate and can be extremely expensive in small quantities. Sixteen-gage tubes are readily available.

**Figure A-2** Thin-Walled Tube for Sampling (ASTM D 1587)

### 2.2 Disturbed Sample

A split spoon sampler commonly obtains disturbed sample. The sampler consists of a tool-steel driving shoe at the bottom, a steel tube in the middle, and a coupling at the top. The dimension of split spoon sampler is shown in **Figure A-3**.

When the borehole is advanced to the desired depth, the drilling tools are removed. The split spoon sampler is attached to the drilling rod and then lowered to the bottom of the borehole. The sample is driven into the soil at the bottom of the borehole using hammer blows. The hammer blows occur at the top of the drilling rod. This testing is called standard penetration test. The interpretation of standard penetration test is given in the following section. After driving is completed, the sample is withdrawn, and the shoe and coupling are removed. The soil sample collected inside the split spoon tube is then removed and transported to the laboratory.



The 1 ½ in (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

**Figure A-3** Split Spoon Sampler (ASTM D 1586)

## 3. Standard Penetration Test, SPT

Standard Penetration Test, SPT is commonly used with a split spoon sampler has outside diameters of 2 in and 18 in length. The split spoon sampler is driven into the soil by hammer blows weight 140 lb (64 kg). For each blow, the hammer drops a distance of 30 in (76 cm). The number of blows required for driving the sampler through three 6 in intervals is recorded. The sum of the number of blows required for driving the last two 6 in the interval is referred to as the standard penetration number, N. It is also commonly called the blows count. A detail of hammer and a schematic standard penetration test shown in **Figures A-4** and **A-5**, respectively. **Table A-1** gives the relative relationship among the standard penetration number at a given depth, the consistency, the unconfined compression strength for cohesive soils and the relative density of cohesionless soils.

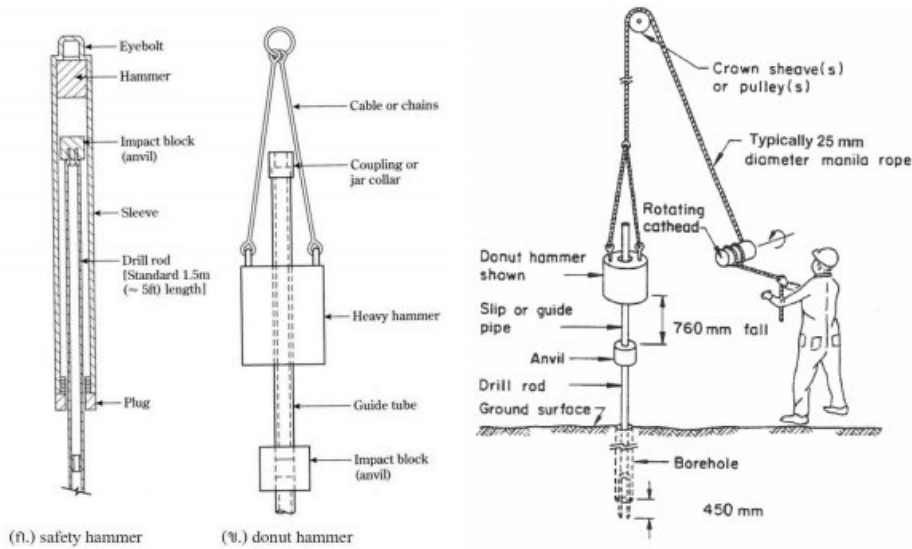


Figure A-4 Hammer for Standard Penetration Test (Seed et al.,1985)

Figure A-5 Standard Penetration Test

Table A-1 Approximate relationship among the standard penetration number, the consistency, the unconfined compression strength for cohesive soils and the relative density for cohesionless soils. (Peck, Hanson and Thornburn, 1974)

Cohesive Soils (CLAY)			Cohesionless Soils (SAND)		
SPT-N (Blows/ft)	Consistency	Unconfined Compressive Strength, $q_u$ (ksc)	SPT-N (Blows/ft)	Compactness	Relative Density (%)
0-2	Very Soft	0-0.25	0-4	Very Loose	0-15
2-4	Soft	0.25-0.50	4-10	Loose	15-35
4-8	Medium	0.50-1.00	10-30	Medium	35-65
8-15	Stiff	1.00-2.00	30-50	Dense	65-85
15-30	Very Stiff	2.00-4.00	Over 50	Very Dense	85-100
Over 30	Hard	Over 4.00			

4. Hand Auger

The hand auger is the simplest method for making boreholes by at least two labor. At soft to medium stiff clay, the auger can be used for marking boreholes up to a depth of about 6 to 10 m. The auger is commercially available in 1 m sections. During the drilling operation, section after section of the auger can be added, and the borehole extended downward. The auger brings the loose soil from the bottom of the hole to the surface. The driller can detect the change into the ground type encountered by the change of speed and the sound of drilling. **Figure A-6** shows the equipment of hand auger. Types of hand auger are presented in **Figure A-7**.



Figure A-6 Equipment of hand auger

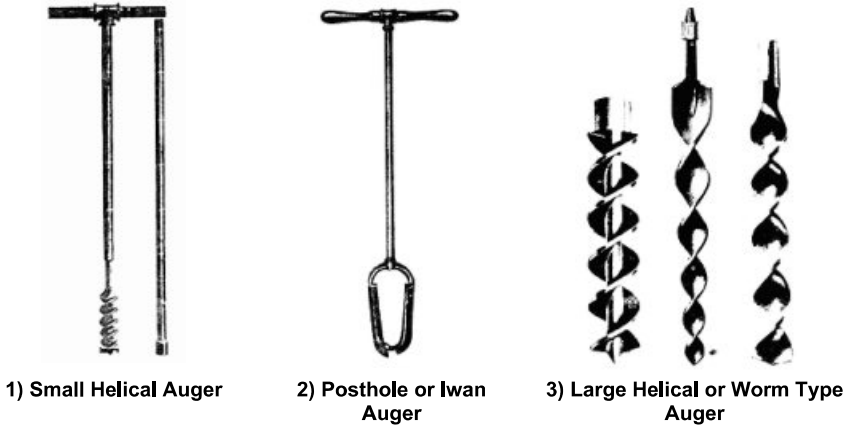


Figure A-7 Types of hand auger

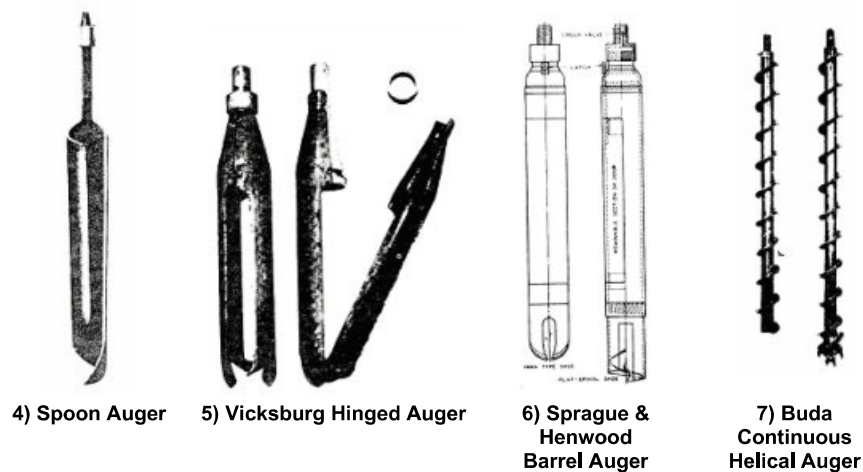


Figure A-7 Types of hand auger (continuous)

Reference: Figure A-6 and Figure A-7 (GERD, 2010)

5. Pocket Penetrometer

The pocket penetrometer is designed as a lightweight instrument for use by field personnel to check visual classification of soils. It indicates consistency, shear strength, and relative unconfined shear strength. Direct-reading scale in tons/sq.ft, or kg/sq.cm corresponds to equivalent unconfined compressive strength. The readings obtained from the penetrometer do not replace laboratory test results because a small area of penetration test could give misleading results. Figure A-8 shows the pocket penetrometer devices.



Figure A-8 Pocket penetrometer devices

6. Subsurface Water Level in Borehole

Determining of subsurface water level in the borehole is carried out according to ASTM D 4750. The water level measuring is performed after drilling completed at least 24 hours.

7. Screw Driving Sounding Test

- 1) The rod is always rotated at a constant rate (25r.p.m) during the test.
- 2) Loading starts from 0.25kN and then keeps on increasing by 0.125kN up to 1kN.
- 3) After every 25cm penetration, the rod is lifted up by a few cm and rotated to measure the rod friction.

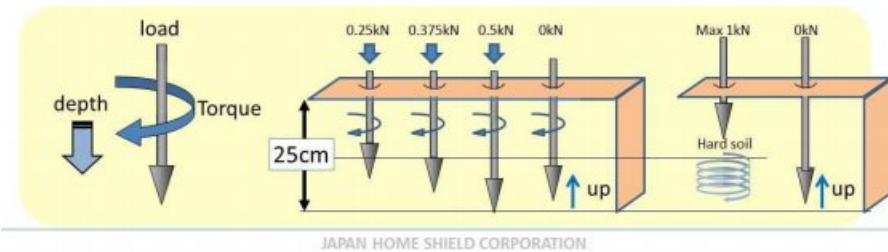


Figure A-9 Screw Driving Sounding devices

8. Spectral Analysis of Surface Waves (SASW) Testing

Spectral Analysis of Surface Waves (SASW) is a non-destructive, in-situ, test developed by University of Texas at Austin (Nazarian and Stokoe, 1983; Stokoe et al., 1994). The SASW method is an easy testing that uses only 2 receivers and a source or sources to generate seismic waves, the test configuration is shown in Figure 1. The concept of this technique is to determine the phase velocity between these two receivers placed on the ground. The surface waves are created by a source or sources that generated energy over a wide range of frequencies. A low frequency source is required for deeper profiling and a high frequency source is required to profile near-surface soils. The generated waves are measured using receivers (accelerometers or geophones). The signals from the receivers, shown in Figure 2, are recorded using a spectrum analyzer to calculates the energy and phase of each frequency. Wave velocities are calculated at each frequency based upon the phase-shift and receiver spacing using Equation 1 and 2. Subsequently, a dispersion curve is created and a shear wave velocity profile, Figure 3, can be determined using a forward modeling and inversion analysis.

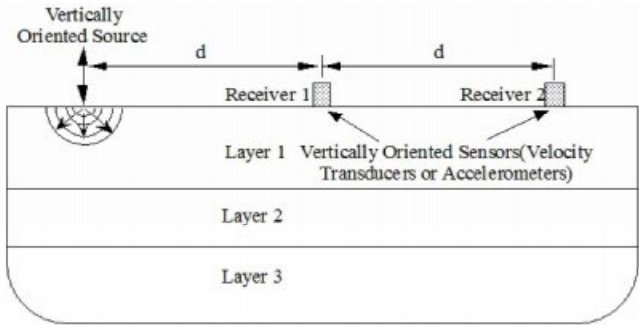


Figure A-10 Test configuration of SASW testing (Bay, 2002)

$$\lambda_R = d * \left( \frac{360}{\phi_{21}} \right) \tag{1}$$

$$v_R = f * \lambda_R \tag{2}$$

- $\lambda_R$  = wavelength of Rayleigh waves
- $d$  = spacing between two receivers
- $\phi_{21}$  = phase-shift between two receivers
- $v_R$  = velocity of Rayleigh waves

$f$  = frequency

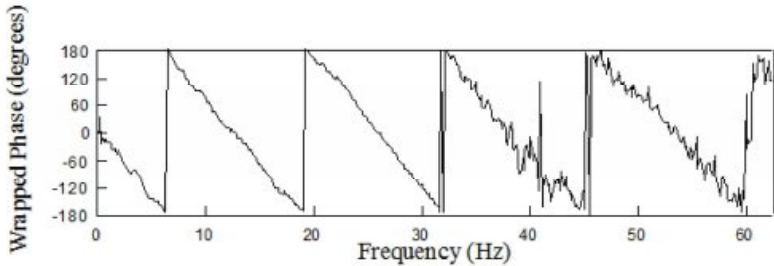


Figure A-11 An example of phase spectrum from two receivers (Bay, 2002)

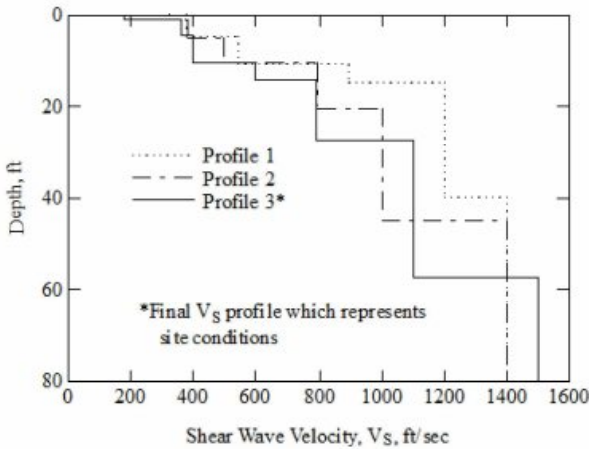


Figure A-12 An example of shear wave velocity profile (Bay, 2002)

## 9. Cone Penetration Testing

The field work shall be accomplished in accordance with ASTM standards and following the requirements of the specification. The CPTs' location should be marked and surveyed in the site by the client and on good dry land access capable of supporting 10 wheel truck self - driven to each location.

### 9.1 Cone Penetration Testing Procedure

Cone Penetration Testings (CPTs) will be executed in accordance with ASTM D 3441 using an electrical cone. A 20 MPa static cone penetrometer apparatus was used to execute the CPTs. The cone penetrometer is mounted on a heavy truck with sufficient weight to mobilize the required reaction force.

CPT – data acquisition system is made by A.P. van den Berg for reading test data during CPT testing. Data are registered by two different channels; cone resistance and local friction and stored on a data logger for subsequent processing. Reading of all channels are taken every 20 mm of penetration.

The CPTs will be carried out by hydraulically forcing a cone into the soil by the penetration rate of 20 - 25 mm/sec. The area of the cone tip is 10 cm<sup>2</sup> with a 60° apex. The force required to advance the cone was recorded by means of an electric pressure meter. The results of these measurement are plotted on a graph versus the depth and indicated as cone resistance  $q_c$  (in MN/m<sup>2</sup>).

Directly above the cone tip a friction sleeve is presented with a standard area of 150 cm<sup>2</sup>, used for measurement of the local friction (MN/m<sup>2</sup>). These results are also plotted on the CPT graph. The ratio between local friction and cone resistance is presented on the CPT graph as friction ratio (%). As this ratio is more or less constant for different soil types, it is used for identifying the various soils encountered throughout the profile.



**Figure A-13** Cone Penetration Testing**List of Term Used and Symbols**

1. DRILLING & SAMPLING					
ACR	=	After Casing Removed	HA	=	Hand Augering
AD	=	After Drilling	PA	=	Power Augering
BCR	=	Before Casing Removed	PP	=	Pocket Penetrometer
BS	=	Bentonite Slurry	SPT	=	Standard Penetration Test
CA	=	Casing Advanced	SS	=	Split Spoon
CR	=	Casing Removed	ST	=	Shelby Tube
FVT	=	Field Vane Shear Test	TB	=	Thin-Walled Bit
GWL	=	Ground Water Level	WO	=	Wash Out

2. SOIL PROPERTIES					
Wn	=	Natural Water Content	GS	=	Specific Gravity
LL	=	Liquid Limit	$\gamma_t$	=	Total Unit Weight
PL	=	Plastic Limit	Su	=	Undrained Shear Strength
PI	=	Plasticity Index	St	=	Sensitivity
LI	=	Liquidity Index	SPT-N	=	Standard Penetration Resistance

3. TERM USE FOR IDENTIFYING MINOR COMPONENT OF SOIL	
Descriptive Adjective	Percentage Requirement (%)
Trace	1-10
Trace to Some	10-20
Some	20-35
And	35-50

**List of References**

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1. Soil Boring.....	3
2. Soil Sampling .....	4
2.1 Undisturbed Sample.....	4
2.2 Disturbed Sample .....	4
3. Standard Penetration Test, SPT .....	5
4. Hand Auger.....	7
5. Pocket Penetrometer .....	8
6. Subsurface Water Level in Borehole .....	8
7. Screw Driving Sounding Test.....	9
8. Spectral Analysis of Surface Waves (SASW) Testing .....	10
Figure A-10 Test configuration of SASW testing (Bay, 2002).....	10
11	
9. Cone Penetration Testing.....	12
13	
List of Term Used and Symbols .....	14
List of References .....	15

Figure A-1 Schematic diagram of wash boring with motorized cathead and portable tripod. (Sathaporn, 2001).....	3
Figure A-2 Thin-Walled Tube for Sampling (ASTM D 1587).....	4
Figure A-3 Split Spoon Sampler (ASTM D 1586).....	5
Figure A-4 Hammer for Standard Penetration Test (Seed et al.,1985).....	6
Figure A-5 Standard Penetration Test.....	6
Figure A-6 Equipment of hand auger .....	7
Figure A-7 Types of hand auger.....	7
Figure A-7 Types of hand auger (continuous).....	8

Figure A-8 Pocket penetrometer devices .....	8
Figure A-9 Screw Driving Sounding devices .....	9

Table A-1 Approximate relationship among the standard penetration number, the consistency, the unconfined compression strength for cohesive soils and the relative density for cohesionless soils. (Peck, Hanson and Thornburn, 1974)	6
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# Appendix B

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## Soil Classification

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### Content

	Page
Content	B-2
Unified Soil Classification System (USCS) (ASTM D 2487)	B-3
List of References	B-6
List of Soil Symbols	B-7

### Content of Figures

	Page
Figure B-1 Flow Chart for Classifying Fine-Grained Soil	B-3
Figure B-2 Flow Chart for Classifying Fine-Grained Soil	B-4
Figure B-3 Flow Chart for Classifying Organic Fine-Grained Soil	B-4
Figure B-4 Flow Chart for Classifying Coarse-Grained Soil	B-5
Figure B-5 Plasticity Chart	B-5
Figure B-6 Cumulative Particle-size Plot	B-6

Unified Soil Classification System (USCS) (ASTM D 2487)

Major Divisions	Group Symbols	Typical Names	Laboratory Classification Criteria
Coarse-grained soils (More than half of material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size) Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (Appreciable amount of fines)	GM <sup>a</sup> d	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
Sands (More than half of coarse fraction is smaller than No. 4 sieve size) Clean sands (Little or no fines)	Sands with fines (Appreciable amount of fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	SM <sup>a</sup> d	SM <sup>a</sup> u	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine-grained soils (More than half material is smaller than No. 200 sieve)	Silt and clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	Silt and clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
	Highly organic soils	Pt	Peat and other highly organic soils

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

- More than 5 per cent
- More than 12 per cent
- 5 to 12 per cent

<sup>a</sup>Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

<sup>b</sup>Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example, GW-GC, well-graded gravel-sand mixture with clay binder.

Plasticity Chart

Figure B-1 Flow Chart for Classifying Fine-Grained Soil  
GROUP SYMBOL GROUP NAME

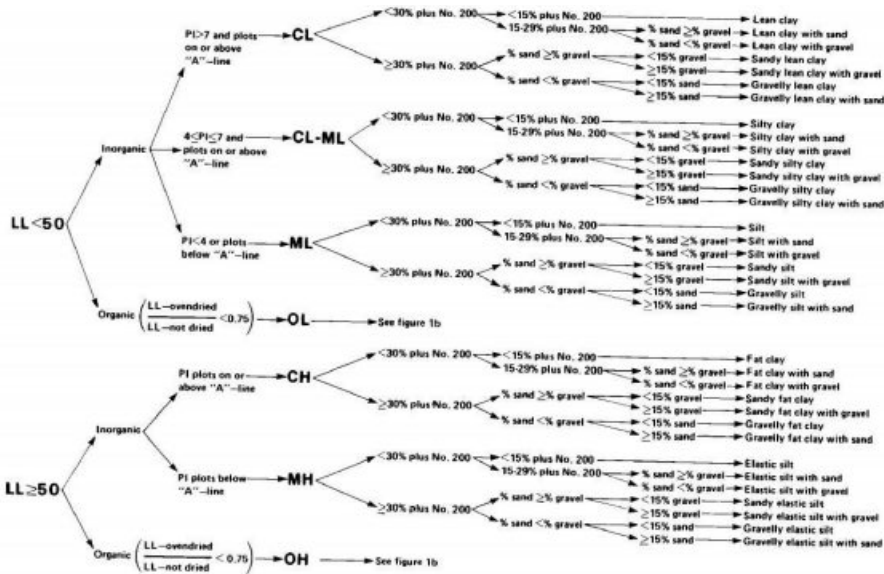


Figure B-2 Flow Chart for Classifying Fine-Grained Soil  
(50% or More Passes No. 200 Sieve)

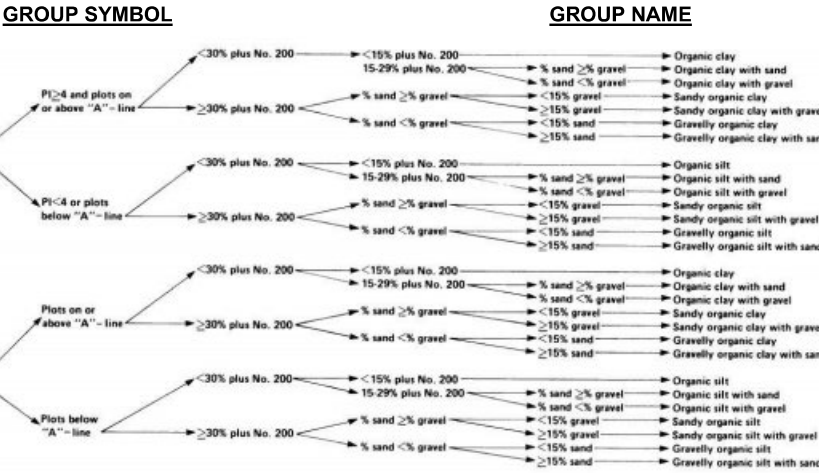

















Figure B-3 Flow Chart for Classifying Organic Fine-Grained Soil  
(50% or More Passes No. 200 Sieve)



ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes

List of Soil Symbols

MAJOR DIVISION			LETTER	SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS	GW		Well graded gravels, gravel sand mixtures, little or no fines.
			GP		Poorly graded gravels, gravel sand mixtures, little or no fines.
		GRAVELS WITH FINES	GM		Silty gravels, gravel-sand-silt mixtures.
			GC		Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	CLEAN SANDS	SW		Well gradeed sands, gravelly sands, little or no fines.
			SP		Poorly gradeed sands, gravelly sands, little or no fines.
		SANDS WITH FINES	SM		Silty sands, sand-silt mixtures.
			SC		Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAY	LIQUID LIMIT LESS THAN 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL		Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAY	LIQUID LIMIT GREATER THAN 50	MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH		Inorganic clays of high plasticity, fat clays.
			OH		Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			PT		Peat and other highly organic soils.

Appendix C

Laboratory Testing Procedures

Content	
Content	Page
1. Natural Water Content	C-2
2. Particle Size Analysis by Sieve or Hydrometer	C-3
3. Atterberg Limits	C-3
4. Unit Weight Determination	C-4
5. Unconfined Compressive Strength	C-5
List of References	C-7

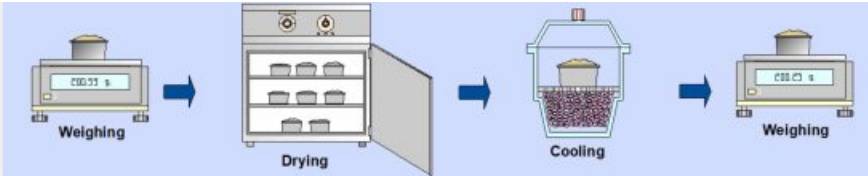
Content of Figures	
Figure C-1 Determination procedure of soil moisture content.	Page
Figure C-2 Sieve apparatus.	C-3
Figure C-3 Liquid limit and plastic limit test devices	C-4
Figure C-4 Determination procedure of unit weight.	C-5
Figure C-5 Unconfined compression test apparatus	C-6

**Laboratory Testing Procedures**

Specific laboratory testing procedures are discussed in the following paragraphs. Tests procedures and reporting are conducted according to American Society for Testing and Materials Standards (ASTM).

**1. Natural Water Content**

Weight may express the soil water content as the ratio of the mass of water present to the dry to the dry weight of the soil sample, or by volume as the ratio of the amount of water to the total volume of the soil sample. The water mass must be determined by drying the soil to constant weight and measuring the soil sample mass after and before drying. The water mass (or weight) is the difference between the weights of the wet and oven dry specimens. The criterion for a dry soil sample is the soil sample that has been dried to constant weight in an oven at a temperature between 100 – 110 °C (105 °C is typical). **Figure C-1** shows the determination procedure of soil moisture content.



**Figure C-1 Determination procedure of soil moisture content.**

**2. Particle Size Analysis by Sieve or Hydrometer**

Particle size analysis can be performed by means of sieving and/or hydrometer readings. Sieving is carried out for particles that would be retained on a 0.075 mm sieve, while additional hydrometer readings may be carried out when a significant fraction of the material passes a 0.075 mm sieve. Tests are conducted in accordance with ASTM D422.

In a sieve analysis, the mass of soil retained on each sieve is determined, and expressed as a percentage of the total mass of the sample. Prior to sieving the samples are washed on a 0.075 mm sieve to remove the fine fraction and are oven dried. **Figure C-2** presents the sieve apparatus.

The hydrometer method allows measurement of the density of a suspension consisting of fine grained soil particles and distilled water, to which a dispersion agent (sodium hexameta phosphate) is added. This suspension is mixed using a high speed stirrer. Testing is performed in a thermostatically controlled water bath (25° ± 0.5°). The particle size is calculated according to Stokes' Law for a single sphere, on the basis that particles of a particular diameter are at the surface of the suspension at the beginning of sedimentation and had settled to the level at which the hydrometer is measuring the density of the suspension.

These calculations require a value for the specific gravity of solid particles. Generally, a value of 2.65 is assumed. When other values are used, this is included in the laboratory report. The hydrometer results for selected particle sizes are presented as a percentage of the total mass of the soil sample.

Particle size is presented on a logarithmic scale so that two soils having the same degree of uniformity are represented by curves of the same shape regardless of their positions on the particle size distribution plot. The general slope of the distribution curve may be described by the coefficient of uniformity,  $C_u$ , where  $C_u = D_{60}/D_{10}$ , and the coefficient of curvature,  $C_c$ , where  $C_c = (D_{30})^2 / D_{10} \cdot D_{60}$ .  $D_{60}$ ,  $D_{30}$ , and  $D_{10}$  are effective particle sizes indicating that 60%, 30%, and 10% respectively of the particles (by weight) are smaller than the given effective size.

Typically onboard testing is limited to determination of percentage passing the 0.075 mm (No. 200) sieve by wet washing. In some instances the particle size of coarse material is determined by sieving. Hydrometer testing of fine grained material is conducted onshore.



Figure C-2 Sieve apparatus.

### 3. Atterberg Limits

The liquid and plastic limits, together with the resulting plasticity indices, are determined for selected cohesive samples. Testing is performed in accordance with ASTM D4318.

Atterberg limits are determined on soil specimens with a particle size of less than 0.425 mm. If necessary, coarser material is removed by dry sieving. The Atterberg limits refer to arbitrarily defined boundaries between the liquid and plastic states (Liquid Limit), and between the plastic and brittle states (Plastic Limit) of fine grained soils. They are expressed as water content, in percent.

The liquid limit is defined as the water content at which a part of soil placed in a standard cup and cut by a groove of standard dimensions (Figure C-3) will flow together at the base of the groove, when the cup is subjected to 25 standard shocks. Distilled water is added as required during soil mixing to achieve the desired consistency. The plastic limit is defined as the water content at which a soil can no longer be deformed by rolling into 3 mm diameter threads without crumbling. The range of water contents over which a soil behaves plastically is the Plasticity Index, PI. This is the difference between the liquid limit and the plastic limit.



Figure C-3 Liquid limit and plastic limit test devices

### 4. Unit Weight Determination

This lab is performed to determine the in-place unit weight of undisturbed soil obtained by pushing or drilling a thin-walled cylinder. The bulk unit weight is the ratio of the mass of moist soil to the volume of the soil sample, and the dry unit weight is the ratio of the mass of the dry soil to the volume of the soil sample. Figure C-4 shows the determination procedure of unit weight.

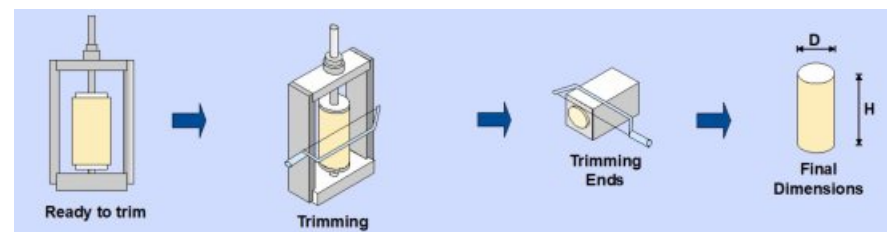


Figure C-4 Determination procedure of unit weight.

### 5. Unconfined Compressive Strength

The primary purpose of this test is to determine the unconfined compressive strength, which is then used to calculate the unconsolidated undrained shear strength of the clay under unconfined conditions. According to the ASTM D 2166, the unconfined compressive strength ( $C_u$ ) defined as the compressive stress at which an unconfined cylindrical specimen of soil will fail in a simple compression test. Also, in this test method, the unconfined compressive strength is taken as the maximum load attained per unit area, or the load per unit area at 15% axial strain, whichever occurs first during the performance of a test. Figure C-5 presents the unconfined compression test apparatus.

For soils, the undrained shear strength ( $s_u$ ) is necessary for the determination of the bearing capacity of foundations, dams, etc. The undrained shear strength ( $s_u$ ) of clays is commonly determined from an unconfined compression test. The undrained shear strength ( $s_u$ ) of a cohesive soil is equal to one-half the unconfined compressive strength ( $q_u$ ) when the soil is under the  $\phi = 0$  condition ( $\phi$  = the angle of internal friction).The most critical condition for the soil occurs immediately after construction, which represents undrained conditions when the undrained shear strength is equal to the cohesion ( $c$ ). This is expressed as:

$$c = s_u = q_u / 2$$

- where
- $c$  = Cohesion
  - $s_u$  = Undrained Shear Strength
  - $q_u$  = Unconfined Compressive Strength



Figure C-5 Unconfined compression test apparatus

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American Society for Testing and Materials (ASTM), 2009, Soil and Rock, Annual Book of ASTM Standards, Section 4, Volume 04.08 and 04.09, March.

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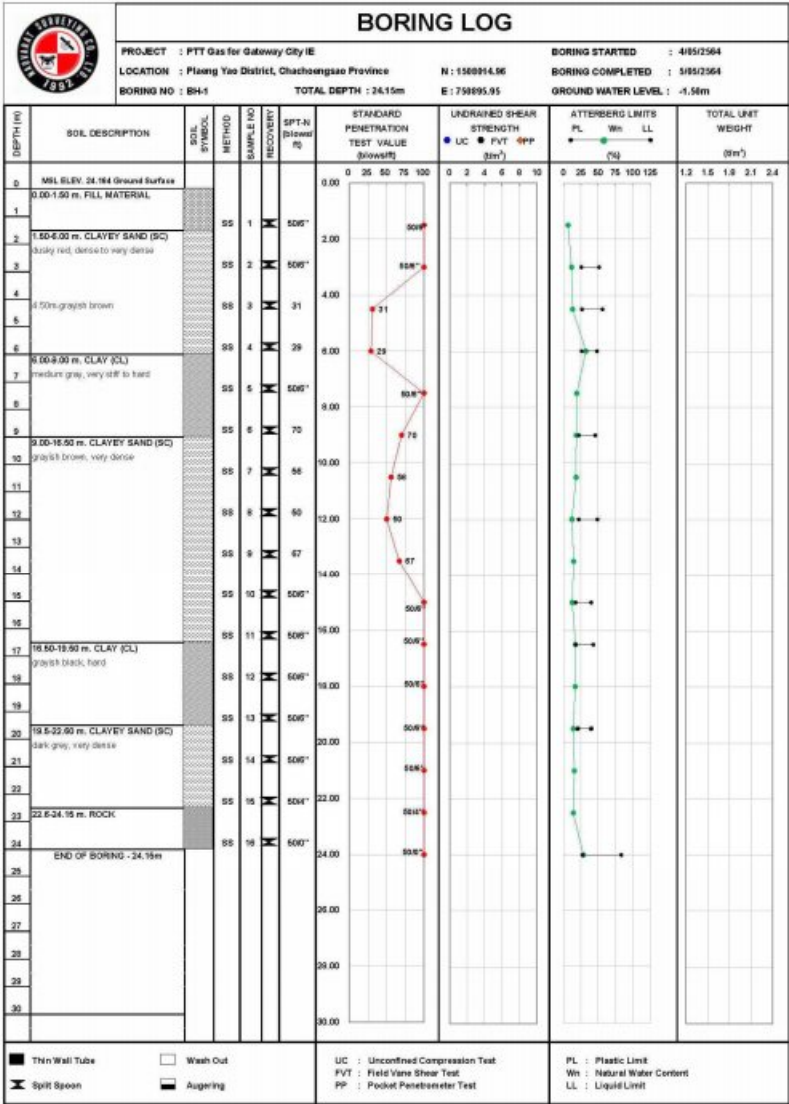
British Standard, 1990a, Methods of Tests for Soil for Civil Engineering Purposes, Part 7: Shear Strength Tests (Total Stress), BS 1377-7; 1990.

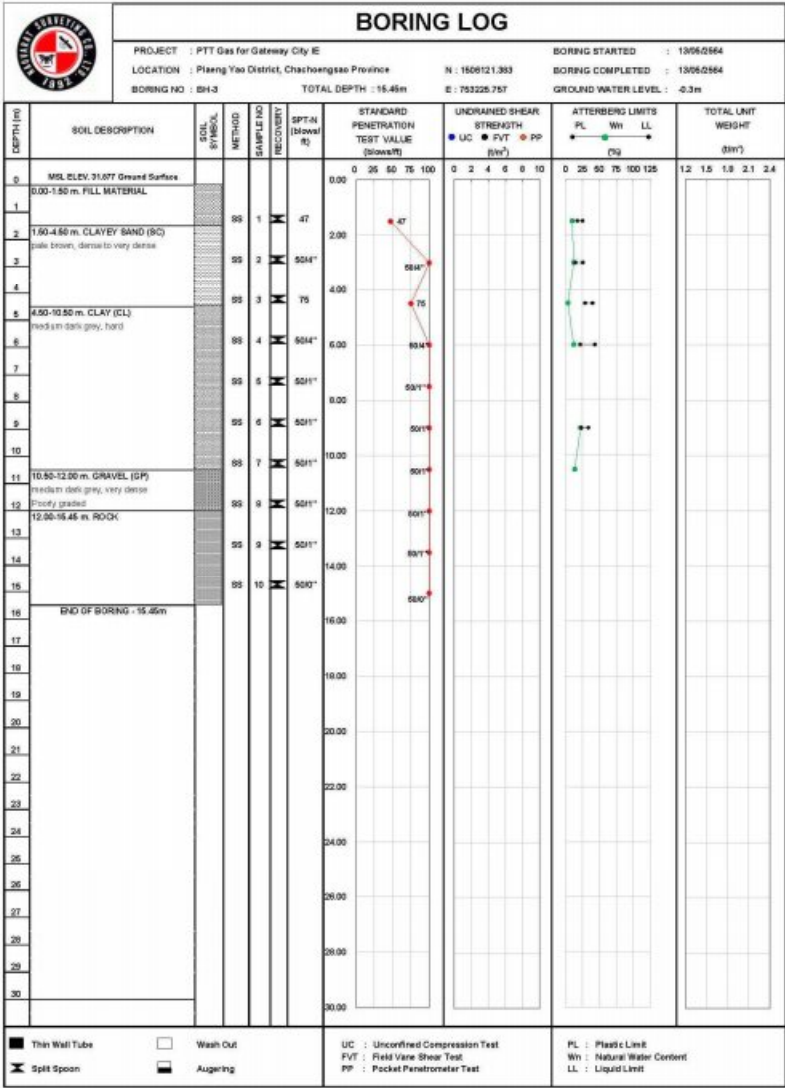
Appendix D

Boring Log

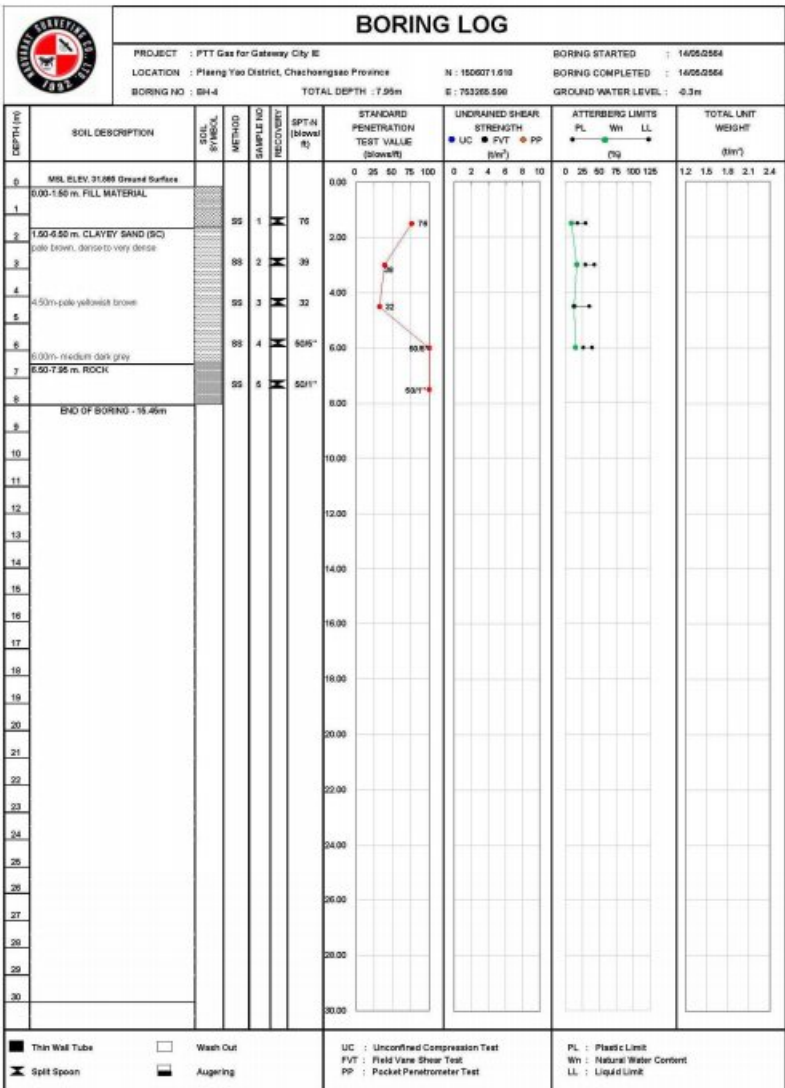
Content	
	Page
Content	D-2
1. Boring Log of BH-1	D-3
2. Boring Log of BH-2	D-4
3. Boring Log of BH-3	D-5
4. Boring Log of BH-4	D-6
5. Boring Log of BH-5	D-7
6. Boring Log of BH-6	D-8
7. Boring Log of BH-7	D-9
8. Boring Log of BH-8	D-10
9. Boring Log of BH-9	D-11
10. Boring Log of BH-10	D-12

1. Boring Log of BH-1



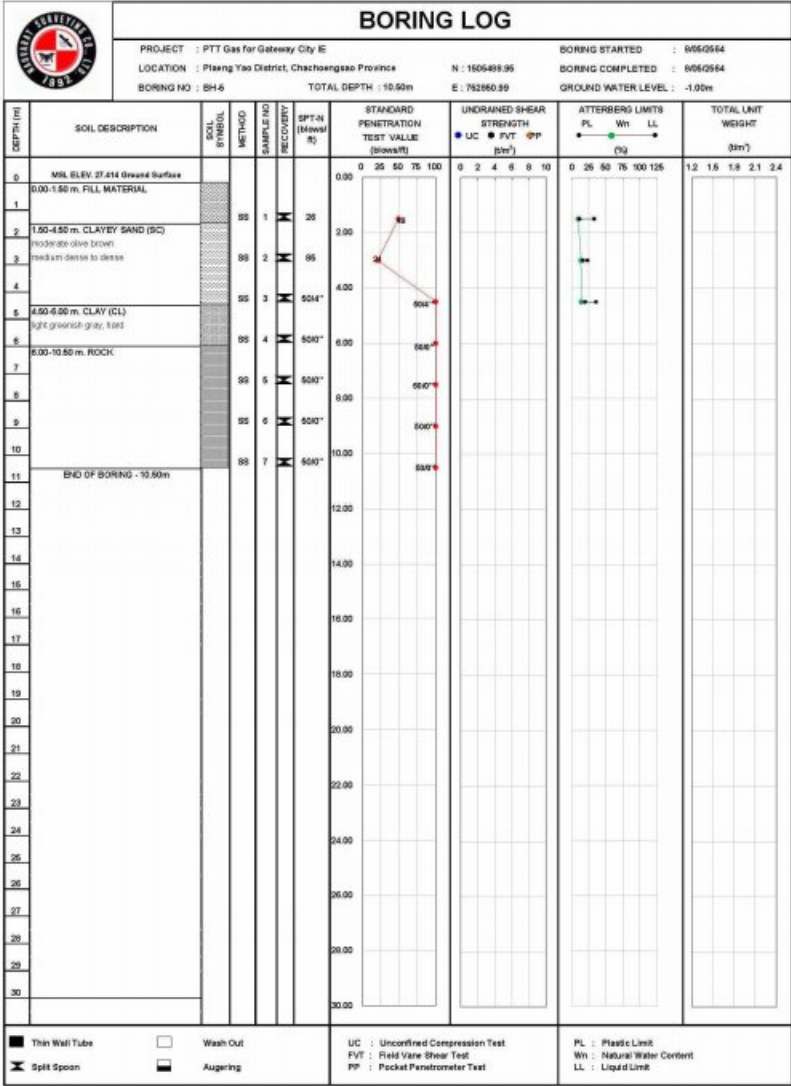


4. Boring Log of BH-4

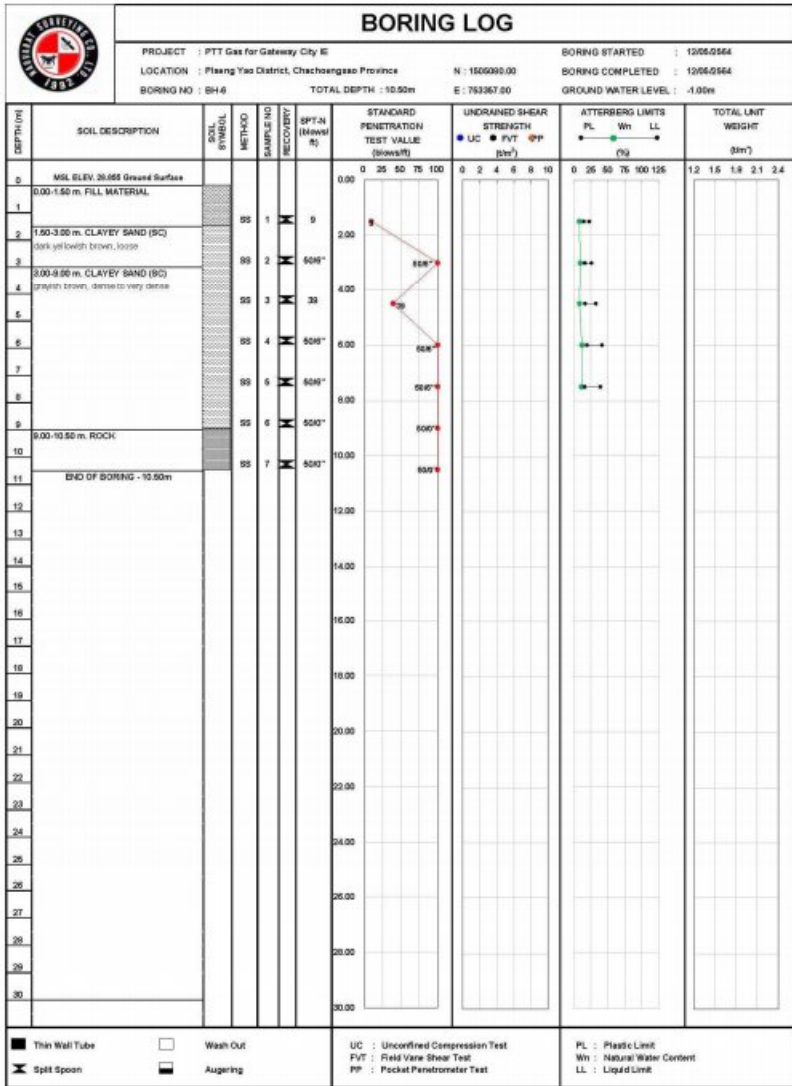


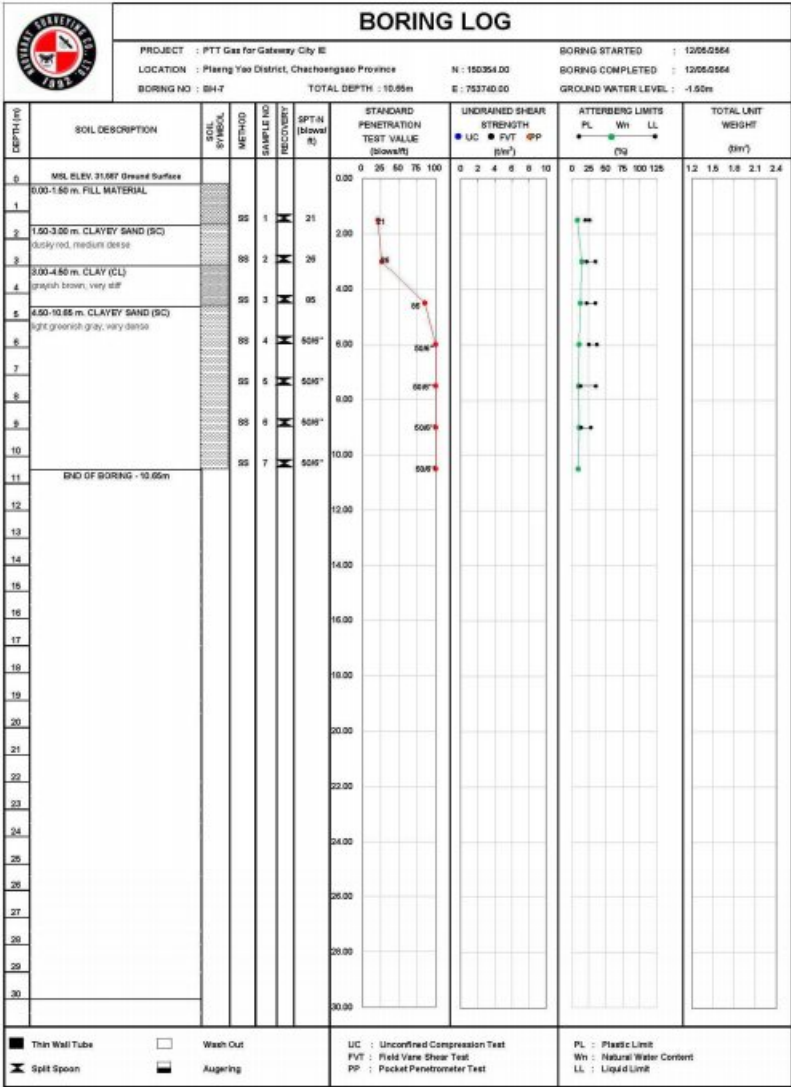
5. Boring Log of BH-5

6. Boring Log of BH-6

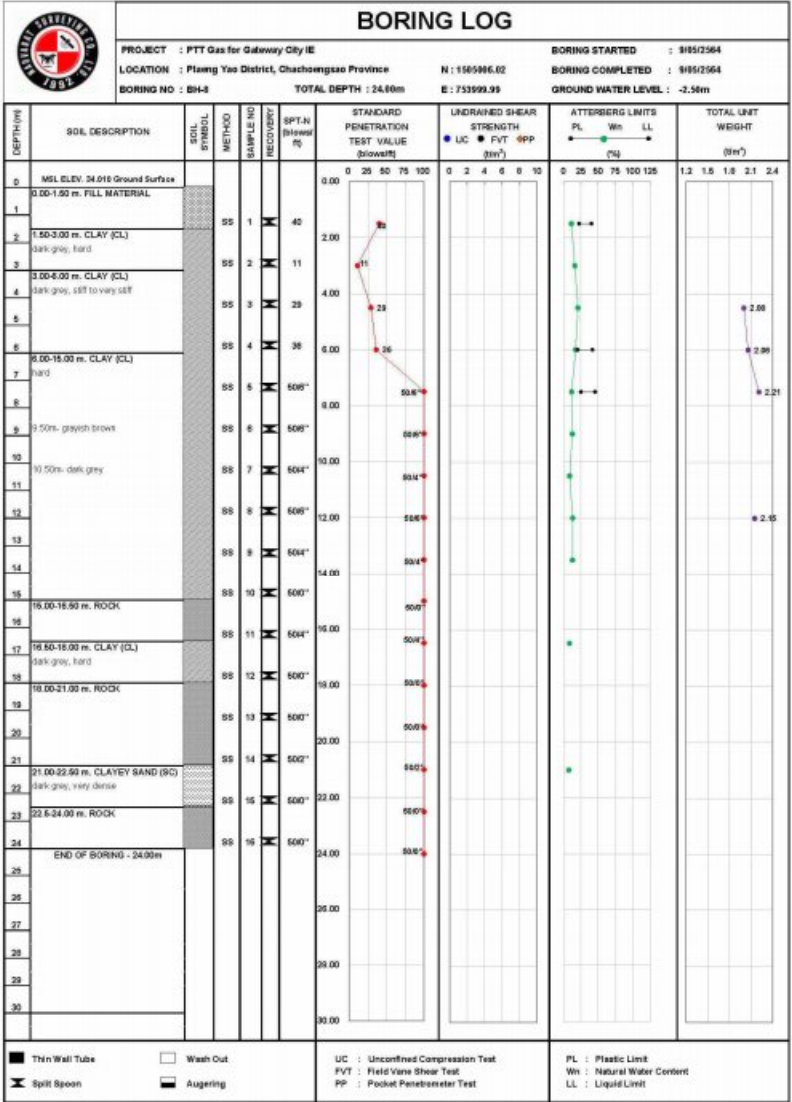


7. Boring Log of BH-7

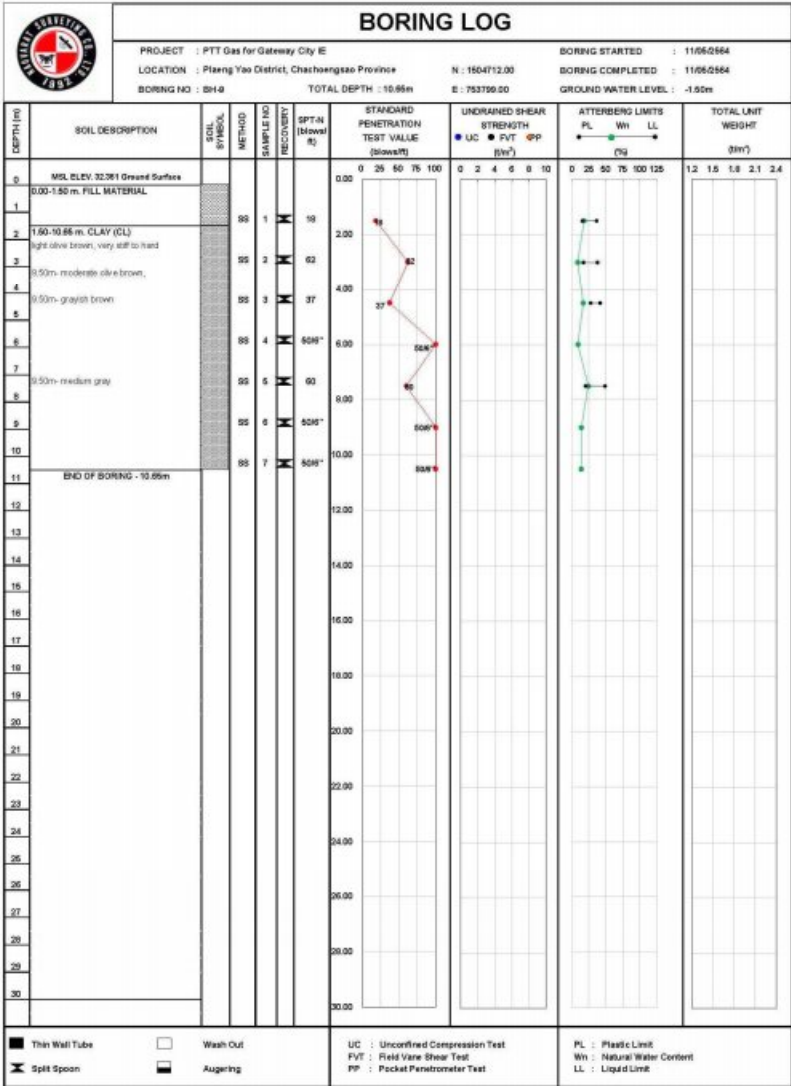




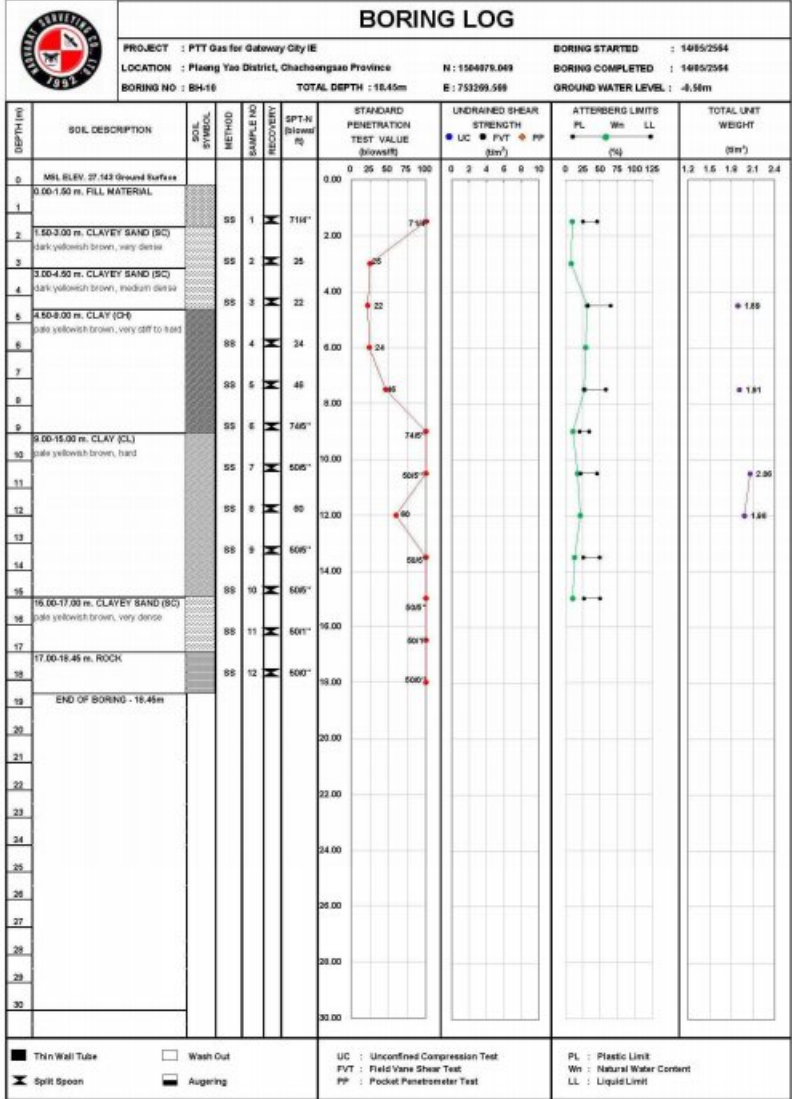
8. Boring Log of BH-8



9. Boring Log of BH-9



10. Boring Log of BH-10



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# Appendix E

## Summary of Laboratory Test

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### Content

	Page
Content	E-2
1. Summary of laboratory test of BH-1	E-3
2. Summary of laboratory test of BH-2	E-4
3. Summary of laboratory test of BH-3	E-5
4. Summary of laboratory test of BH-4	E-6
5. Summary of laboratory test of BH-5	E-7
6. Summary of laboratory test of BH-6	E-8
7. Summary of laboratory test of BH-7	E-9
8. Summary of laboratory test of BH-8	E-10
9. Summary of laboratory test of BH-9	E-11
10. Summary of laboratory test of BH-10	E-12

1. Summary of laboratory test of BH-1

SUMMARY OF TEST RESULTS															Date of Testing : 4-5/05/2021			Ground Water Level (m): -1.50m		
Project : PTT Gas for Gateway City IE															Boring No : BH-1			North : 1508014.95 East : 750895.95		
Location : Phraeng Yao District, Chachoengsao Province																				
Sample	Depth, m		Wt (%)	Atterberg Limits (%)					Grain Size Analysis					USCS	γ <sub>d</sub> (ton/m <sup>3</sup> )	S <sub>u</sub> (ton/m <sup>2</sup> )	SPT-N (blows/ft)			N value
	From	To		LL	PL	PI	35φ	#4	#10	#40	#100	#200	Group				(mm <sup>3</sup> )	1st	2nd	
SS-1	1.50	1.80	6.35										(SC)			35	50φ <sup>6</sup>	-	50φ <sup>6</sup>	
SS-2	3.00	3.15	11.47	51.25	25.90	25.65	93.16	78.53	59.77	45.41	36.22	30.42	SC				50φ <sup>6</sup>	-	50φ <sup>6</sup>	
SS-3	4.50	4.95	13.05	55.29	28.59	28.70	75.70	68.43	61.29	54.57	51.49	49.48	SC	2.16		12	15	16	31	
SS-4	6.00	6.45	32.30	48.36	28.13	22.23	100.00	100.00	98.39	93.44	85.98	79.03	CL			9	17	12	29	
SS-5	7.50	7.80	18.93										(CL)			20	50φ <sup>6</sup>	-	50φ <sup>6</sup>	
SS-6	9.00	9.45	18.35	45.96	22.09	23.87	100.00	91.73	78.39	59.49	47.19	40.87	SC			20	35	35	70	
SS-7	10.50	10.95	18.02										(SC)			16	27	29	56	
SS-8	12.00	12.45	12.15	48.75	21.77	26.96	87.05	82.35	74.55	61.60	49.76	43.23	SC			13	23	27	50	
SS-9	13.50	13.95	14.44				100.00	97.43	73.17	54.61	42.81	37.45	SC			11	17	50φ <sup>6</sup>	67	
SS-10	15.00	15.15	12.61	39.85	17.44	22.41	100.00	95.43	84.64	61.33	47.69	41.25	SC			50φ <sup>6</sup>	-	-	50φ <sup>6</sup>	
SS-11	16.50	16.80	17.22	42.89	17.24	25.65	97.28	91.79	89.14	84.27	76.80	71.27	CL			32	50φ <sup>6</sup>	-	50φ <sup>6</sup>	
SS-12	18.00	18.15	16.95										(CL)			50φ <sup>6</sup>	-	-	50φ <sup>6</sup>	
SS-13	19.50	19.65	14.03	39.85	20.49	19.36	100.00	98.40	94.65	79.89	66.43	48.12	SC			50φ <sup>6</sup>	-	-	50φ <sup>6</sup>	
SS-14	21.00	21.15	15.47				100.00	95.13	86.76	70.99	56.76	40.28	SC			50φ <sup>6</sup>	-	-	50φ <sup>6</sup>	
SS-15	22.50	22.60	14.88										(SC)			50φ <sup>4</sup>	-	-	50φ <sup>4</sup>	
SS-16	24.00	24.15					FOCK									50φ	-	-	50φ	

2. Summary of laboratory test of BH-2

SUMMARY OF TEST RESULTS															Date of Testing : 4-5/05/2021			Ground Water Level (m): -1.20m		
Project : PTT Gas for Gateway City IE															Boring No : BH-2			North : 1507165.03		
Location : Phraeng Yao District, Chachoengsao Province															East : 752193.05					
Sample No.	Depth, m		Wt (%)	Atterberg Limits (%)			Grain Size Analysis							USCS	γ <sub>d</sub>	S <sub>u</sub>	SPT-N (blows/m)			N value
	From	To		LL	PL	PI	35φ	#4	#10	#40	#100	#200	Comp				(mm <sup>3</sup> )	1 st	2nd	
SS-1	1.50	1.95	4.44	37.42	17.57	19.85	100.00	99.50	96.10	84.70	75.07	63.94	CL				16	13	13	26
SS-2	3.00	3.45	11.37	31.49	16.69	14.80	77.14	59.38	45.67	35.67	30.46	27.02	QC				30	35	5015	65
SS-3	4.50	4.95	10.63	40.25	21.84	18.41	100.00	97.01	87.70	75.57	63.54	57.01	CL	2.13			27	35	47	82
SS-4	6.00	6.30	6.74	37.52	20.32	17.20	100.00	98.27	90.44	70.61	57.54	48.37	SC				37	50φ <sup>6</sup>	-	50φ <sup>6</sup>
SS-5	7.50	7.80	8.24	39.63	20.33	18.70	100.00	100.00	97.73	74.82	52.28	44.91	SC				43	50φ <sup>6</sup>	-	50φ <sup>6</sup>
SS-6	9.00	9.15	8.93	37.41	21.80	15.53	88.40	84.42	76.24	58.67	47.84	42.21	SC				50φ <sup>6</sup>	-	-	50φ <sup>6</sup>
SS-7	10.50	10.65	7.24	47.37	27.03	20.34	100.00	97.77	86.54	59.84	48.15	42.54	SC				50φ <sup>6</sup>	-	-	50φ <sup>6</sup>

## 3. Summary of laboratory test of BH-3

SUMMARY OF TEST RESULTS																		
Project : PTT Gas for Gateway City IE										Date of Testing : 13/05/2021		Ground Water Level (m): -0.30m						
Location : Plangng Yao District, Chachoengsao Province										Boring No : BH-3		North : 1506121.383 East : 753225.757						
Sample	Depth m	Wn (%)	Atterberg Limits (%)			Grain Size Analysis					USCS	γ <sub>s</sub> (t/m <sup>3</sup> )	S <sub>u</sub> (kN/m <sup>2</sup> )			SPT-N (Blow/meter)	Penetration N	
			LL	PL	PI	3#	#4	#10	#40	#100			#200	1 st	2nd			3rd
SS-1	1.50	1.95	9.81	25.15	18.38	6.79	30.95	72.25	50.33	28.17	32.25	25.65	SC		20	25	22	47
SS-2	3.00	3.45	12.04										(SC)		50.4 <sup>+</sup>	-	-	50.4 <sup>+</sup>
SS-3	4.50	4.95	3.38	40.02	28.74	11.28	100.00	86.31	91.00	79.31	67.72	62.95	CL		16	35	40	75
SS-4	6.00	6.45	12.02										(CL)		50	50.4 <sup>+</sup>	-	50.4 <sup>+</sup>
SS-5	7.50	7.95	NR										(CL)		50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>
SS-6	9.00	9.45	22.20	33.71	23.45	10.25	100.00	97.21	90.67	75.23	64.69	58.11	CL		50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>
SS-7	10.50	10.95	13.65		NP		100.00	96.85	49.08	3.75	2.46	1.92	GC		50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>
SS-8	12.00	12.45													50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>
SS-9	13.50	13.95													50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>
SS-10	15.00	15.45													50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>

## 4. Summary of laboratory test of BH-4

SUMMARY OF TEST RESULTS																		
Project : PTT Gas for Gateway City IE										Date of Testing : 14/05/2021				Ground Water Level (m): -0.30m				
Location : Plangng Yao District, Chachoengsao Province										Boring No : BH-4				North : 1506071.618 East : 753285.596				
Sample	Depth m	Wn (%)	Atterberg Limits (%)			Grain Size Analysis					USCS	%	S <sub>u</sub>	SPT-N (Blow/cm)			average	
No.	From	To	LL	PL	PI	3#	#10	#40	#100	#200	Group	(mm) <sup>3</sup>	mm <sup>2</sup>	1 st	2nd	3rd	N	
SS-1	1.50	1.95	8.64	29.31	12.02	97.82	74.83	51.05	38.10	32.55	25.82	SC		28	38	38	76	
SS-2	3.00	3.45	16.57								(SC)			10	15	24	39	
SS-3	4.50	4.75	12.69		NP		92.96	76.53	62.77	48.85	38.38	31.35	SC		10	12	20	32
SS-4	6.00	6.45	14.79	29.17	26.12	13.05	100.00	100.00	92.68	70.67	53.88	47.38	SC				50.5 <sup>+</sup>	
SS-5	7.50	7.95												50.0 <sup>+</sup>	-	-	50.0 <sup>+</sup>	
ROCK																		

5. Summary of laboratory test of BH-5

SUMMARY OF TEST RESULTS																			
Project : PTT Gas for Gateway City IE										Date of Testing : 8/05/2021		Ground Water Level (m): -1.00m							
Location : Plang Yao District, Chachoengsao Province										Boring No : BH-5		North : 1505488.95 East : 752950.99							
Sample	Depth m		Wn	Atterberg Limits (%)			Grain Size Analysis						USCS	$\gamma$	$S_u$	SPT-N (Blow/meter)			N value
No.	From	To	(%)	LL	PL	PI	3 $\phi$	#4	#10	#40	#100	#200	Group	( $\text{ton}^3$ )	$\text{ton}^2$	1st	2nd	3rd	
SS-1	1.50	1.95	9.37	32.46	10.87	21.59	97.37	86.90	69.66	62.54	53.86	43.66	SC			29	29	20	49
SS-2	3.00	3.45	13.24	22.87	16.29	6.58	97.24	78.39	67.82	62.18	53.52	41.20	SC			2	5	16	21
SS-3	4.50	4.75	13.56	35.42	19.14	16.28	100.00	100.00	99.08	94.90	83.86	71.02	CL			14	504 <sup>+</sup>	47	504 <sup>+</sup>
SS-4	6.00	6.90					ROCK									500	-	-	500
SS-5	7.50	7.50					ROCK									500	-	-	500
SS-6	9.00	9.00					ROCK									500	-	-	500
SS-7	10.50	10.50					ROCK									500	-	-	500

May 05, 2021

E-7  
Naovarat Surveying Co., Ltd

6. Summary of laboratory test of BH-6

SUMMARY OF TEST RESULTS																			
Project : PTT Gas for Gateway City IE										Date of Testing : 12/05/2021					Ground Water Level (m): -1.00m				
Location : Plang Yao District, Chachoengsao Province										Boring No : BH-6					North : 1505980.00 East : 753357.00				
Sample	Depth m		Wn	Atterberg Limits (%)			Grain Size Analysis						USCS	γ <sub>d</sub> (ton/m <sup>3</sup> )	S <sub>u</sub> (ton/m <sup>2</sup> )	SPT-N (Blow/feet)			value
	From	To		LL	PL	PI	35 $\phi$	#4	#10	#40	#100	#200				Group	1st	2nd	
SS-1	1.50	1.95	7.74	22.83	14.18	8.45	100.00	88.41	75.31	68.57	59.16	43.05	SC			9	5	4	9
SS-2	3.00	3.45	9.28	25.55	15.17	9.78	97.08	80.37	67.57	55.80	47.27	35.16	SC			504 <sup>+</sup>	-	-	504 <sup>+</sup>
SS-3	4.50	4.75	8.01	32.19	16.23	15.95	96.52	79.63	64.70	49.67	42.70	39.66	SC	2.13		24	17	22	39
SS-4	6.00	6.00	11.71	41.16	18.66	22.32	97.01	76.99	58.52	44.34	39.48	37.12	SC			504 <sup>+</sup>	-	-	504 <sup>+</sup>
SS-5	7.50	7.50	10.92	38.80	15.59	23.21	100.00	99.43	89.01	55.67	39.50	31.51	SC			504 <sup>+</sup>	-	-	504 <sup>+</sup>
SS-6	9.00	9.00					ROCK									500	-	-	500
SS-7	10.50	10.50					ROCK									500	-	-	500

May 05, 2021

E-8  
Naovarat Surveying Co., Ltd.

7. Summary of laboratory test of BH-7

SUMMARY OF TEST RESULTS																			
Project : PTT Gas for Gateway City IE				Date of Testing : 12/05/2021				Ground Water Level (m): -1.50m											
Location : Plangng Yoo District, Chachoengsao Province				Boring No : BH-7				North : 1505354.00 East : 753740.00											
Sample	Depth m		Wt	Atterberg Limits (%)			Grain Size Analysis						USCS	$\gamma_s$ ( $\text{ton}^3$ )	$S_u$ $\text{ton}^2$	SPT-N (blows/m)			N value
	From	To		LL	PL	PI	3/8"	#4	#10	#40	#100	#200				Group	1 st	2nd	
SS-1	1.50	1.95	7.94	25.55	19.57	5.98	97.96	91.57	79.25	64.38	55.69	46.29	SC			6	9	12	21
SS-2	3.00	3.45	14.39	34.63	21.45	13.18	100.00	100.00	99.47	97.06	76.04	62.58	CL	2.15		6	14	12	26
SS-3	4.50	4.95	12.39	34.63	21.45	13.18	100.00	92.65	76.16	55.95	41.41	32.08	SC			21	35	50/6"	65
SS-4	6.00	6.30	10.34	39.64	24.64	12.00	100.00	100.00	100.00	70.72	56.01	45.09	SC			31	50/6"	-	50/6"
SS-5	7.50	7.65	9.69	34.63	12.42	22.51	100.00	100.00	97.66	63.46	59.55	41.33	SC			50/6"	-	-	50/6"
SS-6	9.00	9.20	19.51	27.61	13.38	14.23	100.00	100.00	99.06	63.46	38.57	29.88	SC			26	50/6"	-	50/6"
SS-7	10.50	10.65	9.09										SC(C)			50/6"	-	-	50/6"

8. Summary of laboratory test of BH-8

SUMMARY OF TEST RESULTS																			
Project : PTT Gas for Gateway City IE				Date of Testing : 9/05/2021				Ground Water Level (m): -2.00m											
Location : Plang Yoo District, Chachoengsao Province				Boring No : BH-8				North : 1505006.02 East : 753999.99											
Sample	Depth m		Wt (%)	Atterberg Limits (%)			Grain Size Analysis						USCS	γ <sub>s</sub> (ton/m <sup>3</sup> )	S <sub>u</sub> (ton/m <sup>2</sup> )	SPT-N (blows/m)			N value
	From	To		LL	PL	PI	3/8"	#4	#10	#40	#100	#200				Group	1st	2nd	
SS-1	1.50	1.95	11.25	40.12	22.22	17.90	95.69	95.40	94.71	90.67	84.64	74.17	CL			12	20	28	40
SS-2	3.00	3.45	16.16										CL			2	4	7	11
SS-3	4.50	4.95	20.80										CL	2.00		7	13	16	29
SS-4	6.00	6.45	17.30	41.71	20.19	21.52	100.00	97.58	96.56	95.00	93.56	89.16	CL	2.05		9	18	18	35
SS-5	7.50	7.90	11.54	45.48	25.11	20.37	100.00	100.00	99.88	97.96	91.38	85.81	CL	2.21		28	50/6"	-	50/6"
SS-6	9.00	9.15	12.71				100.00	100.00	99.77	96.62	92.53	87.78	CL			50/6"	-	-	50/6"
SS-7	10.50	10.60	8.75				100.00	100.00	99.31	91.91	82.77	78.76	CL			50/6"	-	-	50/6"
SS-8	12.00	12.15	13.31				100.00	100.00	100.00	99.52	98.65	97.52	CL	2.15		50/6"	-	-	50/6"
SS-9	13.50	13.60	12.80				100.00	100.00	99.42	95.63	91.17	87.16	CL			50/6"	-	-	50/6"
SS-10	15.00	15.00					ROCK									50/6"	-	-	50/6"
SS-11	16.50	16.60	8.43				100.00	99.61	92.79	74.48	55.74	53.45	CL			50/6"	-	-	50/6"
SS-12	18.00	18.00					ROCK									50/6"	-	-	50/6"
SS-13	19.50	19.50					ROCK									50/6"	-	-	50/6"
SS-14	21.00	21.05	7.55				70.69	60.44	58.88	47.66	38.32	27.15	SC			50/2"	-	-	50/2"
SS-15	22.50	22.50					ROCK									50/6"	-	-	50/6"
SS-16	24.00	24.00					ROCK									50/6"	-	-	50/6"

9. Summary of laboratory test of BH-9

SUMMARY OF TEST RESULTS																			
Project : PTT Gas for Gateway City IE										Date of Testing : 11/05/2021					Ground Water Level (m): -1.50m				
Location : Plang Yao District, Chachoengsao Province										Boring No : BH-9					North : 1004712.00 East : 753799.00				
Sample	Depth m		Wt	Atterberg Limits (%)				Grain Size Analysis						USCS		$\gamma_s$		$S_u$	
	From	To		LL	PL	PI	38 $\phi$	#4	#10	#40	#100	#200	Group			( $\text{mm}^3$ )	$\text{mm}^2$	1 st	2nd
SS-1	1.50	1.95	17.63	36.21	15.27	20.94	100.00	100.00	99.54	94.57	81.28	60.20	CL					5	9
SS-2	3.00	3.45	8.44	37.38	16.67	20.71	100.00	100.00	100.00	99.55	88.11	63.50	CL					13	23
SS-3	4.50	4.95	16.53	41.57	27.47	14.10	100.00	98.48	97.50	92.35	78.90	63.63	CL					15	22
SS-4	6.00	6.15	8.75				100.00	98.75	85.92	82.57	71.34	68.98	CL					50.9 $\phi$	-
SS-5	7.50	7.95	23.86	48.60	19.89	28.71	100.00	100.00	100.00	99.65	94.03	79.48	CL					15	23
SS-6	9.00	9.30	13.63				100.00	98.97	95.40	70.22	62.54	51.61	CL					24	50.9 $\phi$
SS-7	10.50	10.65	13.43				100.00	100.00	99.20	78.15	62.16	55.19	CL					50.9 $\phi$	-

10. Summary of laboratory test of BH-10

SUMMARY OF TEST RESULTS																				
Project : PTT Gas for Gateway City IE										Date of Testing : 14/05/2021					Ground Water Level (m): -0.50m					
Location : Phang Yao District, Chachoengsao Province										Boring No : BH-10					North : 1504079.049 East : 753269.569					
Sample	Depth m		Wt	Atterberg Limits (%)				Grain Size Analysis						USCS	γ <sub>s</sub>	S <sub>u</sub>	SPT-N (blow/meter)			
	From	To		(Fs)	LL	PL	PI	3/8"	#4	#10	#40	#100	#200				Group	(mm <sup>3</sup> )	mm <sup>2</sup>	1st
SS-1	1.50	1.95	9.49						95.58	89.66	76.54	68.47	58.34	42.87	SC			29	30	41.4 <sup>o</sup>
SS-2	3.00	3.45	8.05												(SC)			16	16	9
SS-3	4.50	4.95	31.22	65.12	31.79	33.36		100.00	100.00	100.00	96.54	83.52	69.54	CH			8	10	12	
SS-4	6.00	6.45	29.01											(CH)			10	11	13	
SS-5	7.50	7.95	27.07											(CH)			18	23	23	
SS-6	9.00	9.45	10.67											(CL)			26	46	28.5 <sup>o</sup>	
SS-7	10.50	10.95	17.36	45.52	21.59	23.94		100.00	100.00	100.00	92.89	85.44	77.61	CL			35	50.5 <sup>o</sup>	-	
SS-8	12.00	12.45	21.22											(CL)			6	29	31	
SS-9	13.50	13.95	12.99											(CL)			30	50.5 <sup>o</sup>	-	
SS-10	15.00	15.45	10.38	49.67	26.59	23.08		89.55	73.60	57.46	40.28	33.37	29.14	SC			34	50.5 <sup>o</sup>	-	
SS-11	16.50	16.95												(SC)			50.1 <sup>o</sup>	-	-	
SS-12	18.00	18.45															50.0 <sup>o</sup>	-	-	
REMARK																				

Appendix F

Design of Pile Foundation

Calculation of load capacity of pile foundations

(Pile Foundation)

The ultimate bearing capacity of a pile is determined by the following equation.

$$Q_u = Q_f + Q_e$$

The allowable bearing capacity of a pile is determined taking into account the factor of safety as shown below.

$$Q_{all} = \frac{(Q_f + Q_e) - W_p}{FS}$$

- When,  $Q_u$  = Ultimate bearing load (ton)
- $Q_{all}$  = Allowable bearing load (ton)
- $Q_f$  = Ultimate skin friction load (ton)
- $Q_e$  = Ultimate end bearing load (ton)
- $W_p$  = Weight of pile (ton)
- FS = Factor of safety (2.00 to 3.00)

Ultimate skin friction load

$$Q_f = \Sigma(f_s A_s)$$
$$Q_f = \Sigma(f_s P L)$$

- When,  $f_s$  = Skin friction (ton/square meter)
- $A_s$  = Surface area of pile foundation (square meter)
- P = Perimeter of pile (meter)
- L = Length of pile for soil layer (meter)

Pile foundation (Clay)

$$f_s = \alpha \cdot S_u$$

- When,  $\alpha$  = Adhesion Factor (Figure H-1)
- $S_u$  = Undrained shear strength (ton/square meter) (Figure F-2)

Pile foundation (Sand)

$$f_s = K_s (po')_{av} \tan \delta$$

- When,  $K_s$  = Coefficient for earth pressure
- = 1 for loose sand and 2 for dense sand (For driven pile)
- =  $1 - \sin \phi$  (for bored pile)
- $(po')_{av}$  = Effective overburden Stress (ton/square meter)
- $\delta$  = Friction angle between soil and pile
- =  $\frac{3}{4} \phi$
- $\phi$  = Friction angle of Soil obtained from corrected  $N_{SPT}$  (Figure F-3)

**Ultimate end bearing capacity**

$$Q_e = q_e A_p$$

When,  $q_e$  = Ultimate end bearing capacity (ton/square meter)  
 $A_p$  = Pile tip area (square meter)

**For Pile foundation in clay**

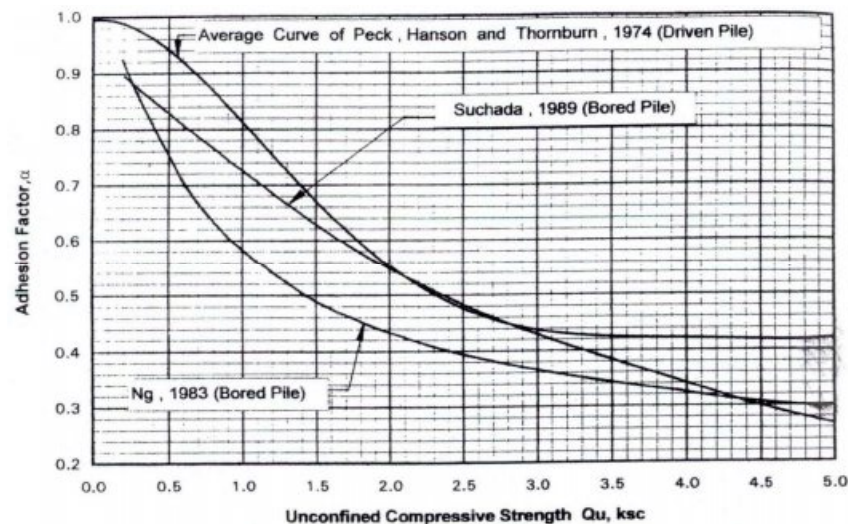
$$q_e = N_c \cdot S_u$$

When,  $N_c$  = Bearing Capacity Factors (Figure F-4)  
 $S_u$  = Undrained shear strength (ton/square meter)

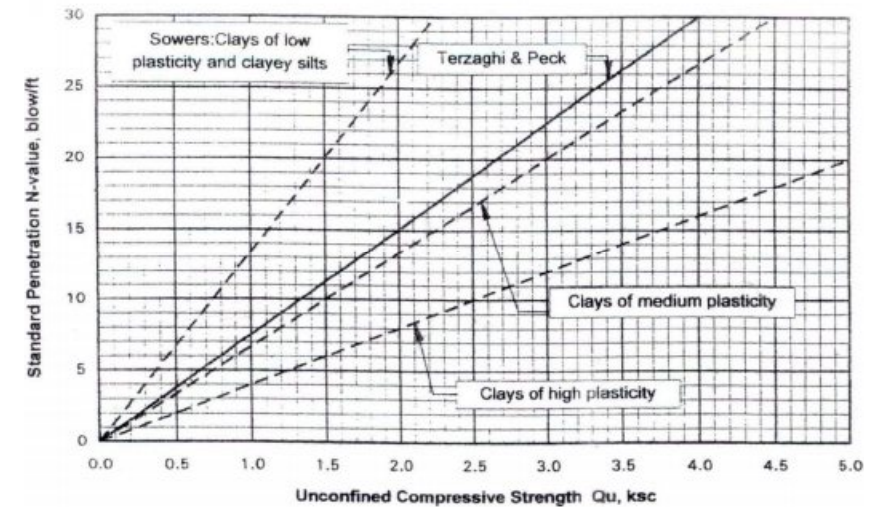
**For Pile foundation in sandy soil**

$$q_e = p_o' \cdot N_q$$

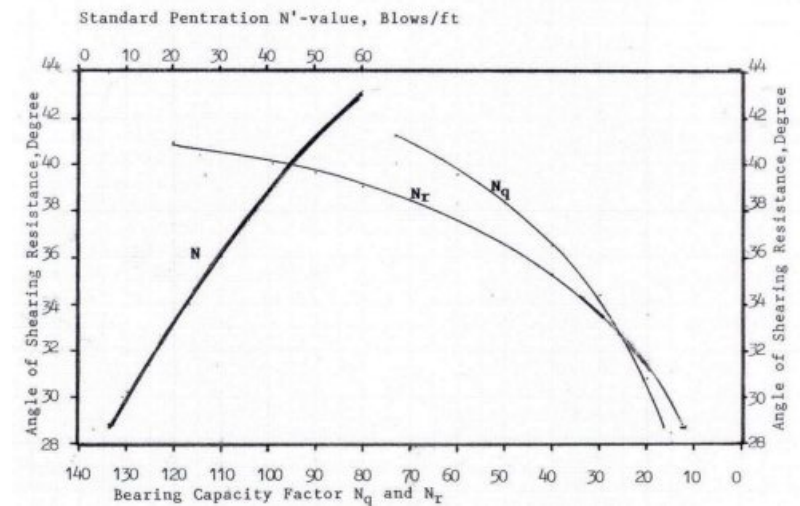
When,  $p_o'$  = Effective Stress at end of pile (ton/square meter)  
 $N_q$  = Bearing Capacity Factors (Figure F-5) or (Table 1)



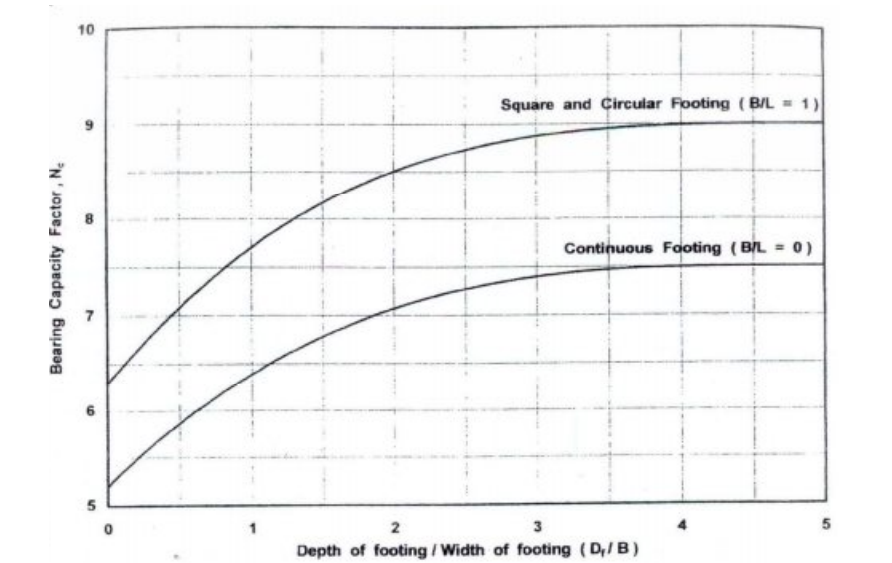
**Figure F-1.** Correlation of Adhesion Factor of pile in clay with Unconfined Compressive Strength



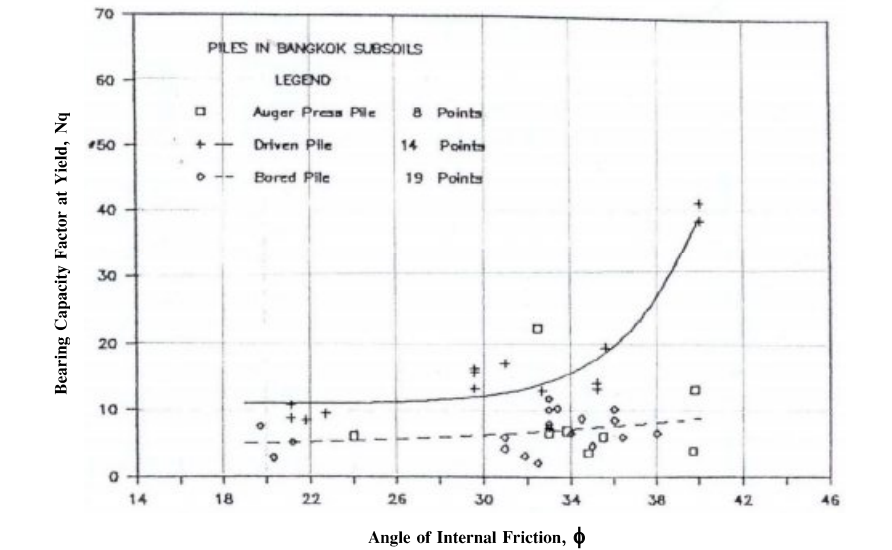
**Figure F-2.** Correlation of Standard Penetration with Unconfined Compressive Strength of Clay (NAVFAC DM-7.1, 1982)



**Figure F-3.** Correlation of Standard Penetration with Bearing Capacity Factors and Angle of Shearing Resistance (Peck, Hanson and Thornburn 1974)



**Figure F-4.** Bearing Capacity Factor,  $N_c$  for Foundation on Clay under  $\phi = 0$  condition (Skempton, 1951)



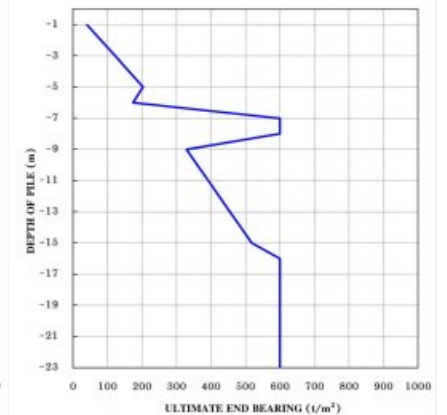
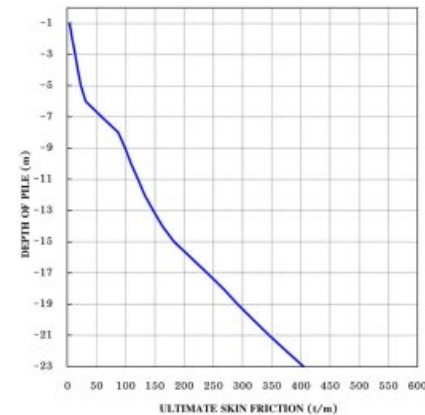
**Figure F-5.** Relation between Bearing Capacity Factor and Angle of Internal Friction of Bangkok Sand

**Table 1.** The relationship between friction angle and Bearing Capacity Factor ( $N_q$ ) (NAVFAC, 1986)

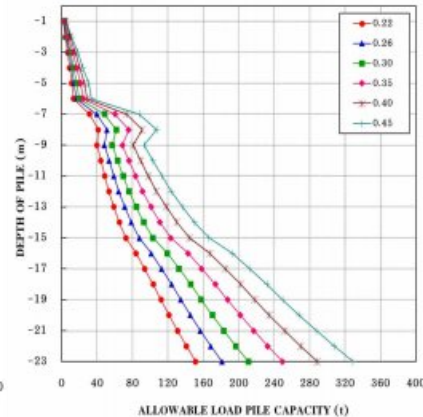
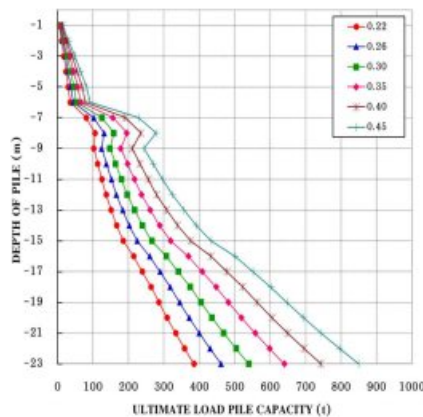
$\phi$ (Degree)	26	28	30	31	32	33	34	35	36	37	38	39	40
$N_q$ (Driven Pile)	10	15	20	24	29	35	42	50	60	77	86	120	145
$N_q$ (Bored pile)	5	8	10	12	14	17	21	25	30	38	43	60	72

## Driven Pile Design

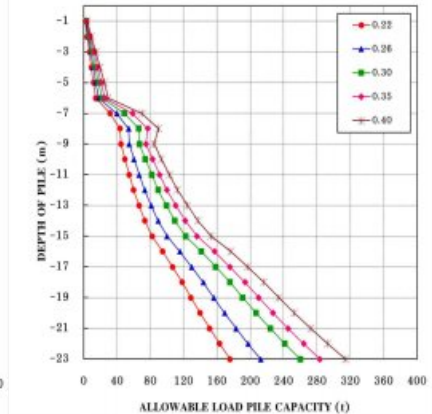
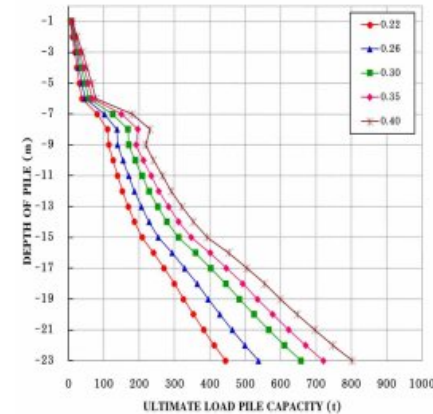
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PET Gas for G.0.0m City II LOCATION : Pongm Yao District, Chachoengsao Province Date :							BORE HOLE : BH-1 LOCATION : 1.08 m CALCULATED BY : MUHAMMAD AZHAR							
DEPTH (OF PILE TIP) (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECTED) (blows/ft)	$S_u$ (t/m <sup>2</sup> )	$\alpha$	$N_c$	TOTAL OVBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (degree)	$N_q$	Qf (t/m)	SUM Qf (t/m)	Qe (t/m)
-1.00	CLAYEY SAND	100	59	2.36			2.36	1.036	40.2	35.0	3.6	3.6	40.6	
-2.00	CLAYEY SAND	100	59	4.32			3.32	1.925	40.2	35.0	4.4	4.4	81.2	
-3.00	CLAYEY SAND	100	59	6.48			4.48	1.925	40.2	35.0	5.7	13.7	121.8	
-4.00	CLAYEY SAND	31	23	8.64			5.64	1.421	34.1	36.0	6.2	17.6	166.4	
-5.00	CLAYEY SAND	31	23	10.80			6.80	1.421	34.1	35.0	5.0	23.2	220.0	
-6.00	CLAY	29	20	19.34	0.400	9.0	19.34	7.70			8.1	31.5	174.1	
-7.00	CLAY	100	100	66.70	0.400	9.0	14.60	8.60			28.0	59.1	600.3	
-8.00	CLAY	100	100	66.70	0.400	9.0	16.50	9.50			28.0	67.1	600.3	
-9.00	CLAYEY SAND	70	43	38.40			38.40	20.40	1.862	41.4	35.0	11.4	16.5	329.0
-10.00	CLAYEY SAND	56	36	33.30			33.30	11.30	1.750	37.5	35.0	10.8	109.3	360.5
-11.00	CLAYEY SAND	56	36	22.20			22.20	1.750	37.5	35.0	11.6	120.9	352.0	
-12.00	CLAYEY SAND	50	33	24.10			24.10	13.10	1.644	36.2	35.0	11.6	130.5	423.5
-13.00	CLAYEY SAND	47	41	35.00			35.00	14.00	1.833	39.0	35.0	14.8	147.3	455.0
-14.00	CLAYEY SAND	47	41	17.60			17.60	14.00	1.833	39.0	35.0	15.9	163.1	486.5
-15.00	CLAYEY SAND	100	59	25.80			25.80	15.80	2.043	41.4		19.9	183.0	538.0
-16.00	CLAY	100	100	66.70	0.400	9.0	31.70	16.70			28.0	211.0	600.3	
-17.00	CLAY	100	100	66.70	0.400	9.0	33.60	17.60			28.0	239.0	600.3	
-18.00	CLAY	100	100	66.70	0.400	9.0	35.50	18.50			28.0	267.0	600.3	
-19.00	CLAYEY SAND	100	59	37.40			37.40	19.40	2.069	41.8	35.0	25.0	252.1	600.0
-20.00	CLAYEY SAND	100	59	39.30			39.30	20.30	2.079	42.0	35.0	26.4	318.5	600.0
-21.00	CLAYEY SAND	100	59	41.20			41.20	21.20	2.082	42.0	35.0	27.6	386.1	600.0
-22.00	CLAYEY SAND	100	59	43.10			43.10	22.10	2.083	42.0	35.0	28.8	454.0	600.0
-23.00	CLAYEY SAND	100	59	45.00			45.00	23.00	2.083	42.0	35.0	29.9	524.0	600.0



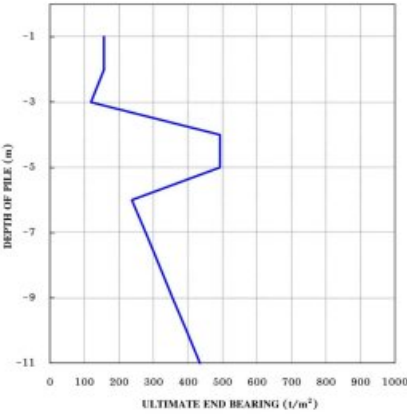
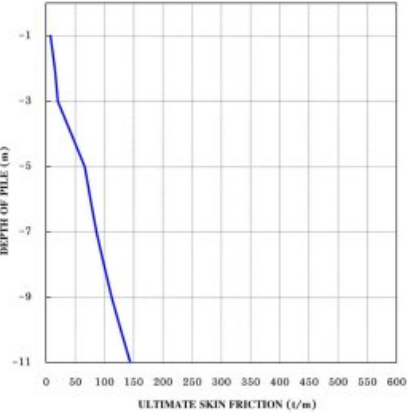
BEARING CAPACITY OF PILE FOUNDATION																
DRIVEN PILE																
PROJECT : PTT Gas for Gateway City E										BORE HOLE : BH-1						
LOCATION : Phang Yao District, Chachoengsao Province										GROUND WATER : 1.50 m						
FACTOR OF SAFETY : 2.50										CALCULATED BY : MOHAMMED AZHAR						
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (Correct) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)						ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)					
					SQUARE CONCRETE PILE SECTION (m x m)						SQUARE CONCRETE PILE SECTION (m x m)					
					0.22	0.26	0.30	0.35	0.40	0.45	0.22	0.26	0.30	0.35	0.40	0.45
-1.00	CLAYEY SAND	58	3.6	40.6	5.3	6.5	7.6	8.7	9.8	10.9	3.3	4.0	4.7	5.4	6.1	6.8
-2.00	CLAYEY SAND	58	8.0	88.2	11.0	13.6	15.9	18.2	20.5	22.8	5.2	6.3	7.3	8.3	9.3	10.4
-3.00	CLAYEY SAND	58	14.2	154.6	18.6	22.5	26.4	30.4	34.3	38.2	8.5	10.3	12.1	13.9	15.7	17.5
-4.00	CLAYEY SAND	58	17.9	192.4	23.7	28.6	34.2	39.8	45.4	51.0	11.2	13.4	15.6	17.8	20.0	22.2
-5.00	CLAYEY SAND	58	23.0	250.0	30.0	37.6	45.8	53.9	62.0	70.1	14.4	17.2	20.0	22.8	25.6	28.4
-6.00	CLAY	100	11.1	124.1	25.8	31.4	37.0	42.6	48.2	53.8	10.9	13.2	15.4	17.6	19.8	22.0
-7.00	CLAY	100	59.1	650.3	81.3	100.0	124.9	150.8	176.6	202.5	59.1	73.8	88.5	103.2	117.9	132.6
-8.00	CLAY	100	87.1	950.3	121.2	151.2	186.6	222.0	257.4	292.8	87.1	106.7	126.3	145.9	165.5	185.1
-9.00	CLAYEY SAND	58	36.5	398.0	102.6	124.7	147.8	170.9	194.0	217.1	48.4	58.2	68.0	77.8	87.6	97.4
-10.00	CLAYEY SAND	58	109.3	1190.3	138.0	165.6	193.2	220.8	248.4	276.0	109.3	131.2	153.1	175.0	196.9	218.8
-11.00	CLAYEY SAND	58	109.0	1187.0	137.5	165.0	192.5	220.0	247.5	275.0	108.8	130.6	152.4	174.2	196.0	217.8
-12.00	CLAYEY SAND	58	108.7	1184.7	137.0	164.4	191.8	219.2	246.6	274.0	108.3	130.0	151.8	173.6	195.4	217.2
-13.00	CLAYEY SAND	58	108.4	1182.4	136.5	163.8	191.2	218.6	246.0	273.4	107.8	129.4	151.2	173.0	194.8	216.6
-14.00	CLAYEY SAND	58	108.1	1180.1	136.0	163.2	190.6	218.0	245.4	272.8	107.3	128.8	150.6	172.4	194.2	216.0
-15.00	CLAYEY SAND	58	107.8	1177.8	135.5	162.6	189.9	217.4	244.8	272.2	106.8	128.2	150.0	172.2	193.8	215.4
-16.00	CLAYEY SAND	58	107.5	1175.5	135.0	162.1	189.4	216.9	244.3	271.7	106.3	127.6	149.4	171.6	193.2	214.8
-17.00	CLAY	100	234.0	2500.3	244.7	295.9	347.1	398.3	449.5	500.7	234.0	284.2	335.3	386.5	437.6	488.8
-18.00	CLAY	100	257.0	2780.3	268.0	324.2	375.4	426.6	477.8	528.9	257.0	307.2	358.3	409.5	460.6	511.8
-19.00	CLAYEY SAND	58	292.1	3180.1	356.0	429.1	502.2	575.3	648.4	721.5	292.1	349.8	407.5	465.2	522.9	580.6
-20.00	CLAYEY SAND	58	333.5	3630.5	416.8	500.2	593.3	686.4	779.5	872.6	333.5	400.2	483.3	566.4	649.5	732.6
-21.00	CLAYEY SAND	58	348.1	3780.1	436.1	520.5	613.6	706.7	799.8	892.9	348.1	416.8	500.0	583.2	666.4	749.6
-22.00	CLAYEY SAND	58	374.9	4050.9	476.2	568.8	661.9	755.0	848.1	941.2	374.9	445.0	528.2	611.4	694.6	777.8
-23.00	CLAYEY SAND	58	404.6	4350.6	516.3	616.6	716.9	817.2	917.5	1017.8	404.6	483.3	566.6	649.9	733.2	816.5



BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE																
PROJECT : PTT Gas for Gateway City E				BORE HOLE : BH-1												
LOCATION : Phang Yao District, Chachoengsao Province				GROUND WATER : 1.50 m												
FACTOR OF SAFETY : 2.50				CALCULATED BY : MOHAMMED AZHAR												
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)						
					I SECTION (cm x cm)					I SECTION (cm x cm)						
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40		
-1.00	CLAYEY SAND	58	3.6	40.6	5.1	6.3	7.4	8.5	9.6	10.7	3.1	3.8	4.5	5.2	5.9	6.6
-2.00	CLAYEY SAND	58	8.0	88.2	11.0	13.6	15.9	17.9	20.4	24.5	4.3	5.2	6.5	7.8	9.2	
-3.00	CLAYEY SAND	58	14.2	154.6	18.6	22.5	26.4	31.4	36.4	39.7	7.1	8.8	10.8	12.8	15.0	
-4.00	CLAYEY SAND	22	17.9	192.4	24.0	30.1	36.9	43.9	52.4	5.2	11.6	14.2	16.8	19.8		
-5.00	CLAYEY SAND	22	24.0	252.0	30.6	38.3	46.9	55.7	66.4	11.6	14.9	18.1	21.2	25.1		
-6.00	CLAY	30	31.1	174.3	38.4	47.2	57.8	66.6	77.4	14.8	18.2	22.2	26.2			
-7.00	CLAY	100	59.1	600.3	81.3	100.1	125.2	150.3	180.5	31.9	40.1	49.1	58.9	70.1		
-8.00	CLAY	100	87.1	600.3	110.7	137.4	168.4	196.6	230.9	43.6	54.1	66.3	77.1	90.0		
-9.00	CLAYEY SAND	41	88.5	329.0	114.0	138.2	170.2	194.4	218.6	44.2	54.2	67.0	74.8	88.5		
-10.00	CLAYEY SAND	36	109.3	360.5	136.5	154.3	188.8	212.1	241.3	49.7	50.4	74.2	82.6	93.5		
-11.00	CLAYEY SAND	36	103.0	392.0	136.5	170.3	205.5	233.9	266.0	54.9	66.9	91.4	91.4	103.1		
-12.00	CLAYEY SAND	32	126.5	412.5	152.7	196.4	238.2	265.9	299.0	60.1	73.2	89.6	100.0	112.7		
-13.00	CLAYEY SAND	41	147.3	455.0	169.2	200.6	250.8	283.1	331.4	66.2	81.2	99.3	110.7	124.7		
-14.00	CLAYEY SAND	41	163.1	486.5	188.8	227.6	278.9	298.9	311.9	73.6	89.6	109.5	122.0	137.9		
-15.00	CLAYEY SAND	58	213.0	518.0	208.7	254.4	311.3	347.5	393.3	82.3	100.1	122.5	136.1	150.9		
-16.00	CLAY	100	211.0	511.0	240.8	295.5	359.1	403.0	453.9	95.5	115.6	141.5	157.3	176.8		
-17.00	CLAY	100	248.0	600.0	270.2	338.8	403.2	447.7	504.3	106.7	128.8	156.7	175.6	196.5		
-18.00	CLAY	100	257.0	600.0	299.6	364.1	445.4	492.4	554.8	118.8	143.8	175.7	193.0	216.5		
-19.00	CLAYEY SAND	58	292.1	600.0	326.9	395.6	484.0	534.7	599.8	138.4	156.1	191.0	210.2	234.3		
-20.00	CLAYEY SAND	58	318.5	600.0	353.5	428.9	524.8	576.3	647.3	138.8	159.9	203.7	227.4	253.0		
-21.00	CLAYEY SAND	58	348.1	600.0	386.4	461.9	567.2	623.2	697.4	151.4	169.3	204.0	245.5	272.6		
-22.00	CLAYEY SAND	58	374.9	600.0	412.8	500.0	611.2	671.4	748.9	163.4	187.0	214.6	254.3	289.0		
-23.00	CLAYEY SAND	58	404.6	600.0	444.3	537.7	657.6	720.5	803.8	175.9	212.5	250.9	283.8	314.3		



BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PTT Gas for Gateway City/E							BORE HOLE : BH-2							
LOCATION : Phang Yao District, Chachoengsao Province							GROUND WATER : 1.20 m							
Date :							CALCULATED BY: MOHAMMED AZHAR							
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD ) (blows/ft)	SPT (CORRECTED ) (blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree s)	Nq	Qf (t/m)	SPT Qf (t/m)	Qe (t/m <sup>2</sup> )
-1.00	CLAY	26	26	17.34	0.426	9.0	2.13	2.13			25.0	7.4	7.4	126.1
-2.00	CLAY	26	26	17.34	0.426	9.0	4.26	3.26			25.0	7.4	14.7	156.1
-3.00	CLAY WITH SILT & GRAVEL	88	88				6.28	4.26	1.026	40.2	24.0	6.4	20.9	148.5
-4.00	CLAY	82	82	54.69	0.420	9.0	8.52	5.32			25.0	23.0	43.3	492.2
-5.00	CLAY	82	82	54.69	0.420	9.0	10.65	6.65			25.0	23.0	66.3	492.2
-6.00	CLAYEY SAND	100	99				12.78	7.39	1.046	40.4	25.0	6.5	25.7	427.3
-7.00	CLAYEY SAND	100	99				14.91	9.91	1.056	40.5	25.0	13.9	39.6	476.9
-8.00	CLAYEY SAND	100	99				17.04	12.04	1.067	40.6	25.0	17.3	56.9	516.4
-9.00	CLAYEY SAND	100	99				19.17	14.17	1.077	40.7	25.0	19.7	74.2	556.0
-10.00	CLAYEY SAND	100	99				21.30	16.30	1.087	40.9	25.0	22.1	91.7	595.6
-11.00	CLAYEY SAND	100	99				23.43	18.43	1.098	41.0	25.0	24.5	109.3	635.1
										</				



BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE																
PROJECT : PTT Gas for Gateway City/E						BORE HOLE : BH-2						BH-2				
LOCATION : Phang Yao District, Chachoengsao Province						GROUND WATER : 1.20 m						MOHAMMED AZHAR				
DATE : 22/01/2020																
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECTED) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)						ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)					
					SQUARE CONCRETE PILE SECTION (30 x 30)						SQUARE CONCRETE PILE SECTION (30 x 30)					
					0.22	0.26	0.30	0.35	0.40	0.45	0.22	0.26	0.30	0.35	0.40	0.45
-1.00	CLAY	26	7.4	126.1	14.0	38.2	22.9	29.4	36.8	44.9	5.5	7.1	8.9	11.5	14.3	17.5
-2.00	CLAY	26	14.7	156.1	20.5	25.2	21.7	29.9	40.6	50.1	6.0	10.0	12.2	15.2	18.7	22.5
-3.00	CLAY WITH SILT & GRAVEL	88	24.0	148.5	24.4	24.4	24.4	24.4	24.4	24.4	5.1	14.6	15.1	15.1	15.1	15.1
-4.00	CLAY	82	43.3	492.2	51.9	79.3	96.2	120.9	148.0	177.6	24.3	30.7	37.6	47.2	57.7	69.1
-5.00	CLAY	82	66.3	492.2	82.1	102.7	122.8	151.1	189.4	230.9	30.3	40.1	49.4	59.8	72.0	85.1
-6.00	CLAYEY SAND	99	75.7	427.3	75.1	94.6	112.2	135.1	166.1	199.4	30.6	36.9	43.6	52.2	63.4	75.8
-7.00	CLAYEY SAND	99	95.6	235.9	89.6	108.9	128.8	159.1	192.2	231.5	35.0	42.4	50.0	60.0	70.4	81.4
-8.00	CLAYEY SAND	99	122.9	235.9	119.3	141.1	167.1	202.2	237.0	279.7	45.9	52.0	61.9	72.9	84.9	97.9
-9.00	CLAYEY SAND	99	147.7	235.9	140.5	169.5	198.8	237.2	267.6	309.9	53.4	60.2	71.4	82.9	95.2	109.1
-10.00	CLAYEY SAND	99	174.3	235.9	168.0	179.5	212.2	255.3	300.5	347.9	57.9	70.0	82.6	96.9	115.0	133.9
-11.00	CLAYEY SAND	99														

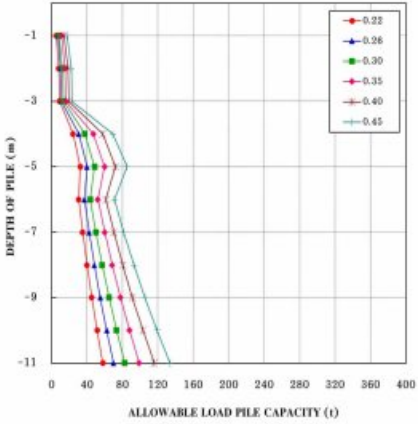
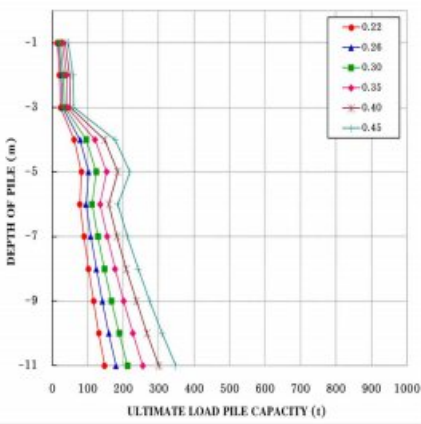


Figure 10 consists of two line graphs side-by-side. Both graphs have 'DEPTH OF PILE (m)' on the y-axis, ranging from 0 to -11 in increments of 2. The left graph has 'ULTIMATE LOAD PILE CAPACITY (t)' on the x-axis, ranging from 0 to 1000 in increments of 100. The right graph has 'ALLOWABLE LOAD PILE CAPACITY (t)' on the x-axis, ranging from 0 to 400 in increments of 40. Both graphs share a common legend with five data series: 0.22 (red diamonds), 0.26 (blue triangles), 0.30 (green squares), 0.35 (magenta crosses), and 0.40 (brown pluses). In both graphs, the capacity increases with depth and is higher for larger pile diameters. The ultimate capacity values are approximately 100-1100 t, while the allowable capacity values are approximately 100-120 t.

The figure consists of two side-by-side line graphs. Both graphs have 'DEPTH OF PILE (m)' on the y-axis, ranging from 0 to -11 in increments of 2. The left graph has 'ULTIMATE SKIN FRICTION (t/m)' on the x-axis, ranging from 0 to 600 in increments of 50. The right graph has 'ULTIMATE END BEARING (t/m²)' on the x-axis, ranging from 0 to 1000 in increments of 100. Both graphs show a blue line representing the data.

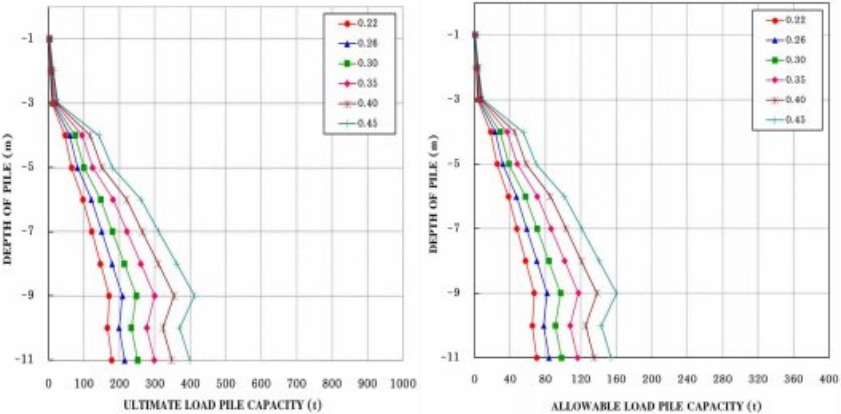
**Left Graph: Ultimate Skin Friction vs. Depth of Pile**

Depth of Pile (m)	Ultimate Skin Friction (t/m)
0	0
-1	~10
-2	~50
-3	~100
-4	~150
-5	~200
-6	~250
-7	~300
-8	~350
-9	~400
-10	~450
-11	~500

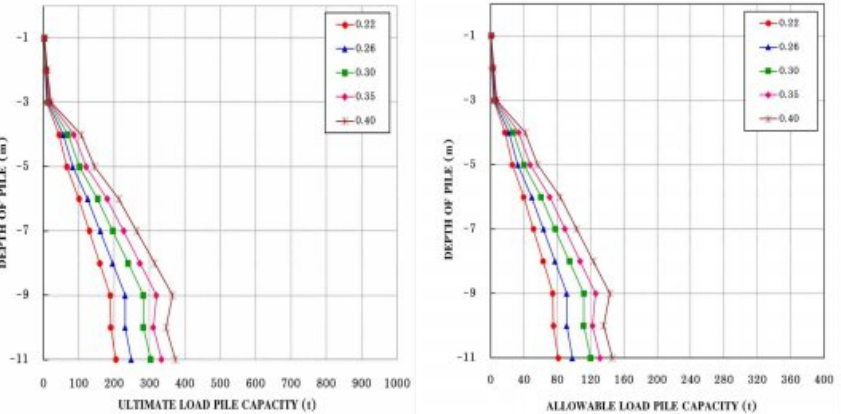
**Right Graph: Ultimate End Bearing vs. Depth of Pile**

Depth of Pile (m)	Ultimate End Bearing (t/m²)
0	0
-1	~50
-2	~100
-3	~150
-4	~200
-5	~250
-6	~300
-7	~350
-8	~400
-9	~450
-10	~500
-11	~550

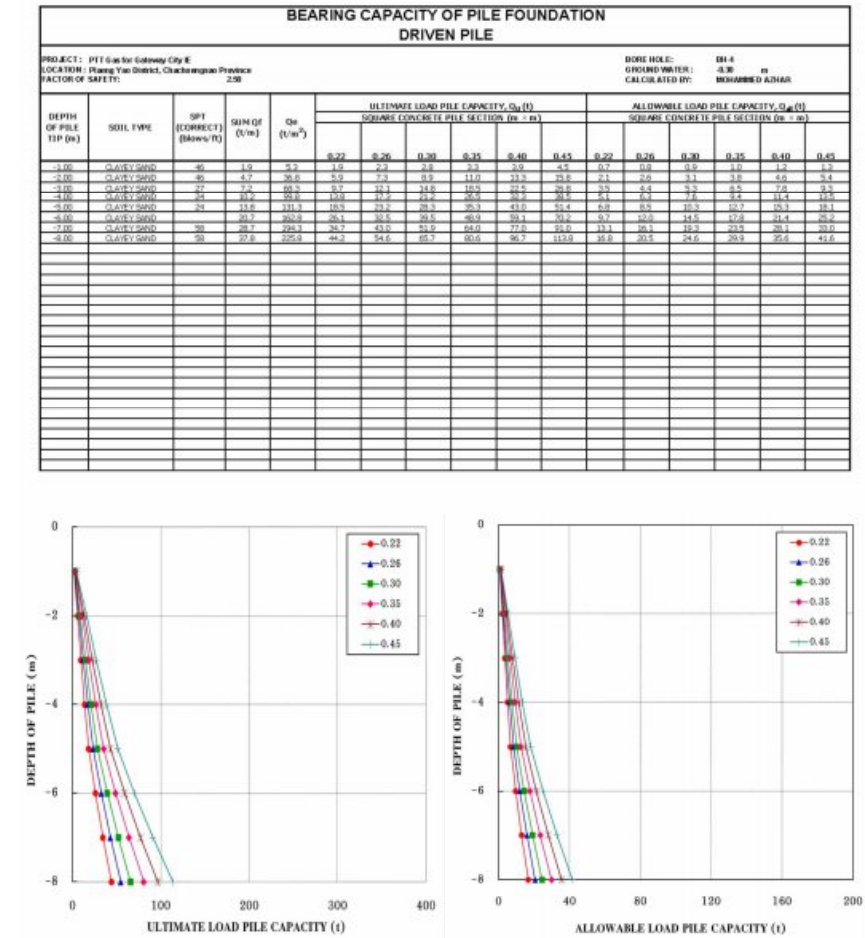
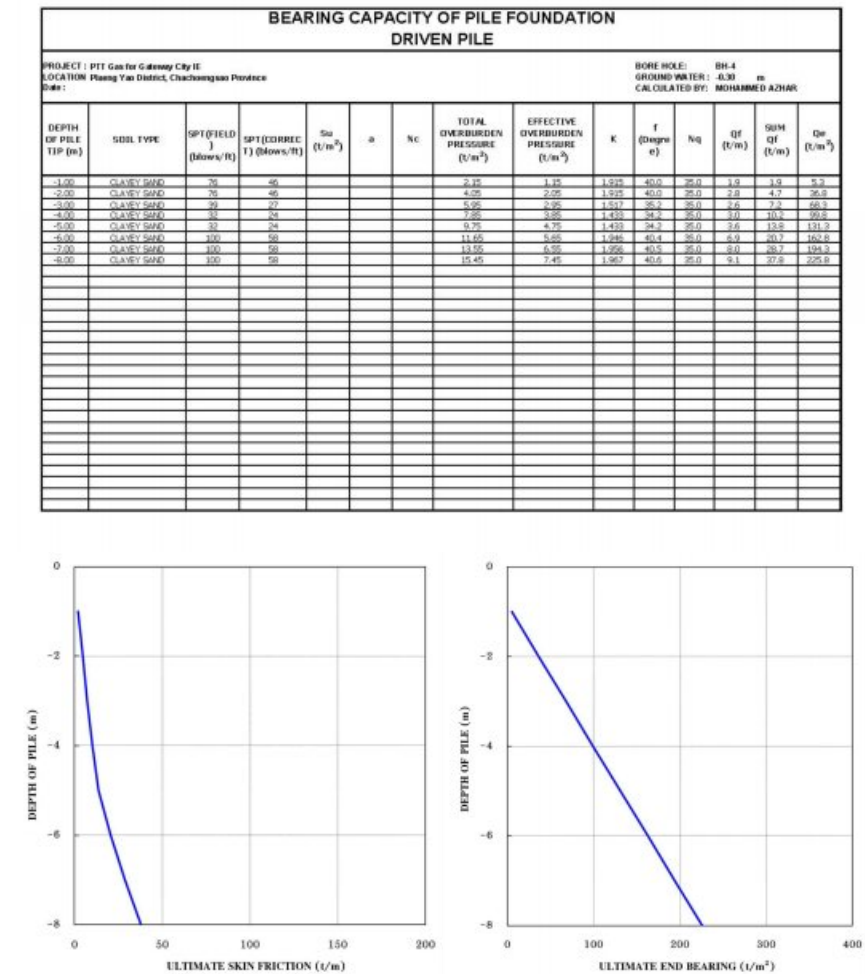
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE																
PROJECT : PTT Gas for Gateway City IE					BORE HOLE : BH-3											
LOCATION : Phang Yao District, Chachoengsao Province					GROUND WATER : 0.30 m											
FACTOR OF SAFETY : 2.50					CALCULATED BY : MOHAMMED AZHAR											
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (Blows/ft)	SUM OF Q <sub>u</sub> (t/m <sup>2</sup> )	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>all</sub> (t)						
					SQUARE CONCRETE PILE SECTION (m - m)					SQUARE CONCRETE PILE SECTION (m - m)						
					0.22	0.26	0.30	0.35	0.40	0.45	0.22	0.26	0.30	0.35	0.40	0.45
-1.00	CLAYEY SAND	31	1.4	3.1	3.8	4.2	4.6	5.1	5.6	6.1	3.0	3.4	3.8	4.2	4.6	5.0
-2.00	CLAYEY SAND	31	2.5	26.0	4.5	5.1	5.5	5.9	6.4	6.8	3.2	3.6	4.0	4.4	4.8	5.2
-3.00	CLAYEY SAND	56	7.3	68.3	9.8	12.2	14.9	18.6	22.7	27.0	3.6	4.4	5.3	6.4	7.6	9.4
-4.00	CLAYEY SAND	75	28.3	450.2	59.2	69.9	82.8	97.8	114.4	132.6	4.0	4.9	5.9	7.0	8.2	9.6
-5.00	CLAYEY SAND	75	49.4	450.2	69.4	81.8	95.7	110.3	126.6	144.6	4.5	5.4	6.5	7.7	9.0	10.5
-6.00	CLAYEY SAND	100	77.4	800.3	97.1	122.0	146.5	171.9	200.0	230.0	5.0	6.0	7.1	8.4	9.8	11.4
-7.00	CLAYEY SAND	100	105.4	800.3	124.0	150.6	180.5	211.3	245.8	283.1	5.5	6.6	7.8	9.2	10.7	12.4
-8.00	CLAYEY SAND	100	133.4	800.3	148.4	178.1	210.3	243.9	281.7	322.8	6.0	7.2	8.5	10.0	11.6	13.4
-9.00	CLAYEY SAND	100	161.4	800.3	171.3	208.4	247.7	289.9	334.2	381.3	6.5	7.8	9.2	10.8	12.5	14.4
-10.00	CLAY WITH GRAVEL	56	172.8	288.5	166.1	194.2	223.4	253.2	283.7	314.9	7.0	8.4	9.9	11.6	13.4	15.4
-11.00	CLAY WITH GRAVEL	56	165.4	330.3	176.7	214.5	245.0	276.0	307.6	340.0	7.5	9.0	10.6	12.4	14.3	16.4



BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PTT Gas for Gateway City IE					BORE HOLE : BH-3									
LOCATION : Phang Yao District, Chachoengsao Province					GROUND WATER : 0.30 m									
FACTOR OF SAFETY : 2.50					CALCULATED BY : MOHAMMED AZHAR									
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (Blows/ft)	SUM OF Q <sub>u</sub> (t/m <sup>2</sup> )	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>all</sub> (t)				
					1 SECTION (cm - cm)					1 SECTION (cm - cm)				
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40
-1.00	CLAYEY SAND	31	1.4	3.1	3.8	4.2	4.6	5.1	5.6	3.0	3.4	3.8	4.2	4.6
-2.00	CLAYEY SAND	31	2.5	26.0	4.5	5.1	5.5	5.9	6.4	3.2	3.6	4.0	4.4	4.8
-3.00	CLAYEY SAND	56	7.3	68.3	9.8	12.2	14.9	18.6	22.7	3.6	4.4	5.3	6.4	7.6
-4.00	CLAYEY SAND	75	28.3	450.2	59.2	69.9	82.8	97.8	114.4	4.0	4.9	5.9	7.0	8.2
-5.00	CLAYEY SAND	75	49.4	450.2	69.4	81.8	95.7	110.3	126.6	4.5	5.4	6.5	7.7	9.0
-6.00	CLAYEY SAND	100	77.4	800.3	97.1	122.0	146.5	171.9	200.0	5.0	6.0	7.1	8.4	9.8
-7.00	CLAYEY SAND	100	105.4	800.3	124.0	150.6	180.5	211.3	245.8	5.5	6.6	7.8	9.2	10.7
-8.00	CLAYEY SAND	100	133.4	800.3	148.4	178.1	210.3	243.9	281.7	6.0	7.2	8.5	10.0	11.6
-9.00	CLAYEY SAND	100	161.4	800.3	171.3	208.4	247.7	289.9	334.2	6.5	7.8	9.2	10.8	12.5
-10.00	CLAY WITH GRAVEL	56	172.8	288.5	166.1	194.2	223.4	253.2	283.7	7.0	8.4	9.9	11.6	13.4
-11.00	CLAY WITH GRAVEL	56	165.4	330.3	176.7	214.5	245.0	276.0	307.6	7.5	9.0	10.6	12.4	14.3



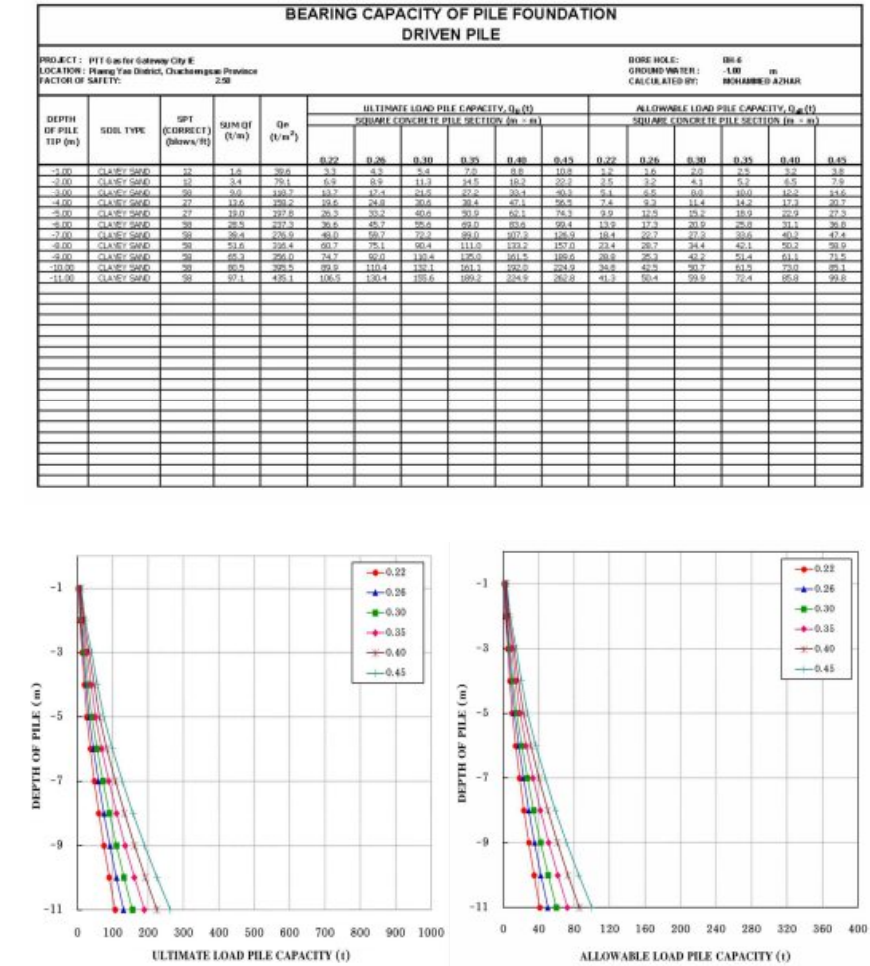
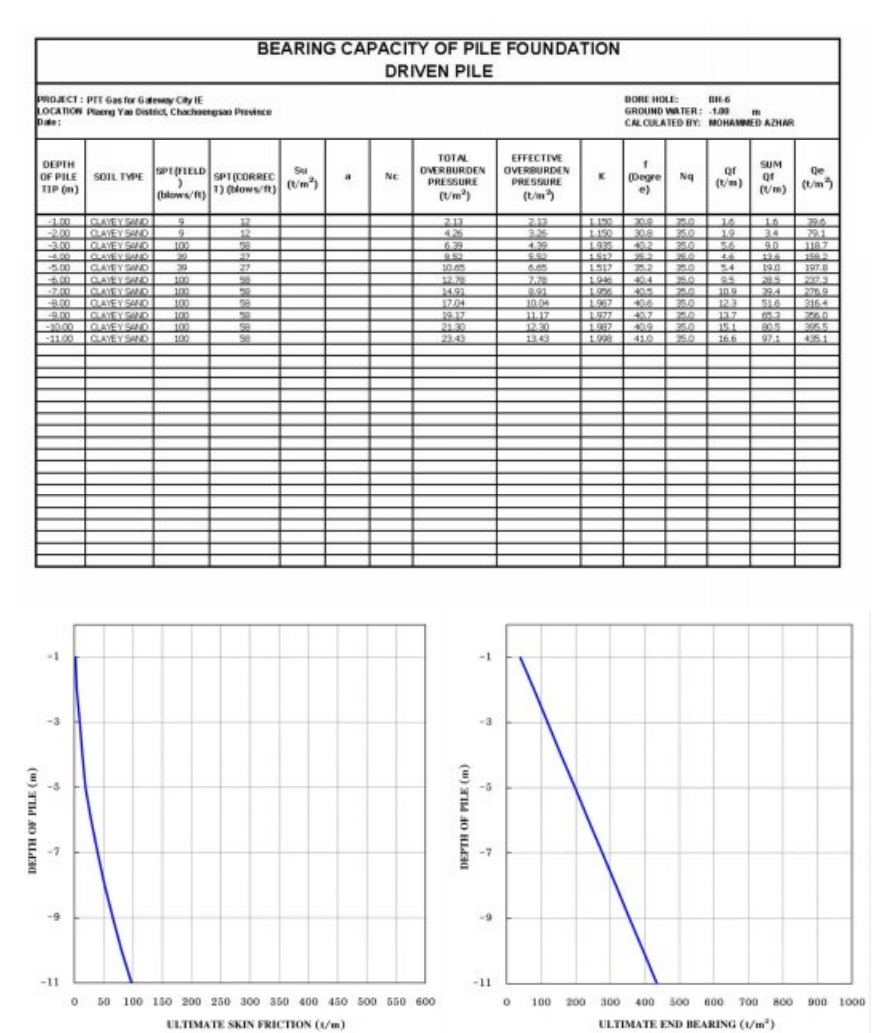
4. Driven Pile BH-4



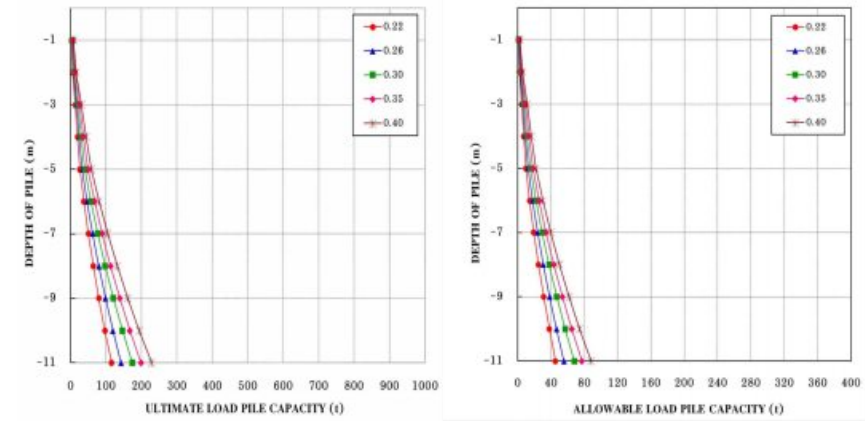
## H-13

## H-14

Figure 10 consists of two side-by-side line graphs. Both graphs have 'DEPTH OF PILE (m)' on the y-axis, ranging from 0 to -5. The left graph has 'ULTIMATE LOAD PILE CAPACITY (t)' on the x-axis, ranging from 0 to 1000. The right graph has 'ALLOWABLE LOAD PILE CAPACITY (t)' on the x-axis, ranging from 0 to 400. Both graphs share a common legend with five data series representing different pile diameters: 0.22 m (red circles), 0.26 m (blue triangles), 0.30 m (green squares), 0.35 m (magenta diamonds), and 0.40 m (brown crosses). In both graphs, the capacity increases sharply with depth from 0 to about -3 meters and then levels off. The ultimate load capacity for the 0.40 m diameter pile reaches nearly 1000 t at -5 m depth, while the allowable load capacity for the same pile is approximately 80 t.

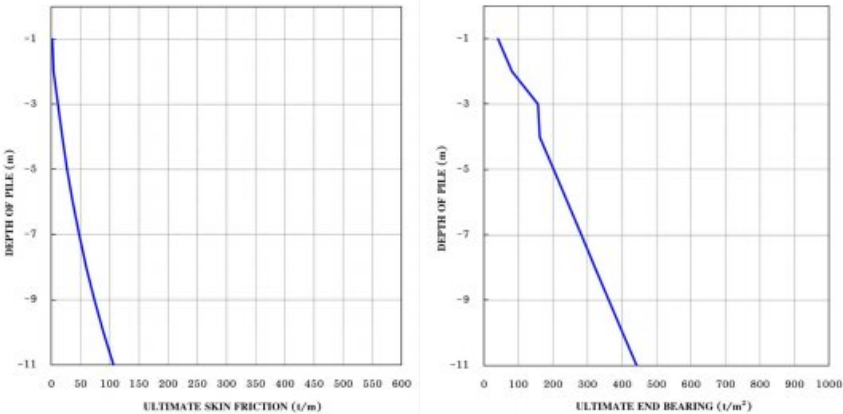


BEARING CAPACITY OF PILE FOUNDATION														
DRIVEN PILE														
PROJECT : PTT Gas for Gateway City IE				BORE HOLE: BH-6										
LOCATION : Phraya Yae District, Chachoengsao Province				GROUND WATER : 4.80 m										
FACTOR OF SAFETY: 2.50				CALCULATED BY: MOHAMMED AZHAR										
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>u</sub> (t)				
					1 SECTION (cm x cm)					1 SECTION (cm x cm)				
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40
-1.00	CLAYEY SAND	12	1.6	26.6	2.9	3.6	4.7	5.1	7.7	1.1	1.4	1.7	2.2	2.8
-2.00	CLAYEY SAND	12	3.4	75.1	6.1	8.0	9.8	12.6	16.0	2.3	3.0	3.7	4.7	5.6
-3.00	CLAYEY SAND	59	8.6	118.7	13.9	18.6	23.5	28.9	36.4	6.4	8.4	10.4	13.4	16.4
-4.00	CLAYEY SAND	27	13.6	150.2	19.3	25.4	30.0	36.4	44.0	7.4	9.3	11.4	13.8	16.4
-5.00	CLAYEY SAND	27	19.0	197.8	26.3	33.1	40.6	48.8	58.7	10.1	12.7	15.5	18.6	22.0
-6.00	CLAYEY SAND	58	28.4	232.2	37.5	48.8	57.4	67.8	80.9	14.4	18.1	22.1	26.0	30.5
-7.00	CLAYEY SAND	59	29.4	276.5	50.2	62.2	74.4	86.9	105.0	19.5	24.2	29.6	34.4	39.9
-8.00	CLAYEY SAND	58	51.6	316.4	64.9	79.6	97.5	113.0	130.0	25.1	31.0	37.9	43.7	50.4
-9.00	CLAYEY SAND	58	65.2	356.0	80.0	96.7	120.9	139.1	161.5	31.3	38.5	47.1	53.9	61.9
-10.00	CLAYEY SAND	58	80.5	395.5	97.1	119.6	146.4	167.6	193.7	38.1	46.7	57.2	65.1	74.5
-11.00	CLAYEY SAND	59	97.1	426.1	115.9	142.3	174.3	198.5	228.5	45.5	55.7	68.2	77.3	88.1
													</	

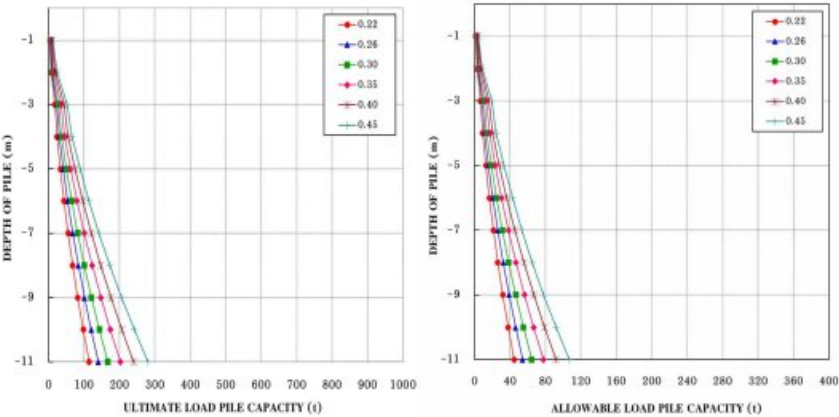


7. Driven Pile BH-7

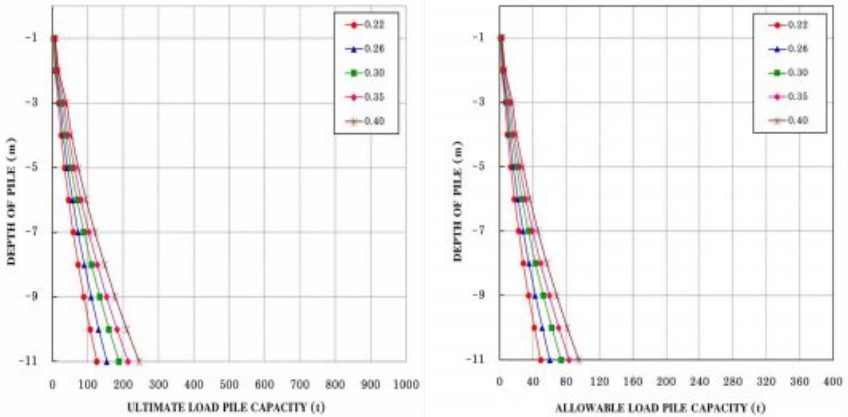
BEARING CAPACITY OF PILE FOUNDATION													
DRIVEN PILE													
PROJECT : PTT Gas for Gateway City IE				BORE HOLE: BH-7									
LOCATION : Pongng Yao District, Chachoengsao Province				GROUND WATER : -1.50 m									
Date:				CALCULATED BY: MOHAMMED AZHAR									
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT(FIELD) (blows/ft)	SPT(CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	Nq	Qf (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )
-1.00	CLAYEY SAND	21	18				2.15	2.15	1.296	32.6	35.0	1.9	1.9
-2.00	CLAYEY SAND	21	18				4.30	3.30	1.296	32.6	35.0	2.3	4.2
-3.00	CLAY	26	20	17.34	0.425	9.0	6.45	4.45				7.4	13.6
-4.00	CLAYEY SAND	85	50				9.60	5.40	1.926	40.2	35.0	6.9	18.8
-5.00	CLAYEY SAND	85	50				20.75	5.75	1.926	40.2	35.0	8.2	26.7
-6.00	CLAYEY SAND	100	59				32.90	7.90	1.946	40.4	35.0	9.6	36.4
-7.00	CLAYEY SAND	100	59				45.05	9.05	1.956	40.4	35.0	11.0	47.4
-8.00	CLAYEY SAND	100	59				57.20	10.20	1.967	40.6	35.0	12.4	59.8
-9.00	CLAYEY SAND	100	59				69.35	11.35	1.977	40.7	35.0	13.8	73.8
-10.00	CLAYEY SAND	100	59				81.50	12.50	1.987	40.9	35.0	15.4	89.1
-11.00	CLAYEY SAND	100	59				93.65	13.65	1.998	41.0	35.0	16.9	106.0



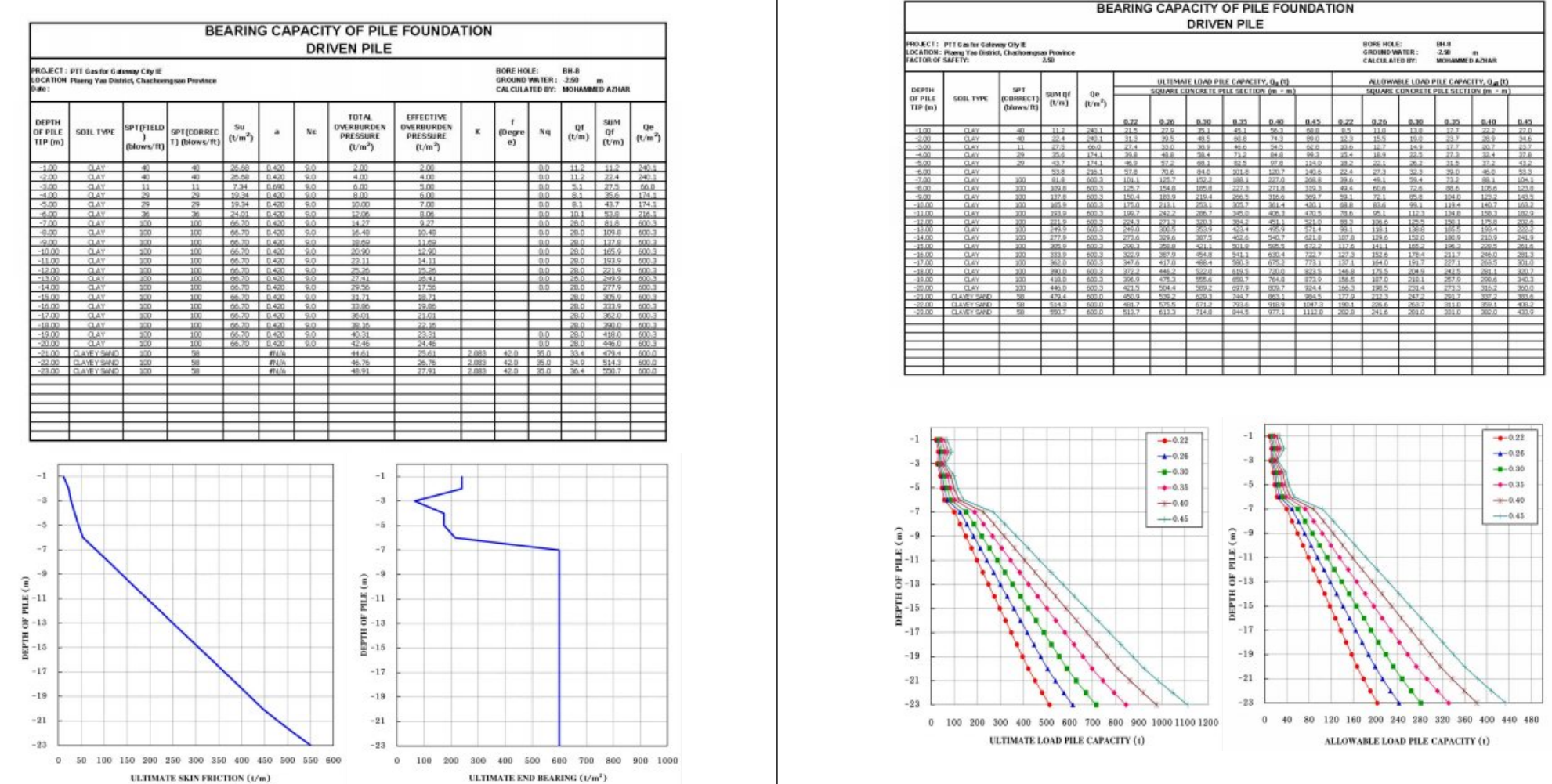
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE															
PROJECT : PTT Gas for Gateway City IE				BORE HOLE : BH-7											
LOCATION : Prang Yai District, Chachoengsao Province				GROUND WATER : 1.50 m											
FACTOR OF SAFETY : 2.50				CALCULATED BY : MOHAMMED AZHAR											
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (Blows/ft)	SUM OF (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)					
					SQUARE CONCRETE PILE SECTION (m × m)					SQUARE CONCRETE PILE SECTION (m × m)					
					0.22	0.26	0.30	0.35	0.40	0.45	0.22	0.26	0.30	0.35	0.40
-1.00	CLAYEY SAND	18	1.9	40.3	3.5	4.7	5.9	7.6	9.5	11.6	1.7	2.1	2.7	3.4	4.1
-2.00	CLAYEY SAND	18	4.2	80.5	7.6	9.8	12.3	15.7	19.5	23.9	2.9	3.6	4.5	5.7	7.1
-3.00	CLAYEY SAND	25	14.3	126.1	22.7	29.4	36.9	46.9	58.4	72.4	9.1	11.5	14.5	18.2	22.8
-4.00	CLAYEY SAND	25	18.5	161.0	28.1	36.7	46.2	58.2	72.4	88.4	11.2	14.3	17.7	22.1	27.6
-5.00	CLAYEY SAND	50	26.7	201.3	31.3	41.4	50.3	62.1	76.9	94.2	12.5	16.0	19.4	24.1	30.1
-6.00	CLAYEY SAND	25	26.4	241.5	33.1	43.7	53.4	65.4	80.9	99.4	13.5	17.0	20.5	25.4	31.6
-7.00	CLAYEY SAND	25	47.4	281.0	35.1	46.1	56.4	68.9	85.4	105.4	14.5	18.2	22.1	27.6	34.1
-8.00	CLAYEY SAND	50	59.8	322.0	48.2	64.0	78.0	95.2	117.5	143.9	22.3	28.2	34.4	42.9	53.5
-9.00	CLAYEY SAND	25	73.8	362.4	48.4	63.0	77.4	94.6	116.9	143.9	22.3	28.2	34.4	42.9	53.5
-10.00	CLAYEY SAND	25	89.1	402.5	52.5	68.9	84.4	103.4	127.9	158.4	23.9	30.4	37.4	46.4	58.1
-11.00	CLAYEY SAND	50	106.0	442.8	114.7	149.3	183.1	220.7	270.5	340.5	44.6	54.9	67.8	84.4	105.9



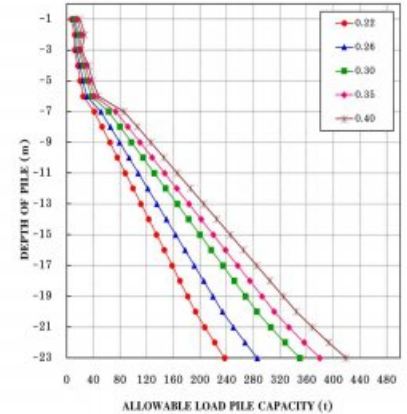
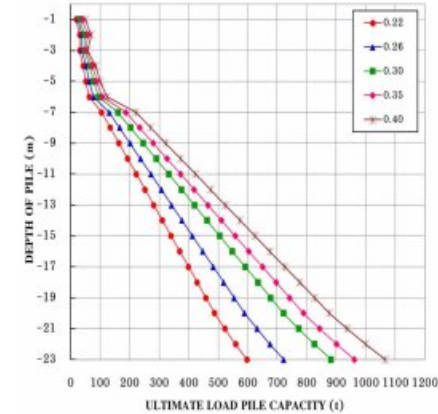
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PTT Gas for Gateway City IE				BORE HOLE : BH-7										
LOCATION : Prang Yai District, Chachoengsao Province				GROUND WATER : 1.50 m										
FACTOR OF SAFETY : 2.50				CALCULATED BY : MOHAMMED AZHAR										
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					I SECTION (cm × cm)					I SECTION (cm × cm)				
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40
-1.00	CLAYEY SAND	18	1.9	40.3	3.5	4.7	5.9	7.6	9.5	1.4	1.7	2.1	2.7	3.4
-2.00	CLAYEY SAND	18	4.2	80.5	7.0	9.0	11.0	14.0	17.5	2.6	3.4	4.3	5.2	6.4
-3.00	CLAYEY SAND	26	11.5	156.1	17.1	21.7	26.7	34.8	40.1	5.6	8.4	10.3	14.5	15.1
-4.00	CLAYEY SAND	50	18.5	161.0	24.6	30.7	37.7	48.7	53.2	9.5	11.8	14.5	17.1	20.1
-5.00	CLAYEY SAND	50	26.7	201.3	34.5	42.9	52.6	61.8	73.0	13.4	16.6	20.4	23.8	27.7
-6.00	CLAYEY SAND	50	56.4	241.5	45.9	56.9	69.9	81.2	95.3	17.2	21.1	27.1	31.3	36.3
-7.00	CLAYEY SAND	58	47.4	281.8	58.8	72.7	88.0	103.0	120.1	22.9	28.3	34.7	39.8	46.0
-8.00	CLAYEY SAND	58	59.8	322.0	72.1	88.2	107.5	127.1	147.5	28.5	35.2	43.1	49.3	56.6
-9.00	CLAYEY SAND	58	73.8	362.2	88.0	108.6	134.7	153.6	177.5	34.9	42.8	52.5	59.7	68.1
-10.00	CLAYEY SAND	58	89.1	402.5	106.5	130.8	160.2	180.5	210.2	41.8	51.2	62.7	71.1	81.1
-11.00	CLAYEY SAND	58	106.0	442.8	125.5	154.0	188.5	213.9	245.6	49.3	60.4	73.9	83.4	95.0



8. Driven Pile BH-8

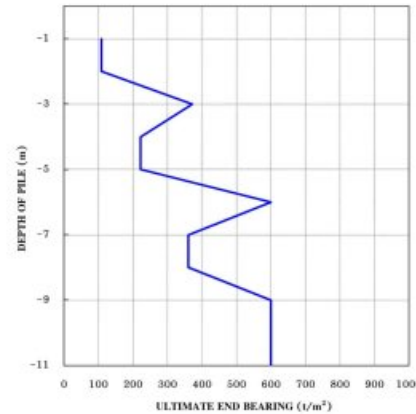
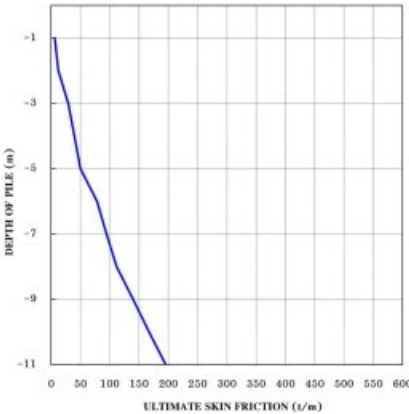


BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PTT Gas for Gateway City IE LOCATION : Phang Yao District, Chachoengsao Province FACTOR OF SAFETY : 2.00						BORE HOLE: BH-8 GROUND WATER : -2.50 m CALCULATED BY: MOHAMMED AZHAR								
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					1 SECTION (cm = cm)					1 SECTION (cm = cm)				
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40
-1.00	CLAY	40	11.2	240.1	19.4	25.2	30.9	36.6	42.3	7.7	10.0	12.2	15.7	19.6
-2.00	CLAY	40	22.4	240.1	31.2	39.3	48.2	58.1	70.0	14.0	17.5	21.0	25.2	31.2
-3.00	CLAY	33	27.5	56.0	31.0	37.7	45.3	53.1	62.0	12.3	14.7	18.0	19.9	22.4
-4.00	CLAY	29	35.6	174.1	62.9	58.9	64.7	74.1	85.6	16.9	20.7	25.3	26.8	31.0
-5.00	CLAY	29	43.7	174.1	51.5	63.1	77.3	87.5	100.2	20.2	24.7	30.2	34.0	38.6
-6.00	CLAY	29	52.8	226.1	63.4	77.7	95.2	107.8	122.5	24.9	30.4	37.2	42.0	47.6
-7.00	CLAY	300	81.8	600.3	105.1	139.7	169.2	187.8	224.4	41.5	51.5	63.1	73.8	86.5
-8.00	CLAY	300	109.8	600.3	134.5	166.0	203.4	234.1	271.8	53.2	65.5	80.2	92.1	106.4
-9.00	CLAY	300	137.8	600.3	164.0	201.3	236.5	280.3	327.3	64.9	79.5	97.4	110.4	126.2
-10.00	CLAY	300	165.9	600.3	193.4	236.6	289.6	336.5	372.7	79.5	93.5	114.5	130.7	146.1
-11.00	CLAY	300	193.9	600.3	222.8	271.9	332.8	372.7	423.1	89.2	107.5	131.6	147.0	166.0
-12.00	CLAY	300	221.9	600.3	252.2	307.2	375.9	418.9	473.5	99.9	121.6	148.7	165.3	186.9
-13.00	CLAY	300	249.9	600.3	281.6	342.5	419.1	460.2	524.0	111.6	135.6	165.9	183.5	206.7
-14.00	CLAY	300	277.9	600.3	311.0	377.8	462.2	511.4	574.4	123.3	149.6	183.0	201.9	225.6
-15.00	CLAY	300	305.9	600.3	340.4	413.1	507.4	557.6	624.6	135.0	161.6	200.1	220.1	245.5
-16.00	CLAY	300	333.9	600.3	369.9	448.4	548.5	603.8	675.2	146.7	177.6	217.2	238.4	265.3
-17.00	CLAY	300	362.0	600.3	399.3	483.7	591.6	650.1	726.7	158.3	191.6	234.3	256.7	285.2
-18.00	CLAY	300	390.0	600.3	428.7	513.0	624.6	686.3	776.1	170.0	205.6	251.4	275.0	305.1
-19.00	CLAY	300	418.0	600.3	458.1	543.3	657.9	724.5	828.5	181.7	219.8	268.6	293.3	325.0
-20.00	CLAY	300	446.0	600.3	487.5	569.6	721.1	788.7	876.9	193.4	233.6	285.7	311.6	344.8
-21.00	CLAYEY SAND	58	479.4	600.0	520.6	631.7	772.5	843.9	937.1	207.4	250.4	306.1	333.5	368.6
-22.00	CLAYEY SAND	58	514.3	600.0	559.7	676.7	826.3	901.4	999.9	221.9	267.8	327.5	356.3	393.4
-23.00	CLAYEY SAND	58	550.7	600.0	597.4	721.5	880.3	961.4	1065.4	237.1	286.1	349.8	380.1	419.3

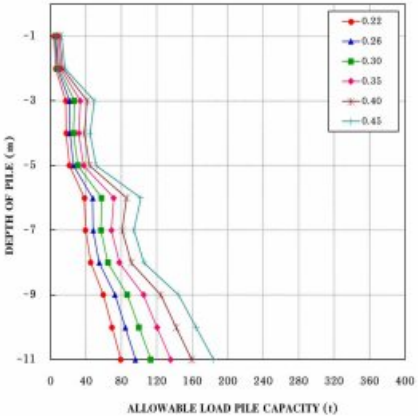
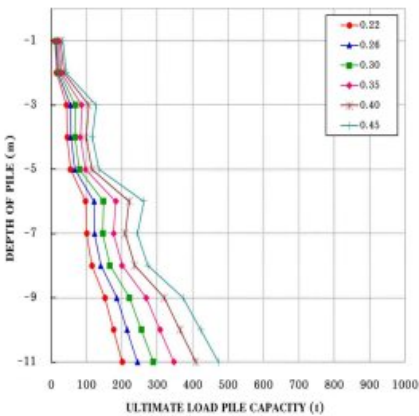


9. Driven Pile BH-9

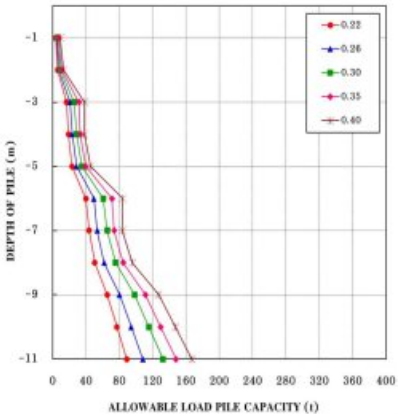
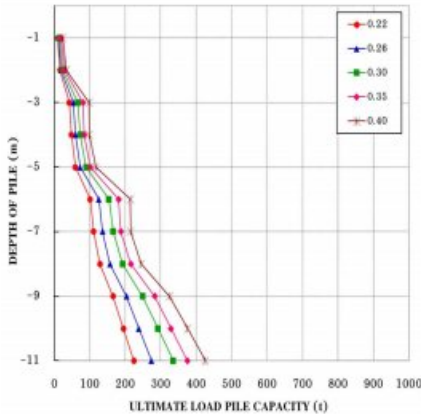
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PET Gas for Gateway City IE LOCATION : Phang Yao District, Chachoengsao Province Date :							BORE HOLE : BH-9 GROUND WATER : -1.50 m CALCULATED BY: MOHAMMED AZHAR							
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT(FIELD ) (blows/ft)	SPT(CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	Nq	Qf (t/m)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )
-1.00	CLAY	18	38	12.01	0.490	9.0	1.90	1.90				5.9	5.9	208.1
-2.00	CLAY	18	38	12.01	0.490	9.0	3.80	2.80				5.9	11.8	108.1
-3.00	CLAY	62	62	41.25	0.420	9.0	5.70	3.70				17.4	29.1	272.2
-4.00	CLAY	37	37	24.68	0.420	9.0	2.60	4.60				10.4	39.5	666.1
-5.00	CLAY	27	27	24.68	0.420	9.0	5.20	5.20				10.4	49.9	222.1
-6.00	CLAY	100	100	66.70	0.420	9.0	11.40	6.40				28.0	77.9	600.3
-7.00	CLAY	60	60	40.00	0.420	9.0	13.30	7.30				16.8	94.7	360.2
-8.00	CLAY	60	60	40.00	0.420	9.0	15.20	8.20				16.8	111.5	260.2
-9.00	CLAY	100	100	66.70	0.420	9.0	17.10	9.10				28.0	139.5	600.3
-10.00	CLAY	100	100	66.70	0.420	9.0	19.00	10.00				28.0	167.5	600.3
-11.00	CLAY	100	100	66.70	0.420	9.0	20.90	10.90				28.0	195.5	600.3



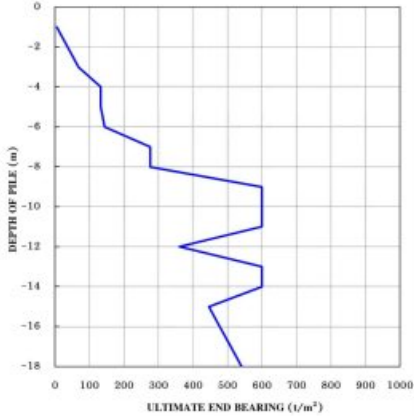
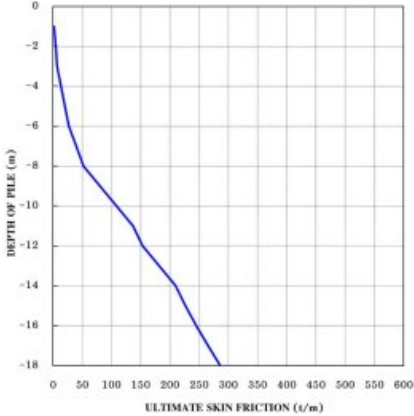
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE																
PROJECT : PTT Gas for Gateway City II					BORE HOLE : BH-9					in						
LOCATION : Phang Yao District, Chachoengsao Province					GROUND WATER : 1.50					m						
FACTOR OF SAFETY : 2.50					CALCULATED BY : MOHAMMED AZHAR											
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)						ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)					
					SQUARE CONCRETE PILE SECTION (m x m)						SQUARE CONCRETE PILE SECTION (m x m)					
					0.22	0.26	0.30	0.35	0.40	0.45	0.22	0.26	0.30	0.35	0.40	0.45
-1.00	CLAY	18	9.0	108.1	18.4	13.4	16.8	21.5	26.7	32.5	6.0	6.7	8.5	9.3	10.3	12.5
-2.00	CLAY	18	11.8	108.1	15.6	10.5	13.0	16.7	16.1	43.1	6.0	7.5	9.1	11.3	13.7	16.3
-3.00	CLAY	42	31.1	302.0	43.2	25.5	38.5	48.4	106.3	122.6	12.1	20.2	26.2	33.2	41.3	49.3
-4.00	CLAY	37	29.5	222.1	45.5	36.1	47.4	49.5	98.7	116.3	12.7	21.8	26.1	31.8	38.0	44.5
-5.00	CLAY	37	49.9	222.1	54.6	66.2	79.8	97.0	135.3	134.7	23.3	29.2	30.9	37.2	41.2	51.5
-6.00	CLAY	100	77.8	600.3	97.6	112.6	147.5	152.6	225.7	261.7	36.3	47.7	52.7	57.5	66.0	125.8
-7.00	CLAY	60	94.7	360.2	900.8	122.6	146.0	176.7	209.1	244.4	35.5	48.0	56.5	68.6	81.0	99.9
-8.00	CLAY	60	111.5	360.2	115.5	145.3	166.2	200.2	226.0	273.6	45.3	54.6	64.8	77.7	91.9	109.6
-9.00	CLAY	100	132.5	600.3	131.8	156.2	176.2	201.4	248.8	319.3	59.7	74.6	86.6	104.8	124.2	144.7
-10.00	CLAY	100	167.5	600.3	176.5	214.9	255.1	298.1	354.1	428.1	69.4	84.5	96.9	120.3	141.8	164.4
-11.00	CLAY	100	295.5	600.3	201.1	243.8	288.7	347.3	408.9	473.5	79.2	95.8	113.1	135.7	159.3	184.1



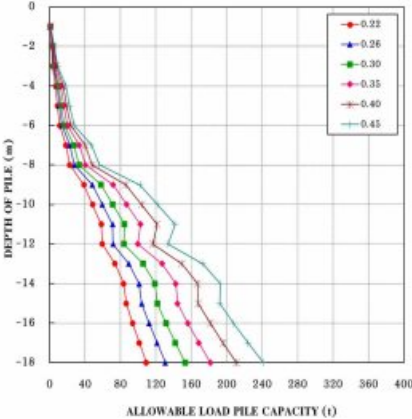
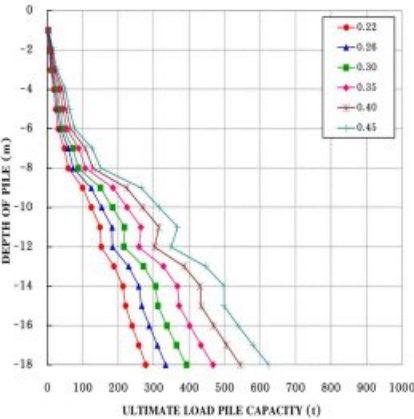
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE														
PROJECT : PTI Gas for Gateway City II				BORE HOLE : BH-9		in								
LOCATION : Phang Yao District, Chachoengsao Province				GROUND WATER : 1.50		m								
FACTOR OF SAFETY : 2.50				CALCULATED BY : MOHAMMED AZHAR										
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					I SECTION (cm x cm)					I SECTION (cm x cm)				
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40
-1.00	CLAY	18	9.9	308.1	9.6	12.4	15.2	19.2	23.9	3.8	4.8	6.0	7.5	9.3
-2.00	CLAY	18	11.8	308.1	15.8	19.8	24.2	28.9	34.5	6.2	7.7	9.4	11.2	13.2
-3.00	CLAY	62	29.1	372.2	42.5	63.8	66.1	80.8	98.4	16.8	21.2	26.0	31.7	38.5
-4.00	CLAY	37	39.5	222.1	48.6	60.0	73.5	84.7	98.5	19.1	23.6	28.8	33.1	38.2
-5.00	CLAY	37	49.9	222.1	59.5	73.0	69.5	101.8	117.2	23.4	28.7	35.3	39.8	45.4
-6.00	CLAY	100	77.9	600.3	101.0	125.7	154.3	181.3	214.3	39.9	49.6	60.8	71.4	83.9
-7.00	CLAY	60	94.7	360.2	130.9	135.9	166.3	187.9	214.9	43.8	53.6	65.6	73.8	83.5
-8.00	CLAY	60	111.5	360.2	135.6	157.1	182.2	215.7	245.2	50.8	61.9	75.8	84.7	95.7
-9.00	CLAY	100	132.5	600.3	185.2	200.4	249.1	280.0	325.3	65.6	80.4	98.4	111.5	127.4
-10.00	CLAY	100	167.5	600.3	195.1	238.7	262.2	328.2	375.7	77.2	94.4	115.5	128.8	147.3
-11.00	CLAY	100	195.5	600.3	224.5	274.0	335.3	375.5	426.1	88.9	108.4	132.6	148.1	167.2



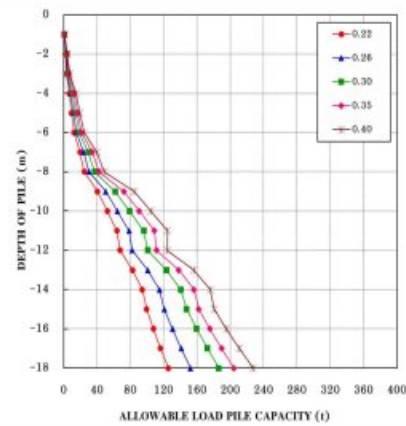
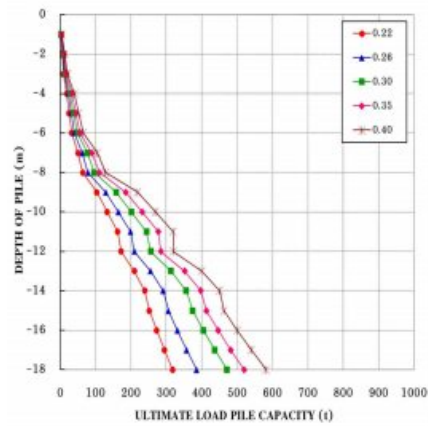
BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE													
PROJECT : PTT Gas for Gateway City II LOCATION : Phang Yao District, Chachoengsao Province Date :										BORE HOLE : BH-01 GROUND WATER : 0.50 m CALCULATED BY: MOHAMMED AZHAR			
DEPTH OF PILE (TIP) (m)	SOIL TYPE	SPT (FIELD) (Blows/T)	SPT (CORRECTED) (Mblows/T)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree a)	Nq	Qf (t/m)	SUM Qf (t/m <sup>2</sup> )
-1.00	CLAYEY SAND	58					2.15	1.25	1.926	40.2	35.0	1.9	1.9
-2.00	CLAYEY SAND	100					4.05	2.05	1.935	40.2	35.0	2.8	4.8
-3.00	CLAYEY SAND	26	20				5.95	3.05	1.346	33.2	35.0	2.1	6.9
-4.00	CLAY	22	22	14.67	0.440	9.0	7.89	3.89			6.5	13.3	13.3
-5.00	CLAY	22	22	14.67	0.440	9.0	9.75	4.75			6.5	19.8	132.1
-6.00	CLAY	24	24	16.01	0.425	9.0	11.65	5.65			6.8	26.6	144.1
-7.00	CLAY	46	46	30.66	0.420	9.0	13.95	6.95			12.2	39.5	276.1
-8.00	CLAY	46	46	30.66	0.420	9.0	15.45	7.45			12.2	52.4	276.1
-9.00	CLAY	100	100	66.70	0.420	9.0	17.35	9.35			28.0	80.4	600.3
-10.00	CLAY	100	100	66.70	0.420	9.0	19.25	9.25			28.0	108.4	600.3
-11.00	CLAY	100	100	66.70	0.420	9.0	21.15	10.15			28.0	136.4	600.3
-12.00	CLAY	50	50	40.02	0.420	9.0	23.05	11.05			28.0	164.4	600.3
-13.00	CLAY	100	100	66.70	0.420	9.0	24.95	11.95			28.0	192.4	600.3
-14.00	CLAY	100	100	66.70	0.420	9.0	26.85	12.85			28.0	220.4	600.3
-15.00	CLAYEY SAND	100					28.75	12.75	2.033	41.4	35.0	17.4	220.6
-16.00	CLAYEY SAND	100					30.65	14.65	2.042	41.5	35.0	20.2	477.8
-17.00	CLAYEY SAND	100					32.55	15.55	2.050	41.6	35.0	23.1	509.3
-18.00	CLAYEY SAND	100					34.45	16.45	2.058	41.7	35.0	26.0	540.8



BEARING CAPACITY OF PILE FOUNDATION DRIVEN PILE																
PROJECT : PTT Gas for Gateway City II LOCATION : Phang Yao District, Chachoengsao Province FACTOR OF SAFETY : 2.0										BORE HOLE : BH-01 GROUND WATER : 0.50 m CALCULATED BY: MOHAMMED AZHAR						
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECTED) (blows/ft)	SUM OF Q <sub>f</sub> (t/m)	Q <sub>e</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)						ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)					
					SQUARE CONCRETE PILE SECTION (30 x 30)						SQUARE CONCRETE PILE SECTION (30 x 30)					
					0.22	0.26	0.30	0.35	0.40	0.45	0.22	0.26	0.30	0.35	0.40	0.45
-1.00	CLAYEY SAND	58	1.9	5.3	2.0	2.4	2.8	3.4	3.9	4.6	0.7	0.8	0.9	1.1	1.2	1.3
-2.00	CLAYEY SAND	58	4.8	26.8	6.0	7.4	9.0	11.2	13.5	16.0	2.2	2.6	3.2	3.9	4.6	5.4
-3.00	CLAYEY SAND	26	6.9	66.3	9.4	11.8	14.4	18.0	21.8	26.2	3.4	4.2	5.1	6.3	7.6	9.0
-4.00	CLAY	22	13.3	132.1	20.1	22.8	27.9	34.8	42.9	50.7	6.0	6.5	10.3	12.0	15.4	18.0
-5.00	CLAY	22	19.8	132.1	23.8	29.5	36.6	43.9	52.8	62.4	8.9	11.0	13.2	16.1	19.2	22.9
-6.00	CLAY	24	26.6	144.1	30.6	37.4	44.9	54.5	65.6	77.6	11.5	14.0	16.7	20.2	23.9	27.9
-7.00	CLAY	46	39.5	276.1	48.1	59.7	72.2	89.1	107.9	127.0	19.4	22.8	27.4	33.6	40.7	47.4
-8.00	CLAY	46	52.4	276.1	59.4	73.1	87.7	107.1	128.0	150.2	22.8	28.0	33.3	40.5	48.1	56.2
-9.00	CLAY	100	80.4	600.3	99.8	124.2	150.5	186.1	224.7	266.2	39.2	48.2	58.2	71.0	86.4	102.1
-10.00	CLAY	100	108.4	600.3	124.4	151.3	184.1	224.1	266.3	316.7	49.6	59.7	71.5	87.2	107.9	127.0
-11.00	CLAY	100	136.4	600.3	149.1	182.4	217.7	264.5	314.2	367.1	59.4	71.2	84.7	102.6	123.5	143.5
-12.00	CLAY	50	164.4	600.3	174.2	210.2	246.2	298.6	350.6	406.2	59.5	71.5	84.9	99.9	116.5	133.7
-13.00	CLAY	100	192.4	600.3	198.5	239.1	277.5	337.1	397.1	467.6	71.9	89.5	105.8	127.1	148.6	172.6
-14.00	CLAY	100	220.4	600.3	213.7	259.2	305.1	366.5	430.9	498.2	83.6	103.0	119.0	142.5	167.0	192.5
-15.00	CLAYEY SAND	100	248.6	496.3	241.0	289.9	314.1	371.9	426.0	486.1	96.7	116.7	132.6	154.4	182.8	214.0
-16.00	CLAYEY SAND	100	276.8	477.8	263.9	317.3	337.3	401.0	460.6	528.2	93.7	112.3	131.5	156.0	181.4	207.5
-17.00	CLAYEY SAND	100	305.1	509.3	287.9	333.1	354.0	420.5	480.3	549.3	103.2	121.3	141.9	166.4	195.7	223.9
-18.00	CLAYEY SAND	100	333.3	540.8	308.2	344.2	362.1	427.0	484.9	544.7	109.1	130.8	153.0	181.9	210.9	241.1



BEARING CAPACITY OF PILE FOUNDATION														
DRIVEN PILE														
PROJECT : PET Gas for Gateway City II					BORE HOLE : 88-10									
LOCATION : Pasing Yau District, Chachoengsao Province					GROUND WATER : 3.60 m									
FACTOR OF SAFETY : 2.50					CALCULATED BY : MOHAMMED AZHAR									
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/H)	SUM Qf (T/m)	Qe (T/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (T)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (T)				
					1 SECTION (cm × cm)					1 SECTION (cm × cm)				
					0.22	0.26	0.30	0.35	0.40	0.22	0.26	0.30	0.35	0.40
-1.00	CLAYEY SAND	38	1.2	9.3	2.2	2.7	3.3	3.7	4.1	0.28	1.0	1.2	1.3	1.4
-2.00	CLAYEY SAND	58	4.8	36.5	8.2	7.7	8.4	11.1	13.1	0.63	2.9	3.5	4.0	4.6
-3.00	CLAYEY SAND	69	6.9	66.0	9.4	11.8	14.5	17.5	20.6	0.5	4.4	5.4	6.4	7.4
-4.00	CLAY	22	13.2	132.1	28.2	22.9	28.1	32.6	40.3	7.0	6.7	10.7	12.7	14.9
-5.00	CLAY	32	19.2	132.1	25.0	31.0	35.0	44.3	51.5	2.9	11.2	14.5	16.7	19.3
-6.00	CLAY	24	26.6	144.1	32.5	40.1	49.2	56.5	65.7	12.9	15.4	18.8	21.5	24.5
-7.00	CLAY	46	39.5	276.1	50.3	63.4	76.5	89.4	105.2	10.6	24.2	29.7	34.4	40.0
-8.00	CLAY	46	52.4	276.1	63.0	78.7	92.4	110.7	128.4	24.9	33.6	37.5	42.7	49.0
-9.00	CLAY	110	81.4	540.3	130.6	158.9	188.0	208.4	238.8	56.7	59.6	66.6	73.4	81.9
-10.00	CLAY	100	108.4	600.3	131.0	164.2	201.1	233.3	259.2	52.4	64.4	79.1	90.7	104.7
-11.00	CLAY	100	136.4	600.3	162.4	199.5	249.3	277.9	319.7	61.1	79.6	96.0	109.0	124.6
-12.00	CLAY	60	163.2	360.2	172.4	209.6	256.5	304.5	350.3	68.0	83.5	100.9	111.5	124.5
-13.00	CLAY	110	181.2	600.3	200.5	256.0	313.3	341.9	400.3	52.8	101.0	122.9	138.4	156.3
-14.00	CLAY	100	209.2	600.3	168.9	201.1	256.4	298.1	350.8	104.4	115.0	140.7	150.5	176.2
-15.00	CLAYEY SAND	58	206.6	640.3	252.2	306.1	374.4	413.2	463.0	99.7	120.8	147.7	162.4	180.8
-16.00	CLAYEY SAND	58	245.2	677.8	272.8	331.0	404.9	446.7	500.4	107.0	130.8	159.8	175.6	195.4
-17.00	CLAYEY SAND	58	265.1	539.3	294.7	357.5	417.7	452.4	540.1	116.5	141.1	172.6	189.6	211.0
-18.00	CLAYEY SAND	58	286.2	540.6	317.8	385.5	471.6	510.9	582.0	125.7	152.1	189.2	204.5	227.5

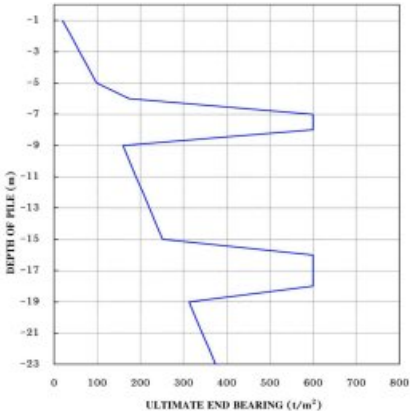
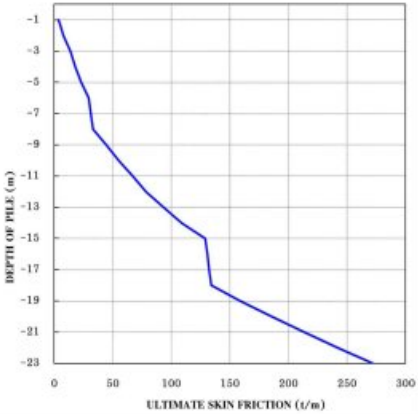


## Appendix H

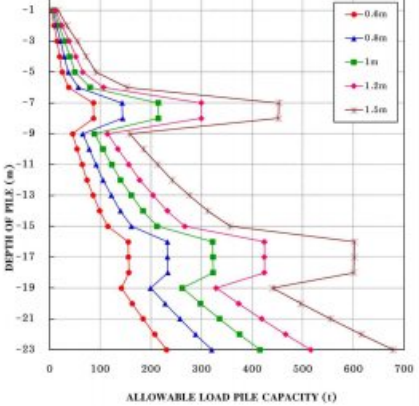
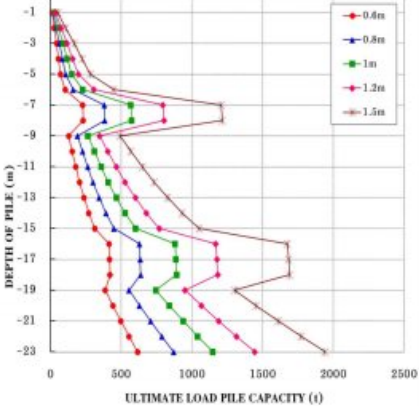
## Bored Pile Design

1. Bored Pile BH-1

BEARING CAPACITY OF PILE FOUNDATION BORED PILE															
PROJECT LOCATION DATE		PTT Gas for Gateway City IE Plang Yao District, Chachoengsao Province 17/05/64										BORE HOLE: BH-1 GROUND WATER: 1.58 m CALCULATED BY: MOHAMMED AZHAR			
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	N/c	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree e)	Nq	Qf (t/m)	SQM Qf (t/m)	Qe (t/m <sup>2</sup> )	
-1.00	CLAYEY SAND	100	56				2.15	2.15	1.939	40.2	17.0	3.6	3.6	10.7	
-2.00	CLAYEY SAND	100	56				4.30	4.30	1.922	40.2	17.0	3.6	3.6	20.4	
-3.00	CLAYEY SAND	100	56				6.45	6.45	1.923	40.2	17.0	3.7	3.7	30.2	
-4.00	CLAYEY SAND	33	22				8.60	8.60	1.402	24.1	17.0	4.2	17.0	38.5	
-5.00	CLAYEY SAND	33	22				10.80	9.30	1.402	24.1	17.0	5.0	22.0	48.2	
-6.00	CLAY	23	22	19.34	0.334	0.0	12.70	7.70	0.0	0.0	0.0	0.0	20.4	174.1	
-7.00	CLAY	100	100	66.70	0.027	0.0	14.60	0.00	0.0	0.0	0.0	0.0	0.0	600.3	
-8.00	CLAY	100	100	66.70	0.027	0.0	16.50	0.00	0.0	0.0	0.0	0.0	0.0	600.3	
-9.00	CLAYEY SAND	70	42				18.40	10.40	1.862	39.4	17.0	11.4	44.4	175.6	
-10.00	CLAYEY SAND	56	36				20.30	11.30	1.710	37.5	17.0	10.8	95.1	176.1	
-11.00	CLAYEY SAND	56	36				22.20	13.20	1.710	37.5	17.0	11.6	66.7	190.4	
-12.00	CLAYEY SAND	56	36				24.10	15.10	1.644	26.7	17.0	11.6	78.2	205.7	
-13.00	CLAYEY SAND	67	43				26.00	17.00	1.833	39.0	17.0	14.8	93.2	221.0	
-14.00	CLAYEY SAND	67	43				27.90	18.90	1.450	1.833	39.0	17.0	15.8	108.0	236.3
-15.00	CLAYEY SAND	120	56				29.80	15.80	2.033	41.4	17.0	19.0	128.0	251.6	
-16.00	CLAY	100	100	66.70	0.027	0.0	31.70	16.70	0.0	0.0	0.0	0.0	0.0	600.3	
-17.00	CLAY	100	100	66.70	0.027	0.0	33.60	17.60	0.0	0.0	0.0	0.0	0.0	600.3	
-18.00	CLAY	100	100	66.70	0.027	0.0	35.50	18.50	0.0	0.0	0.0	0.0	0.0	600.3	
-19.00	CLAYEY SAND	100	56				37.40	19.40	2.009	41.8	17.0	25.0	175.2	313.8	
-20.00	CLAYEY SAND	100	56				39.30	20.30	1.079	42.0	17.0	26.4	185.6	328.1	
-21.00	CLAYEY SAND	100	56				41.20	21.20	2.009	42.0	17.0	27.6	113.2	343.4	
-22.00	CLAYEY SAND	100	56				43.10	22.10	1.082	42.0	17.0	28.8	132.0	358.7	
-23.00	CLAYEY SAND	100	56				45.00	23.00	2.082	42.0	17.0	29.9	271.9	374.0	

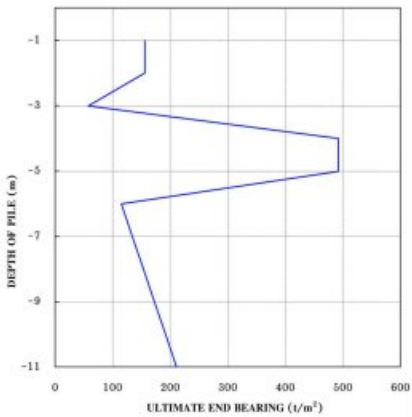
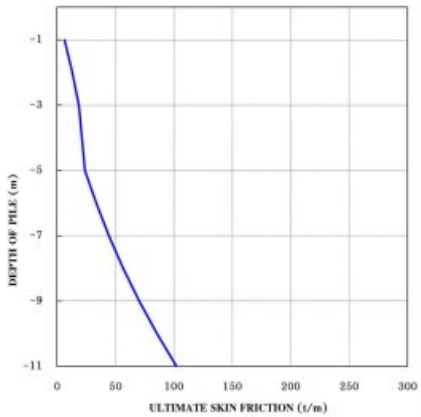


BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : LOCATION : FACTOR OF SAFETY :				PTT Gas for Gateway City IE Phang Yao District, Chachoengsao Province 2.50										
				BORE HOLE: GROUND WATER: CALCULATED BY:										
				BH-1 1.58 m MOHAMMED AZHAR										
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRE CT) (blows/ ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m x m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAYEY SAND	56	3.6	10.7	22.4	12.1	16.9	26.0	35.0	4.3	6.4	9.9	11.7	26.6
-2.00	CLAYEY SAND	56	6.0	35.4	26.3	40.0	56.2	74.8	107.5	5.1	13.6	19.7	24.5	59.0
-3.00	CLAYEY SAND	56	13.7	52.2	42.6	64.2	89.6	116.5	162.2	10.0	22.1	30.2	39.3	95.0
-4.00	CLAYEY SAND	23	17.9	76.9	56.0	84.7	108.0	156.7	212.9	19.7	29.1	36.8	51.8	72.6
-5.00	CLAYEY SAND	23	22.0	95.6	71.0	107.2	140.5	197.8	265.4	25.0	36.8	50.4	69.6	91.7
-6.00	CLAY	22	20.4	174.1	104.5	161.4	229.1	307.5	445.2	27.7	57.3	80.3	106.7	151.0
-7.00	CLAY	100	31.2	600.3	228.3	360.0	569.4	796.2	1207.7	36.6	143.6	214.6	299.5	453.4
-8.00	CLAY	100	33.0	600.3	231.7	364.5	574.0	802.8	1216.0	37.2	144.1	214.9	299.4	453.5
-9.00	CLAYEY SAND	43	44.4	159.8	128.6	191.8	264.5	341.6	491.5	45.3	69.9	95.0	114.6	158.4
-10.00	CLAYEY SAND	36	55.1	175.1	151.2	226.4	310.7	405.4	566.1	54.5	78.5	106.4	136.0	185.2
-11.00	CLAYEY SAND	36	66.7	190.4	179.3	253.2	339.0	446.2	620.7	64.2	92.0	122.9	156.6	213.6
-12.00	CLAYEY SAND	37	78.2	205.7	192.4	269.0	357.5	467.5	652.2	74.0	105.5	140.4	176.7	241.1
-13.00	CLAYEY SAND	43	93.2	221.0	207.6	285.0	369.3	469.3	663.3	82.6	112.3	151.9	204.8	276.6
-14.00	CLAYEY SAND	43	108.0	236.3	221.6	292.2	372.6	476.8	676.8	93.0	124.0	164.7	220.7	310.9
-15.00	CLAYEY SAND	56	128.0	251.6	312.3	449.8	602.1	766.9	1051.4	115.1	161.8	212.6	286.9	396.9
-16.00	CLAY	100	126.0	600.3	416.2	629.6	861.5	1170.8	1675.9	155.2	232.5	322.8	424.4	582.5
-17.00	CLAY	100	132.4	600.3	436.5	658.0	897.1	1179.6	1669.2	158.9	233.1	322.8	424.5	601.6
-18.00	CLAY	100	134.1	600.3	421.9	638.4	892.6	1183.3	1662.5	156.5	233.7	322.1	424.4	600.7
-19.00	CLAYEY SAND	56	152.2	312.8	387.7	556.7	745.4	952.2	1302.4	142.4	199.8	262.4	329.3	448.4
-20.00	CLAYEY SAND	56	165.6	328.1	441.6	620.7	840.4	1098.8	1453.8	153.1	228.1	298.4	372.2	496.7
-21.00	CLAYEY SAND	56	213.2	343.4	497.9	707.8	939.2	1190.0	1611.0	184.9	257.8	336.1	418.0	559.3
-22.00	CLAYEY SAND	56	234.0	358.7	556.3	787.7	1041.6	1313.6	1773.6	207.6	288.5	375.2	466.5	616.1
-23.00	CLAYEY SAND	56	271.9	374.0	617.0	870.5	1147.6	1449.4	1941.7	231.2	320.5	415.7	515.7	679.1



2. Bored Pile BH-2

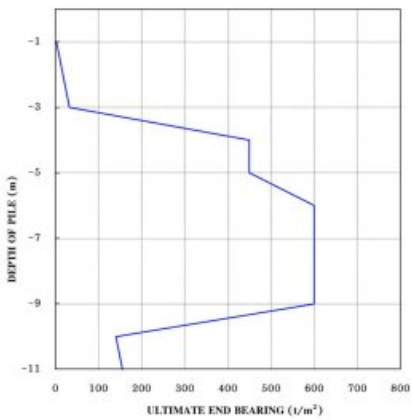
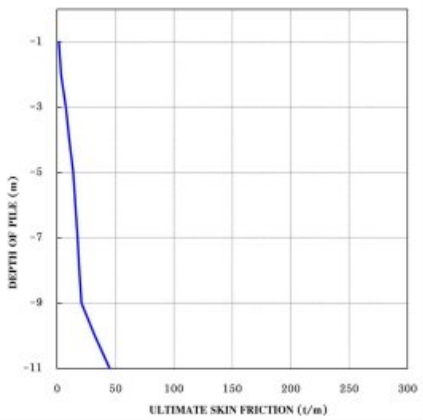
BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City IE				BORE HOLE: BH-2				GROUND WATER: -1.20 m						
LOCATION : Phang Yae District, Chachoengsao Province				CALCULATED BY: MOHAMMED AZHAR										
DATE : 17/05/84														
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	φ	ψ	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	κ	δ (Degree)	Nq	Qf (t/m)	ΣQf (t/m)	Qa (t/m <sup>2</sup> )
-1.00	CLAY	26	26	17.34	0.272	9.0	2.33	2.33				6.4	6.4	196.1
-2.00	CLAY	26	26	17.34	0.272	9.0	4.66	4.66				6.4	12.9	196.1
-3.00	CLAY WITH GRAVEL	50	50				6.99	6.99	1.035	40.2	17.0	6.4	19.3	257.6
-4.00	CLAY	52	52	54.60	0.090	9.0	9.32	9.32				6.4	25.7	494.2
-5.00	CLAY	52	52	54.60	0.090	9.0	11.65	11.65				6.4	32.1	692.2
-6.00	CLAYEY SAND	100	100	57.5			13.98	13.98	1.046	40.4	17.0	6.5	39.5	115.5
-7.00	CLAYEY SAND	100	100	57.5			16.01	16.01	1.058	40.5	17.0	10.6	46.3	184.5
-8.00	CLAYEY SAND	100	100	57.5			17.94	17.94	1.067	40.6	17.0	13.3	56.6	153.7
-9.00	CLAYEY SAND	100	100	57.5			19.17	19.17	1.077	40.7	17.0	13.7	70.3	172.9
-10.00	CLAYEY SAND	100	100	57.5			21.30	21.30	1.087	40.9	17.0	15.1	85.4	182.1
-11.00	CLAYEY SAND	100	100	57.5			23.43	23.43	1.096	41.0	17.0	16.6	100.0	211.2



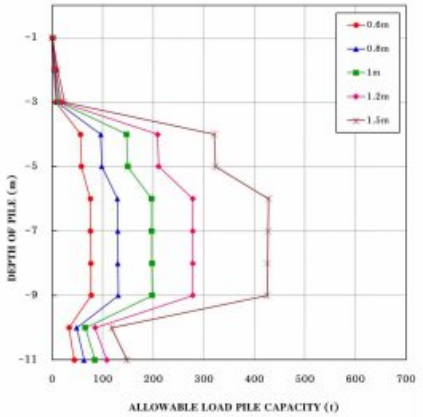
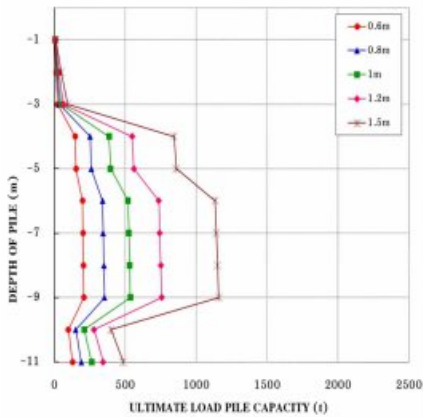
BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City IE				BORE HOLE: BH-2				BORE HOLE: 120 m						
LOCATION : Phang Yae District, Chachoengsao Province				GROUND WATER: 1.20 m				CALCULATED BY: MOHAMMED AZHAR						
FACTOR OF SAFETY: 2.50														
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (Blows/ft)	SUM Qf (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>all</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m < m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAY	26	6.4	19.3	94.6	142.8	190.9	239.0	287.1	21.8	32.6	43.4	54.2	65.0
-2.00	CLAY	26	12.8	38.6	189.2	285.6	380.8	476.0	571.2	43.6	65.2	86.8	108.4	129.9
-3.00	CLAY WITH GRAVEL	50	19.5	57.6	315.0	472.5	629.9	787.4	944.8	65.4	98.1	130.8	163.5	196.2
-4.00	CLAY	52	21.2	62.2	328.1	492.2	656.5	820.6	984.8	68.9	103.5	137.9	174.8	210.0
-5.00	CLAY	52	25.0	75.0	390.2	585.3	780.4	975.5	1170.6	80.3	117.0	156.3	195.4	234.5
-6.00	CLAYEY SAND	100	33.5	115.3	555.5	833.3	1111.1	1388.9	1666.7	104.1	156.2	208.3	260.4	312.5
-7.00	CLAYEY SAND	58	44.3	124.5	721.3	1081.9	1442.5	1803.1	2163.7	140.3	210.5	280.7	350.9	421.1
-8.00	CLAYEY SAND	58	56.4	157.7	899.0	1348.5	1798.0	2247.5	2697.0	184.5	276.8	369.1	461.4	553.7
-9.00	CLAYEY SAND	58	70.3	177.9	1011.0	1516.5	2022.0	2527.5	3033.0	220.3	330.5	440.7	550.9	661.1
-10.00	CLAYEY SAND	58	85.4	200.1	1145.9	1718.9	2291.9	2864.9	3437.9	259.3	388.9	518.1	647.3	776.5
-11.00	CLAYEY SAND	58	102.0	211.3	1251.9	1877.9	2503.9	3129.9	3755.9	303.3	455.0	606.7	758.4	910.1

3. Bored Pile BH-3

BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City E				BORE HOLE: BH-3				GROUND WATER: 4.38 m						
LOCATION : Phang Yai District, Chachoengsao Province				CALCULATED BY: MOHAMMED AZHAR										
DATE : 17/05/64														
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (Blows/ft)	SPT (CORRECT) (Blows/ft)	Su (t/m <sup>2</sup> )	α	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	κ	f (Degree α)	Nq	Qf (t/m)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )
-1.00	CLAYEY SAND	47	31				2.13	1.75	1.612	36.4	17.0	1.4	1.4	2.6
-2.00	CLAYEY SAND	47	31				4.05	2.05	1.612	36.4	17.0	2.1	3.5	17.9
-3.00	CLAYEY SAND	322	97.5				5.95	2.75	1.625	42.2	17.0	3.0	7.3	23.2
-4.00	CLAY	75	75	30.03	0.009	9.0	7.80	3.35				3.2	10.6	450.2
-5.00	CLAY	75	75	30.03	0.009	9.0	9.70	4.70				3.2	13.8	450.2
-6.00	CLAY	322	322	99.30	0.027	9.0	11.65	6.55				3.0	16.8	450.3
-7.00	CLAY	322	322	99.30	0.027	9.0	13.55	8.55				3.0	19.8	450.3
-8.00	CLAY	322	322	99.30	0.027	9.0	15.45	10.45				3.0	22.8	450.3
-9.00	CLAY	322	322	99.30	0.027	9.0	17.35	12.35				3.0	25.8	450.3
-10.00	CLAY WITH GRAVEL	322	322	99.30	0.027	9.0	19.25	14.25	1.007	45.0	17.0	11.4	37.3	420.3
-11.00	CLAY WITH GRAVEL	322	322	99.30	0.027	9.0	21.15	16.15	1.008	45.0	17.0	12.6	49.9	395.6

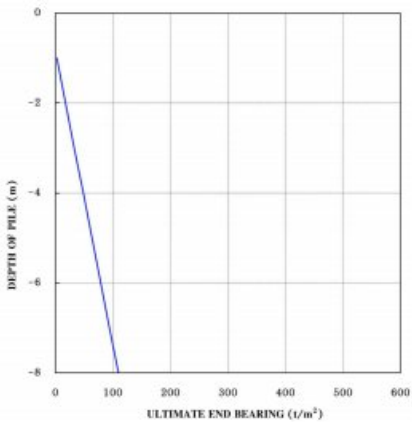
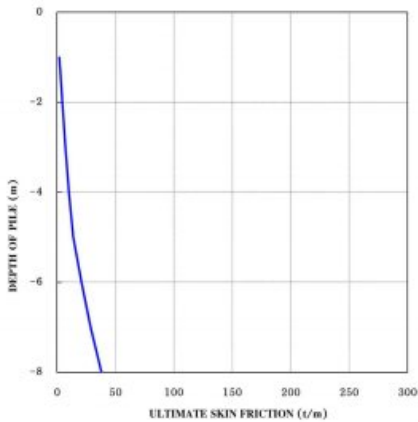


BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City E		BORE HOLE: BH-3		GROUND WATER: 4.38 m										
LOCATION : Phang Yai District, Chachoengsao Province		CALCULATED BY: MOHAMMED AZHAR												
DATE : 17/05/64														
FACTOR OF SAFETY: 2.50														
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m - m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAYEY SAND	31	1.4	2.6	3.4	4.9	6.5	8.3	11.3	0.7	0.7	0.7	0.6	0.5
-2.00	CLAYEY SAND	31	3.5	17.9	11.6	17.8	25.0	33.4	48.1	3.3	4.7	6.2	7.9	10.7
-3.00	CLAYEY SAND	99	7.2	32.2	32.2	35.1	46.1	65.1	95.1	7.2	10.4	14.0	17.6	24.9
-4.00	CLAY	75	30.0	450.2	147.3	232.9	338.9	549.0	845.4	56.1	96.3	147.2	200.7	301.2
-5.00	CLAY	75	33.8	450.2	153.2	243.0	357.0	561.1	860.6	57.0	98.4	149.4	210.9	313.0
-6.00	CLAY	322	32.0	450.2	160.0	249.9	363.9	567.9	867.4	75.0	124.1	166.6	218.7	328.2
-7.00	CLAY	322	37.2	450.2	202.3	345.3	525.9	744.3	1142.3	76.3	129.7	193.2	278.9	407.3
-8.00	CLAY	322	39.1	450.2	206.6	349.7	533.5	750.9	1150.8	76.8	130.2	193.5	279.6	406.4
-9.00	CLAY	322	40.4	450.2	208.0	354.2	537.0	757.4	1159.1	77.5	130.8	197.9	278.5	405.5
-10.00	CLAY WITH GRAVEL	99	44.9	155.6	126.4	150.9	203.1	344.7	489.3	83.9	63.1	84.5	108.0	147.9
-11.00	CLAY WITH GRAVEL	99												
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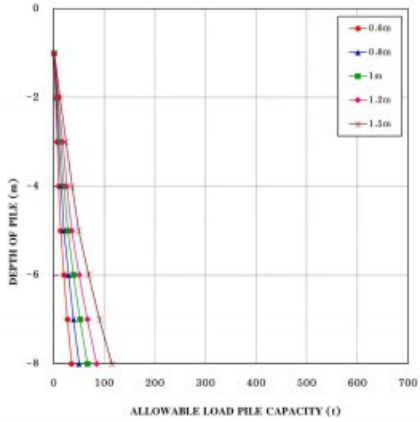
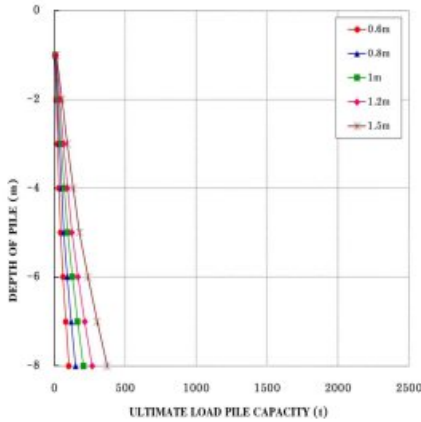


4. Bored Pile BH-4

BEARING CAPACITY OF PILE FOUNDATION BORED PILE												
PROJECT : PTT Gas for Gateway City/E			BORE HOLE: BH-4			BORE HOLE: BH-4						
LOCATION : Plangyao District, Chachoengsao Province			GROUND WATER: 4.30 m			GROUND WATER: 4.30 m						
DATE : 17/05/64			CALCULATED BY: MOHAMMED AZHAR			CALCULATED BY: MOHAMMED AZHAR						
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	Nq	Qf (t/m)
-1.00	CLAYEY SAND	75	45.5				2.15	1.25	1.015	40.0	17.0	1.9
-2.00	CLAYEY SAND	75	45.5				4.09	2.28	1.015	40.0	17.0	2.8
-3.00	CLAYEY SAND	29	27				5.95	2.95	1.017	35.0	17.0	2.6
-4.00	CLAYEY SAND	31	23.5				7.69	3.25	1.033	34.0	17.0	3.0
-5.00	CLAYEY SAND	32	23.5				9.75	4.75	1.033	34.0	17.0	3.6
-6.00	CLAYEY SAND	100	57.5				11.85	5.85	1.046	40.0	17.0	6.9
-7.00	CLAYEY SAND	100	57.5				13.55	5.55	1.056	40.0	17.0	8.0
-8.00	CLAYEY SAND	100	57.5				15.45	7.45	1.067	40.0	17.0	9.1

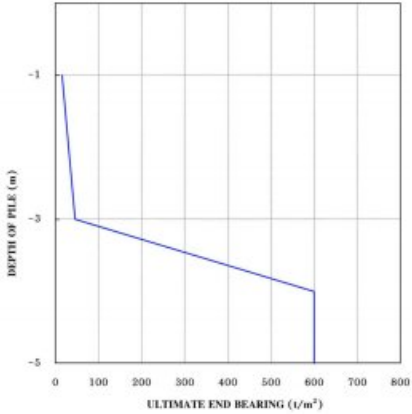
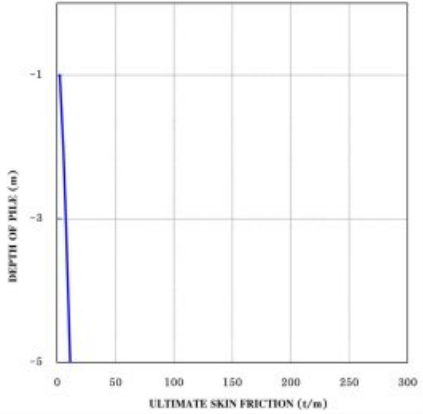


BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City/E			BORE HOLE: BH-4			GROUND WATER: 4.30 m			BORE HOLE: BH-4					
LOCATION : Plang Yao District, Chachoengsao Province			CALCULATED BY: MOHAMMED AZHAR			GROUND WATER: 4.30 m			BORE HOLE: BH-4					
FACTOR OF SAFETY: 2.50			CALCULATED BY: MOHAMMED AZHAR			GROUND WATER: 4.30 m			BORE HOLE: BH-4					
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m x m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAYEY SAND	45	1.9	2.6	4.3	6.1	8.0	10.0	12.5	1.5	1.8	1.3	1.3	1.2
-2.00	CLAYEY SAND	45	4.7	12.9	14.8	20.7	28.0	34.8	43.2	4.4	5.9	4.7	4.7	4.2
-3.00	CLAYEY SAND	27	7.2	33.2	33.0	34.8	48.7	64.7	82.8	7.1	10.3	13.8	17.7	24.3
-4.00	CLAYEY SAND	24	10.2	46.5	32.8	49.9	70.0	93.1	120.6	10.4	15.1	20.5	26.4	36.5
-5.00	CLAYEY SAND	24	12.6	63.8	43.2	66.6	93.9	123.2	157.5	14.2	20.8	27.9	36.0	49.8
-6.00	CLAYEY SAND	92	20.7	73.1	51.2	91.7	127.1	163.2	209.3	20.4	29.4	39.5	50.9	68.1
-7.00	CLAYEY SAND	50	28.7	94.4	80.6	119.5	164.3	214.7	280.0	27.5	39.4	52.5	66.9	91.1
-8.00	CLAYEY SAND	50	37.8	106.7	103.1	150.1	205.0	266.3	322.0	35.4	50.4	66.9	84.8	114.9

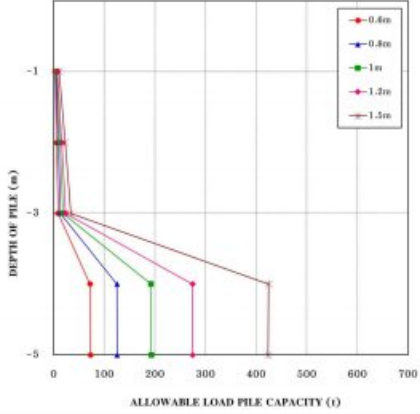
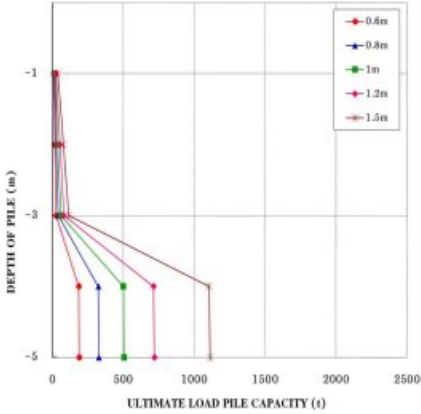


5. Bored Pile BH-5

BEARING CAPACITY OF PILE FOUNDATION BORED PILE												
PROJECT : PTT Gas for Gateway City II			BORE HOLE : BH-5									
LOCATION : Plang Yao District, Chachoengsao Province			GROUND WATER : 1.80 m									
DATE : 17/05/64			CALCULATED BY : MOHAMMED AZHAR									
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	Nq	Qf (t/m)
												Q <sub>u</sub> (t/m <sup>2</sup> )
-1.00	CLAYEY SAND	49	32				1.90	1.90	1.633	36.6	17.0	2.4
-2.00	CLAYEY SAND	49	32				3.80	2.80	1.633	36.6	17.0	2.9
-3.00	CLAYEY SAND	24	16				5.70	2.70	1.296	32.6	17.0	2.4
-4.00	CLAY	100	100	46.50	0.027	9.0	7.60	4.60			17.0	3.9
-5.00	CLAY	100	100	46.50	0.027	9.0	9.50	5.50			17.0	3.9

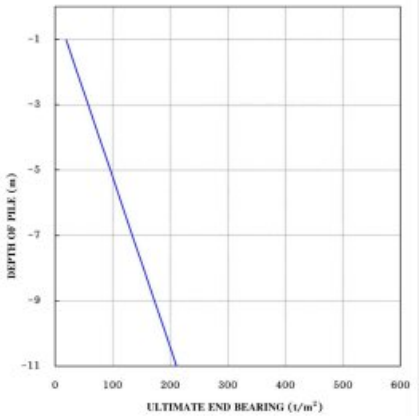
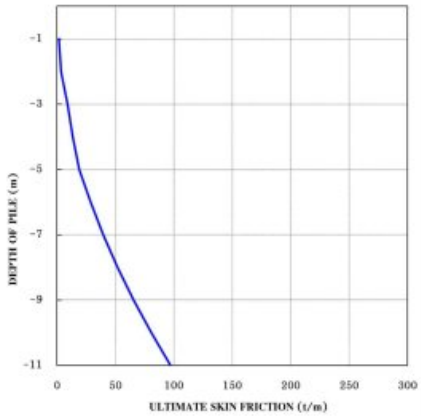


BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City II			BORE HOLE : BH-5											
LOCATION : Plang Yao District, Chachoengsao Province			GROUND WATER : 1.80 m											
FACTOR OF SAFETY: 2.50			CALCULATED BY: MOHAMMED AZHAR											
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/ft)	SUM Qf (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>all</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m x m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAYEY SAND	32	2.4	15.3	8.9	13.6	19.6	26.4	38.4	2.9	4.3	6.0	7.8	11.1
-2.00	CLAYEY SAND	32	5.2	30.6	16.4	28.4	40.3	54.1	79.5	6.0	8.0	10.3	13.2	22.9
-3.00	CLAYEY SAND	16	7.6	45.9	27.3	42.2	60.0	80.6	117.0	8.9	13.3	18.3	24.1	34.1
-4.00	CLAY	100	9.4	600.3	187.8	296.2	500.9	714.2	1105.0	72.2	125.3	194.8	274.8	425.0
-5.00	CLAY	100	11.2	600.3	190.7	309.8	506.5	720.9	1113.3	72.9	125.9	195.2	275.8	425.1
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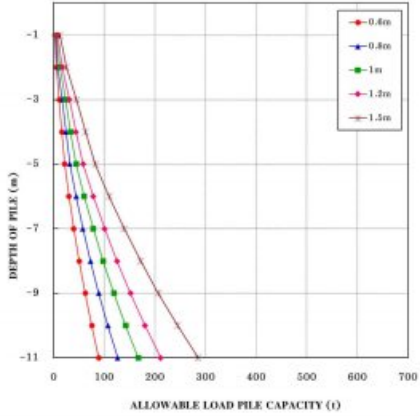
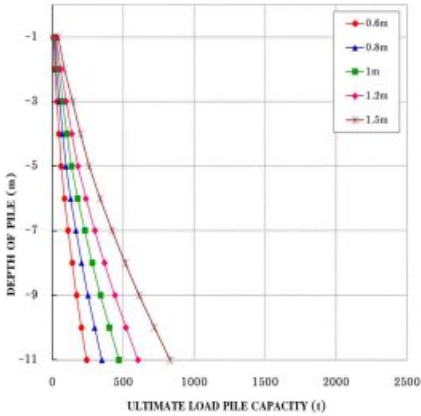


6. Bored Pile BH-6

BEARING CAPACITY OF PILE FOUNDATION BORED PILE													
PROJECT : PTT Gas for Gateway City II				BORE HOLE: BH-6				BORE HOLE: BH-6					
LOCATION : Plangyao District, Chachoengsao Province				GROUND WATER: 1.80 m				GROUND WATER: 1.80 m					
DATE : 5/25/64				CALCULATED BY: MOHAMMED AZHAR				CALCULATED BY: MOHAMMED AZHAR					
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (Blows/ft)	SPT (CORRECT) (Blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	Nq	Qf (t/m)	SUM Qf (t/m)
-1.00	CLAYEY SAND	9	12				2.13	2.13	1.150	30.8	17.0	1.6	1.6
-2.00	CLAYEY SAND	9	12				4.26	3.26	1.150	30.8	17.0	1.6	3.2
-3.00	CLAYEY SAND	20	28				6.39	4.39	1.025	40.2	17.0	3.6	6.8
-4.00	CLAYEY SAND	22	30				8.52	5.52	1.017	35.2	17.0	4.6	11.4
-5.00	CLAYEY SAND	27	37				10.65	7.65	1.017	35.2	17.0	5.6	17.0
-6.00	CLAYEY SAND	30	40				12.78	9.78	1.045	40.4	17.0	5.6	22.6
-7.00	CLAYEY SAND	32	42				14.91	11.91	1.055	40.5	17.0	20.0	42.6
-8.00	CLAYEY SAND	30	40				17.04	14.04	1.067	40.6	17.0	13.7	56.3
-9.00	CLAYEY SAND	30	40				19.17	16.17	1.077	40.7	17.0	13.7	70.0
-10.00	CLAYEY SAND	30	40				21.30	18.30	1.087	40.8	17.0	13.7	83.7
-11.00	CLAYEY SAND	30	40				23.43	20.43	1.098	41.0	17.0	20.0	103.7



BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City II				BORE HOLE: BH-6				BORE HOLE: BH-6						
LOCATION : Plangyao District, Chachoengsao Province				GROUND WATER: 1.80 m				GROUND WATER: 1.80 m						
DATE : 5/25/64				CALCULATED BY: MOHAMMED AZHAR				CALCULATED BY: MOHAMMED AZHAR						
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (Blows/ft)	SUM Qf (t/m)	Qe (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>all</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m > m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAYEY SAND	12	1.6	19.2	8.4	13.6	20.0	27.6	41.3	2.7	4.2	6.1	8.3	12.3
-2.00	CLAYEY SAND	12	3.4	38.4	17.3	28.0	41.0	56.4	84.1	5.6	8.8	12.6	17.1	25.2
-3.00	CLAYEY SAND	20	6.0	57.6	33.2	51.6	73.6	99.1	144.3	11.3	17.0	23.8	31.5	45.0
-4.00	CLAYEY SAND	27	13.6	76.8	47.2	72.8	103.1	138.0	196.8	16.2	24.3	33.7	45.4	63.0
-5.00	CLAYEY SAND	27	19.0	96.1	63.9	94.1	135.2	180.2	258.4	21.9	32.4	44.7	59.5	82.5
-6.00	CLAYEY SAND	30	30.5	115.5	86.2	126.5	180.0	237.5	337.9	30.4	44.6	60.7	79.7	109.7
-7.00	CLAYEY SAND	30	39.4	134.5	112.0	166.4	222.2	290.1	423.0	40.1	58.1	79.5	103.0	139.5
-8.00	CLAYEY SAND	30	51.6	153.7	140.5	206.8	280.8	367.0	514.7	50.9	72.1	98.0	125.4	172.0
-9.00	CLAYEY SAND	30	65.3	172.9	171.7	250.8	340.0	441.1	613.1	62.6	88.5	119.4	152.0	207.1
-10.00	CLAYEY SAND	30	80.5	192.1	205.6	296.5	403.5	519.8	718.4	75.4	107.3	145.6	185.8	249.0
-11.00	CLAYEY SAND	30	97.1	211.3	242.2	340.9	470.8	604.0	830.6	89.4	126.7	167.6	211.7	285.6

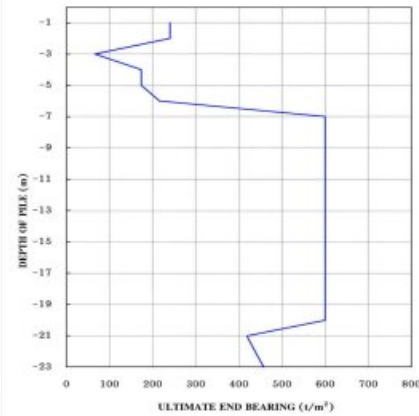
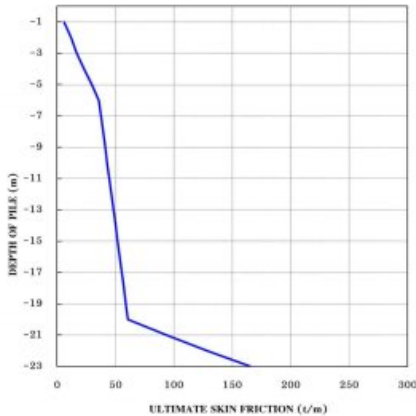


7. Bored Pile BH-7

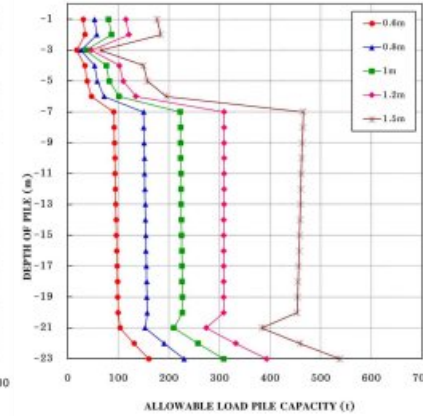
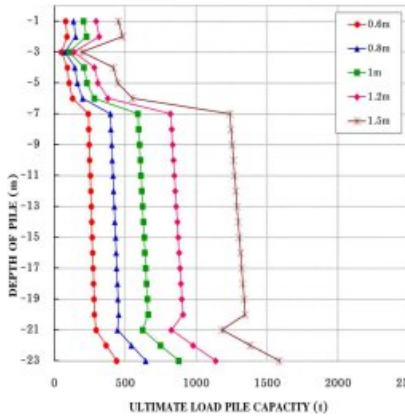
BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City IE LOCATION : Phang Yao District, Chachoengsao Province DATE : 17/05/64							BORE HOLE: BH-7 GROUND WATER : -1.50 m CALCULATED BY: MOHAMMED AZHAR							
DEPTH OF PILE TOP (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	N <sub>c</sub>	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	N <sub>q</sub>	Q <sub>f</sub> (t/m)	Su <sub>m</sub> Q <sub>f</sub> (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )
-1.00	CLAYEY SAND	21	18				2.15	2.15	1.206	37.6	17.5	1.6	1.8	19.4
-3.00	CLAYEY SAND	21	18				4.30	3.30	1.206	37.6	17.5	2.5	4.2	39.1
-5.00	CLAY	25	25	17.34	0.202	9.3	6.45	4.45			17.5	6.4	10.6	156.1
-7.00	CLAYEY SAND	25	25				8.60	6.60	1.025	45.2	17.5	6.9	17.6	78.2
-9.00	CLAYEY SAND	25	25				10.75	8.75	1.025	45.2	17.5	8.2	25.8	97.8
-11.00	CLAYEY SAND	50	50				12.90	7.90	1.045	45.4	17.5	9.6	35.4	117.3
-13.00	CLAYEY SAND	50	50				15.05	9.05	1.050	45.5	17.5	11.0	46.5	156.9
-15.00	CLAYEY SAND	50	50				17.20	10.20	1.067	45.6	17.5	12.5	58.9	195.4
-17.00	CLAYEY SAND	100	50				19.35	11.35	1.077	45.7	17.5	13.9	72.8	278.9
-19.00	CLAYEY SAND	100	50				21.50	12.50	1.087	45.8	17.5	15.4	88.2	335.5
-21.00	CLAYEY SAND	100	50				23.65	13.65	1.099	45.9	17.5	16.9	105.1	412.1

8. Bored Pile BH-8

BEARING CAPACITY OF PILE FOUNDATION BORED PILE												
PROJECT : PTT Gas for Gateway City E			BORE HOLE: BH-8			GROUND WATER : 2.58 m						
LOCATION : Plangyao District, Chachoengsao Province			CALCULATED BY: MOHAMMED AZHAR									
DATE : 17/05/64												
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (blows/R)	SPT (CORRECT) (blows/R)	q <sub>u</sub> (t/m <sup>2</sup> )	α	N <sub>c</sub>	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	N <sub>q</sub>	q <sub>u</sub> (t/m <sup>2</sup> )
												Q <sub>u</sub> (t/m <sup>2</sup> )
-1.00	CLAY	40	40	26.68	0.026	0.0	2.00	2.00				6.0
-2.00	CLAY	50	50	26.68	0.026	0.0	4.00	4.00				9.0
-3.00	CLAY	11	11	7.34	0.026	0.0	6.00	5.00				4.7
-4.00	CLAY	29	29	19.24	0.024	0.0	8.00	6.00				6.5
-5.00	CLAY	29	29	19.24	0.024	0.0	10.00	7.00				6.5
-6.00	CLAY	36	36	24.02	0.020	0.0	12.00	8.06				6.2
-7.00	CLAY	100	100	66.70	0.027	0.0	14.27	9.37				1.8
-8.00	CLAY	100	100	66.70	0.027	0.0	16.49	11.59				1.8
-9.00	CLAY	100	100	66.70	0.027	0.0	18.70	13.81				1.8
-10.00	CLAY	100	100	66.70	0.027	0.0	20.93	16.03				1.8
-11.00	CLAY	100	100	66.70	0.027	0.0	23.15	18.25				1.8
-12.00	CLAY	100	100	66.70	0.027	0.0	25.38	20.48				1.8
-13.00	CLAY	100	100	66.70	0.027	0.0	27.61	22.70				1.8
-14.00	CLAY	100	100	66.70	0.027	0.0	29.84	24.93				1.8
-15.00	CLAY	100	100	66.70	0.027	0.0	32.07	27.15				1.8
-16.00	CLAY	100	100	66.70	0.027	0.0	34.30	29.38				1.8
-17.00	CLAY	100	100	66.70	0.027	0.0	36.53	31.60				1.8
-18.00	CLAY	100	100	66.70	0.027	0.0	38.76	33.83				1.8
-19.00	CLAY	100	100	66.70	0.027	0.0	40.99	36.05				1.8
-20.00	CLAY	100	100	66.70	0.027	0.0	43.22	38.28				1.8
-21.00	CLAY	100	100	66.70	0.027	0.0	45.45	40.50				1.8
-22.00	CLAY	100	100	66.70	0.027	0.0	47.68	42.73				1.8
-23.00	CLAY	100	100	66.70	0.027	0.0	49.91	44.95				1.8

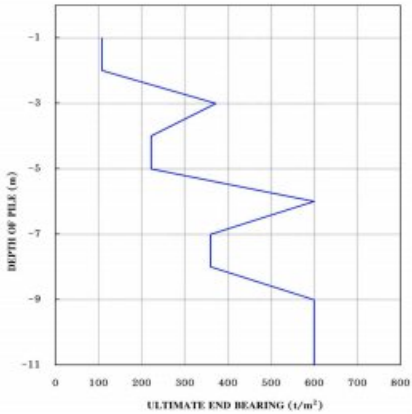
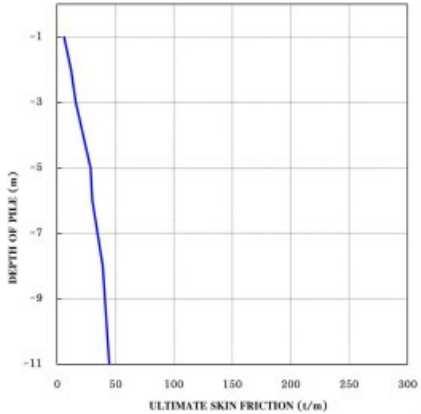


BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City E					BORE HOLE: BH-8					GROUND WATER : 2.58 m				
LOCATION : Plangyao District, Chachoengsao Province					CALCULATED BY: MOHAMMED AZHAR									
DATE : 2.58														
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (blows/R)	SUM Q (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>all</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m - m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAY	40	6.0	240.1	79.2	129.8	207.5	284.2	452.7	31.0	53.1	81.1	115.0	178.9
-2.00	CLAY	40	12.0	240.1	90.5	150.9	236.4	316.8	491.0	34.8	58.0	86.8	123.3	188.9
-3.00	CLAY	11	16.7	66.0	50.0	75.1	104.2	137.4	195.1	32.0	46.4	66.1	96.2	140.4
-4.00	CLAY	29	23.2	174.1	62.7	94.6	129.4	167.9	232.9	34.4	51.4	76.2	109.7	160.7
-5.00	CLAY	29	29.6	174.1	69.9	103.8	139.7	180.2	247.1	36.6	56.7	82.5	119.7	172.6
-6.00	CLAY	36	36.9	216.1	78.5	118.6	160.3	209.2	279.2	37.3	55.8	81.6	118.4	174.9
-7.00	CLAY	100	37.6	600.3	240.4	366.2	492.3	618.4	744.5	150.0	225.0	300.0	375.0	450.0
-8.00	CLAY	100	38.4	600.3	243.8	370.7	500.9	631.1	757.2	151.1	226.7	302.3	377.9	453.5
-9.00	CLAY	100	41.2	600.3	247.1	375.1	505.3	635.5	761.6	152.2	227.8	303.4	379.0	453.7
-10.00	CLAY	100	42.9	600.3	250.4	379.5	509.7	639.9	766.0	153.3	228.9	304.5	380.1	452.8
-11.00	CLAY	100	44.7	600.3	253.7	383.9	514.1	644.3	770.4	154.4	229.9	305.6	381.2	451.9
-12.00	CLAY	100	46.5	600.3	257.1	388.3	518.5	648.7	774.8	155.5	231.0	306.7	382.3	451.1
-13.00	CLAY	100	48.2	600.3	260.4	392.8	522.9	653.1	779.2	156.6	232.1	307.8	383.4	451.1
-14.00	CLAY	100	50.0	600.3	263.7	397.2	527.3	657.5	783.6	157.7	233.2	308.9	384.5	450.9
-15.00	CLAY	100	51.9	600.3	267.0	401.7	531.7	661.9	788.0	158.8	234.3	309.9	385.6	450.8
-16.00	CLAY	100	53.5	600.3	270.4	406.1	536.1	666.3	792.4	159.9	235.4	311.0	386.7	450.7
-17.00	CLAY	100	55.3	600.3	273.7	410.5	540.5	670.7	796.8	161.0	236.5	312.1	387.8	450.4
-18.00	CLAY	100	57.1	600.3	277.0	414.9	544.9	675.1	801.2	162.1	237.6	313.2	388.9	450.5
-19.00	CLAY	100	58.9	600.3	280.3	419.3	549.3	679.5	805.6	163.2	238.7	314.3	389.9	450.6
-20.00	CLAY	100	60.6	600.3	283.7	423.7	553.7	683.9	810.0	164.3	239.8	315.4	391.0	450.4
-21.00	CLAY	100	62.4	600.3	287.0	428.1	558.1	688.3	814.4	165.4	240.9	316.5	392.1	450.8
-22.00	CLAY	100	64.2	600.3	290.3	432.5	562.5	692.7	818.8	166.5	242.0	317.6	393.2	450.8
-23.00	CLAY	100	66.0	600.3	293.7	436.9	566.9	697.1	823.2	167.6	243.1	318.7	394.3	450.8
-24.00	CLAY	100	67.8	600.3	297.0	441.3	571.3	701.5	827.6	168.7	244.2	319.8	395.4	450.8
-25.00	CLAY	100	69.6	600.3	300.3	445.7	575.7	705.9	832.0	169.8	245.3	320.9	396.5	450.8
-26.00	CLAY	100	71.4	600.3	303.7	450.1	580.1	710.3	836.4	170.9	246.4	322.0	397.6	450.8
-27.00	CLAY	100	73.2	600.3	307.0	454.5	584.5	714.7	840.8	172.0	247.5	323.1	398.7	450.8
-28.00	CLAY	100	75.0	600.3	310.3	458.9	588.9	719.1	845.2	173.1	248.6	324.2	399.8	450.8
-29.00	CLAY	100	76.8	600.3	313.7	463.3	593.3	723.5	849.6	174.2	249.7	325.3	400.9	450.8
-30.00	CLAY	100	78.6	600.3	317.0	467.7	597.7	727.9	854.0	175.3	250.8	326.4	402.0	450.8
-31.00	CLAY	100	80.4	600.3	320.3	472.1	602.1	732.3	858.4	176.4	251.9	327.5	403.1	450.8
-32.00	CLAY	100	82.2	600.3	323.7	476.5	606.5	736.7	862.8	177.5	253.0	328.6	404.2	450.8
-33.00	CLAY	100	84.0	600.3	327.0	480.9	610.9	741.1	867.2	178.6	254.1	329.7	405.3	450.8
-34.00	CLAY	100	85.8	600.3	330.3	485.3	615.3	745.5	871.6	179.7	255.2	330.8	406.4	450.8
-35.00	CLAY	100	87.6	600.3	333.7	489.7	619.7	749.9	876.0	180.8	256.3	331.9	407.5	450.8
-36.00	CLAY	100	89.4	600.3	337.0	494.1	624.1	754.3	880.4	181.9	257.4	333.0	408.6	450.8
-37.00	CLAY	100	91.2	600.3	340.3	498.5	628.5	758.7	884.8	183.0	258.5	334.1	409.7	450.8
-38.00	CLAY	100	93.0	600.3	343.7	502.9	632.9	763.1	889.2	184.1	259.6	335.2	410.8	450.8
-39.00	CLAY	100	94.8	600.3	347.0	507.3	637.3	767.5	893.6	185.2	260.7	336.3	411.9	450.8
-40.00	CLAY	100	96.6	600.3	350.3	511.7	641.7	771.9	898.0	186.3	261.8	337.4	413.0	450.8
-41.00	CLAY	100	98.4	600.3	353.7	516.1	646.1	776.3	902.4	187.4	262.9	338.5	414.1	450.8
-42.00	CLAY	100	100.2	600.3	357.0	520.5	650.5	780.7	906.8	188.5	264.0	339.6	415.2	450.8
-43.00	CLAY	100	102.0	600.3	360.3	524.9	654.9	785.1	911.2	189.6	265.1	340.7	416.3	450.8
-44.00	CLAY	100	103.8	600.3	363.7	529.3	659.3	789.5	915.6	190.7	266.2	341.8	417.4	450.8
-45.00	CLAY	100	105.6	600.3	367.0	533.7	663.7	793.9	920.0	191.8	267.3	342.9	418.5	450.8
-46.00	CLAY	100	107.4	600.3	370.3	538.1	668.1	798.3	924.4	192.9	268.4	344.0	419.6	450.8
-47.00	CLAY	100	109.2	600.3	373.7	542.5	672.5	802.7	928.8	194.0	269.5	345.1	420.7	450.8
-48.00	CLAY	100	111.0	600.3	377.0	546.9	676.9	807.1	933.2	195.1	270.6	346.2	421.8	450.8
-49.00	CLAY	100	112.8	600.3	380.3	551.3	681.3	811.5	937.6	196.2	271.7	347.3	422.9	450.8
-50.00	CLAY	100	114.6	600.3	383.7	555.7	685.7	815.9	942.0	197.3	272.8	348.4	424.0	450.8
-51.00	CLAY	100	116.4	600.3	387.0	560.1	690.1	820.3	946.4	198.4	273.9	349.5	425.1	450.8
-52.00	CLAY	100	118.2	600.3	390.3	564.5	694.5	824.7	950.8	199.5	275.0	350.6	426.2	450.8
-53.00	CLAY	100	120.0	600.3	393.7	568.9	698.9	829.1	955.2	200.6	276.1	351.7	427.3	450.8
-54.00	CLAY	100	121.8	600.3	397.0	573.3	703.3	833.5	959.6	201.7	277.2	352.8	428.4	450.8
-55.00	CLAY	100	123.6	600.3	400.3	577.7	707.7	837.9	964.0	202.8	278.3	353.9	429.5	450.8
-56.00	CLAY	100	125.4	600.3	403.7	582.1	712.1	842.3	968.4	203.9	279.4	355.0	430.6	450.8
-57.00	CLAY	100	127.2	600.3	407.0	586.5	716.5	846.7	972.8	205.0	280.5	356.1	431.7	450.8
-58.00	CLAY	100	129.0	600.3	410.3	590.9	720.9	851.1	977.2	206.1	281.6	357.2	432.8	450.8
-59.00	CLAY	100	130.8	600.3	413.7	595.3	725.3	855.5	981.6	207.2	282.7	358.3	433.9	450.8
-60.00	CLAY	100	132.6	600.3	417.0	599.7	729.7	859.9	986.0	208.3	283.8	359.4	435.0	450.8
-61.00	CLAY	100	134.4	600.3	420.3	604.1	734.1	864.3	990.4	209.4	284.9	360.5	436.1	450.8
-62.00	CLAY	100	136.2	600.3	423.7	608.5	738.5	868.7	994.8	210.5	286.0	361.6	437.2	450.8
-63.00	CLAY	100	138.0	600.3	427.0	612.9	742.9	873.1	999.2	211.6	287.1	362.7	438.3	450.8
-64.00	CLAY	100	139.8	600.3	430.3	617.3	747.3	877.5	1003.6	212.7	288.2	363.8	439.4	450.8
-65.00	CLAY	100	141.6	600.3	433.7	621.7	751.7	881.9	1008.0	213.8	289.3	364.9	440.5	450.8
-66.00	CLAY	100	143.4	600.3	437.0	626.1	756.1	886.3	1012.4	214.9	290.4	366.0	441.6	450.8
-67.00	CLAY	100	145.2	600.3	440.3	630.5	760.5	890.7	1016.8	216.0	291.5	367.1	442.7	450.8
-68.00	CLAY	100	147.0	600.3	443.7	634.9	764.9	895.1	1021.2	217.1	292.6	368.2	443.8	450.8
-69.00	CLAY	100	148.8	600.3	447.0	639.3	769.3	899.5	1025.6	218.2	293.7	369.3	444.9	450.8
-70.00	CLAY	100	150.6	600.3	450.3	643.7	773.7	903.9	1030.0	219.3	294.8	370.4	446.0	450.8
-71.00	CLAY	100	152.4	600.3	453.7	648.1	778.1	908.3	1034.4	220.4	295.9	371.5	447.1	450.8
-72.00	CLAY	100	154.2	600.3	457.0	652.5	782.5	912.7	1038.8	221.5	297.0	372.6	448.2	450.8
-73.00	CLAY	100	156.0	600.3	460.3	656.9	786.9	917.1	1043.2	222.6	298.1	373.7	449.3	450.8
-74.00	CLAY	100	157.8	600.3	463.7	661.3	791.3	921.5	1047.6	223.7	299.2	374.8	450.4	450.8
-75.00	CLAY	100	159.6	600.3	467.0	665.7	795.7	925.9	1052.0	224.8	300.3	375.9	451.5	450.8
-76.00	CLAY	100	161.4	600.3	470.3	670.1	800.1	930.3	1056.4	225.9	301.4	377.0	452.6	450.8
-77.00	CLAY	100	163.2	600.3	473.7	674.5	804.5	934.7	1060.8	227.0	302.5	378.1	453.7	450.8
-78.00	CLAY	100	165.0	600.3	477.0	678.9	808.9	939.1	1065.2	228.1	303.6	379.2	454.8	450.8
-79.00	CLAY	100	166.8	600.3	480.3	683.3	813.3	943.5	1069.6	229.2	304.7	380.3	455.9	450.8
-80.00	CLAY	100	168.6	600.3	483.7	687.7	817.7	947.9	1074.0	230.3	305.8	381.4	457.0	450.8
-81.00	CLAY	100	170.4	600.3	487.0	692.1	822.1	952.3</						

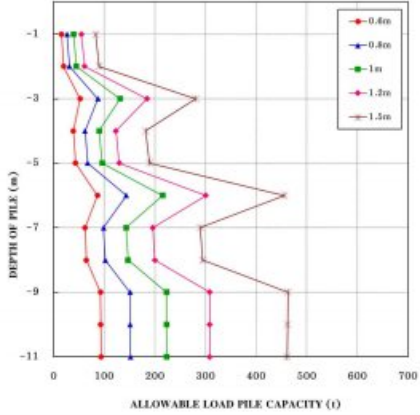
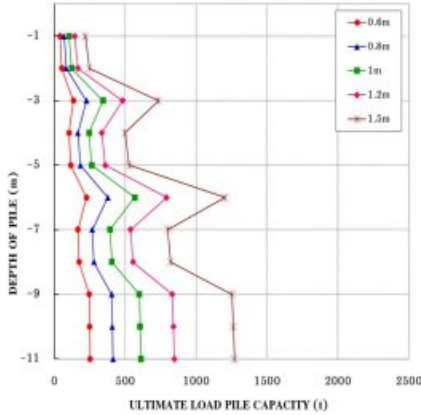


9. Bored Pile BH-9

BEARING CAPACITY OF PILE FOUNDATION BORED PILE													
PROJECT : PTT Gas for Gateway City IE				BORE HOLE: BH-9									
LOCATION : Phrae Yai District, Chachoengsao Province				GROUND WATER : 1.58 m									
DATE : 17/05/64				CALCULATED BY: MOHAMMED AZHAR									
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (Blows/ft)	SPT (CORRECT) (Blows/ft)	q <sub>u</sub> (t/m <sup>2</sup> )	a	N <sub>c</sub>	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	N <sub>q</sub>	Q <sub>f</sub> (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )
-1.00	CLAY	18	18	12.03	0.495	9.0	1.90	1.90				5.9	5.9
-3.00	CLAY	18	18	12.03	0.495	9.0	5.80	2.50				5.9	11.9
-5.00	CLAY	62	62	41.36	0.103	9.0	5.70	2.70				4.9	16.1
-7.00	CLAY	37	37	24.68	0.261	9.0	7.60	4.60				6.2	22.3
-9.00	CLAY	37	37	24.68	0.261	9.0	9.50	5.50				6.2	28.5
-11.00	CLAY	100	100	86.70	0.037	9.0	11.40	6.40				1.8	30.3
-13.00	CLAY	60	60	40.02	0.110	9.0	13.30	7.30				4.4	34.7
-15.00	CLAY	60	60	40.02	0.110	9.0	15.20	9.20				4.4	39.1
-17.00	CLAY	100	100	86.70	0.037	9.0	17.10	9.10				1.8	40.0
-19.00	CLAY	100	100	86.70	0.037	9.0	19.00	10.00				1.8	42.7
-21.00	CLAY	100	100	86.70	0.037	9.0	20.90	10.90				1.8	45.4



BEARING CAPACITY OF PILE FOUNDATION BORED PILE														
PROJECT : PTT Gas for Gateway City IE				BORE HOLE: BH-9				GROUND WATER : 1.58 m						
LOCATION : Phrae Yai District, Chachoengsao Province				CALCULATED BY: MOHAMMED AZHAR										
DATE : 17/05/64														
FACTOR OF SAFETY: 2.50														
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (CORRECT) (Blows/ft)	SUM Q <sub>f</sub> (t/m)	Q <sub>u</sub> (t/m <sup>2</sup> )	ULTIMATE LOAD PILE CAPACITY, Q <sub>u</sub> (t)					ALLOWABLE LOAD PILE CAPACITY, Q <sub>a</sub> (t)				
					CIRCULAR CONCRETE PILE SECTION (m)					CIRCULAR CONCRETE PILE SECTION (m x m)				
					0.60	0.80	1.00	1.20	1.50	0.60	0.80	1.00	1.20	1.50
-1.00	CLAY	38	5.9	108.1	41.7	62.4	103.5	144.5	210.8	35.0	35.2	32.5	35.1	83.3
-3.00	CLAY	38	11.9	108.1	52.9	84.1	122.2	166.9	246.9	39.0	31.2	45.1	61.3	90.3
-5.00	CLAY	62	16.1	272.2	135.5	227.6	343.0	481.6	723.7	52.2	97.4	131.5	184.5	280.7
-7.00	CLAY	37	22.3	222.1	104.8	187.7	244.5	335.1	497.6	39.2	62.2	90.3	123.2	152.1
-9.00	CLAY	37	28.5	222.1	116.4	192.2	244.0	259.4	526.9	41.2	62.2	96.2	126.6	159.5
-11.00	CLAY	100	30.3	600.3	226.0	277.8	366.6	502.2	742.2	120.4	96.6	143.9	215.3	452.2
-13.00	CLAY	60	34.7	360.2	167.1	258.2	351.9	537.9	790.9	62.1	98.8	143.6	196.1	290.3
-15.00	CLAY	60	39.1	360.2	175.4	270.3	436.7	554.9	850.9	64.7	100.1	147.2	200.1	294.4
-17.00	CLAY	100	40.0	600.3	240.6	404.4	559.9	832.7	1251.4	91.5	150.9	222.0	306.7	463.2
-19.00	CLAY	100	42.7	600.3	249.9	408.9	606.8	839.4	1261.7	93.2	151.5	223.3	308.6	462.3
-21.00	CLAY	100	44.4	600.3	253.2	413.3	611.0	846.0	1270.1	93.8	152.0	223.7	308.5	461.4
					</									



10. Bored Pile BH-10

BEARING CAPACITY OF PILE FOUNDATION BORED PILE													
PROJECT : PTT Gas for Gateway City IE LOCATION : Plangyao District, Chachoengsao Province DATE : 17/05/64				BORE HOLE: BH-10 GROUND WATER : 4.50 m CALCULATED BY: MOHAMMED AZHAR									
DEPTH OF PILE TIP (m)	SOIL TYPE	SPT (FIELD) (blows/ft)	SPT (CORRECT) (blows/ft)	Su (t/m <sup>2</sup> )	a	Nc	TOTAL OVERBURDEN PRESSURE (t/m <sup>2</sup> )	EFFECTIVE OVERBURDEN PRESSURE (t/m <sup>2</sup> )	K	f (Degree)	Nq	Qf (t/m)	Qe (t/m <sup>2</sup> )
-1.00	CLAYEY SAND	100	90				2.75	1.75	1.035	40.2	17.0	1.0	1.0
-3.00	CLAYEY SAND	100	90				7.95	7.95	1.035	40.2	17.0	2.0	2.0
-5.00	CLAYEY SAND	75	20				5.95	7.95	1.340	33.2	17.0	2.1	8.9
-7.00	CLAY	22	22	14.67	0.420	9.0	7.85	7.85				6.3	13.2
-9.00	CLAY	22	22	14.67	0.420	9.0	7.95	7.95				6.3	13.2
-11.00	CLAY	22	22	14.67	0.420	9.0	11.85	9.85				6.3	13.2
-13.00	CLAY	22	22	14.67	0.420	9.0	13.75	11.75				6.3	13.2
-15.00	CLAY	22	22	14.67	0.420	9.0	15.65	13.65				6.3	13.2
-17.00	CLAY	22	22	14.67	0.420	9.0	17.55	15.55				6.3	13.2
-19.00	CLAY	22	22	14.67	0.420	9.0	19.45	17.45				6.3	13.2
-21.00	CLAY	22	22	14.67	0.420	9.0	21.35	19.35				6.3	13.2
-23.00	CLAY	22	22	14.67	0.420	9.0	23.25	21.25				6.3	13.2
-25.00	CLAY	22	22	14.67	0.420	9.0	25.15	23.15				6.3	13.2
-27.00	CLAY	22	22	14.67	0.420	9.0	27.05	25.05				6.3	13.2
-29.00	CLAY	22	22	14.67	0.420	9.0	28.95	26.95				6.3	13.2
-31.00	CLAY	22	22	14.67	0.420	9.0	30.85	28.85				6.3	13.2
-33.00	CLAY	22	22	14.67	0.420	9.0	32.75	30.75				6.3	13.2
-35.00	CLAY	22	22	14.67	0.420	9.0	34.65	32.65				6.3	13.2
-37.00	CLAY	22	22	14.67	0.420	9.0	36.55	34.55				6.3	13.2
-39.00	CLAY	22	22	14.67	0.420	9.0	38.45	36.45				6.3	13.2
-41.00	CLAY	22	22	14.67	0.420	9.0	40.35	38.35				6.3	13.2
-43.00	CLAY	22	22	14.67	0.420	9.0	42.25	40.25				6.3	13.2
-45.00	CLAY	22	22	14.67	0.420	9.0	44.15	42.15				6.3	13.2
-47.00	CLAY	22	22	14.67	0.420	9.0	46.05	44.05				6.3	13.2
-49.00	CLAY	22	22	14.67	0.420	9.0	47.95	45.95				6.3	13.2
-51.00	CLAY	22	22	14.67	0.420	9.0	49.85	47.85				6.3	13.2
-53.00	CLAY	22	22	14.67	0.420	9.0	51.75	49.75				6.3	13.2
-55.00	CLAY	22	22	14.67	0.420	9.0	53.65	51.65				6.3	13.2
-57.00	CLAY	22	22	14.67	0.420	9.0	55.55	53.55				6.3	13.2
-59.00	CLAY	22	22	14.67	0.420	9.0	57.45	55.45				6.3	13.2
-61.00	CLAY	22	22	14.67	0.420	9.0	59.35	57.35				6.3	13.2
-63.00	CLAY	22	22	14.67	0.420	9.0	61.25	59.25				6.3	13.2
-65.00	CLAY	22	22	14.67	0.420	9.0	63.15	61.15				6.3	13.2
-67.00	CLAY	22	22	14.67	0.420	9.0	65.05	63.05				6.3	13.2
-69.00	CLAY	22	22	14.67	0.420	9.0	66.95	64.95				6.3	13.2
-71.00	CLAY	22	22	14.67	0.420	9.0	68.85	66.85				6.3	13.2
-73.00	CLAY	22	22	14.67	0.420	9.0	70.75	68.75				6.3	13.2
-75.00	CLAY	22	22	14.67	0.420	9.0	72.65	70.65				6.3	13.2
-77.00	CLAY	22	22	14.67	0.420	9.0	74.55	72.55				6.3	13.2
-79.00	CLAY	22	22	14.67	0.420	9.0	76.45	74.45				6.3	13.2
-81.00	CLAY	22	22	14.67	0.420	9.0	78.35	76.35				6.3	13.2
-83.00	CLAY	22	22	14.67	0.420	9.0	80.25	78.25				6.3	13.2
-85.00	CLAY	22	22	14.67	0.420	9.0	82.15	80.15				6.3	13.2
-87.00	CLAY	22	22	14.67	0.420	9.0	84.05	82.05				6.3	13.2
-89.00	CLAY	22	22	14.67	0.420	9.0	85.95	83.95				6.3	13.2
-91.00	CLAY	22	22	14.67	0.420	9.0	87.85	85.85				6.3	13.2
-93.00	CLAY	22	22	14.67	0.420	9.0	89.75	87.75				6.3	13.2
-95.00	CLAY	22	22	14.67	0.420	9.0	91.65	89.65				6.3	13.2
-97.00	CLAY	22	22	14.67	0.420	9.0	93.55	91.55				6.3	13.2
-99.00	CLAY	22	22	14.67	0.420	9.0	95.45	93.45				6.3	13.2
-101.00	CLAY	22	22	14.67	0.420	9.0	97.35	95.35				6.3	13.2
-103.00	CLAY	22	22	14.67	0.420	9.0	99.25	97.25				6.3	13.2
-105.00	CLAY	22	22	14.67	0.420	9.0	101.15	99.15				6.3	13.2
-107.00	CLAY	22	22	14.67	0.420	9.0	103.05	101.05				6.3	13.2
-109.00	CLAY	22	22	14.67	0.420	9.0	104.95	102.95				6.3	13.2
-111.00	CLAY	22	22	14.67	0.420	9.0	106.85	104.85				6.3	13.2
-113.00	CLAY	22	22	14.67	0.420	9.0	108.75	106.75				6.3	13.2
-115.00	CLAY	22	22	14.67	0.420	9.0	110.65	108.65				6.3	13.2
-117.00	CLAY	22	22	14.67	0.420	9.0	112.55	110.55				6.3	13.2
-119.00	CLAY	22	22	14.67	0.420	9.0	114.45	112.45				6.3	13.2
-121.00	CLAY	22	22	14.67	0.420	9.0	116.35	114.35				6.3	13.2
-123.00	CLAY	22	22	14.67	0.420	9.0	118.25	116.25				6.3	13.2
-125.00	CLAY	22	22	14.67	0.420	9.0	120.15	118.15				6.3	13.2
-127.00	CLAY	22	22	14.67	0.420	9.0	122.05	120.05				6.3	13.2
-129.00	CLAY	22	22	14.67	0.420	9.0	123.95	121.95				6.3	13.2
-131.00	CLAY	22	22	14.67	0.420	9.0	125.85	123.85				6.3	13.2
-133.00	CLAY	22	22	14.67	0.420	9.0	127.75	125.75				6.3	13.2
-135.00	CLAY	22	22	14.67	0.420	9.0	129.65	127.65				6.3	13.2
-137.00	CLAY	22	22	14.67	0.420	9.0	131.55	129.55				6.3	13.2
-139.00	CLAY	22	22	14.67	0.420	9.0	133.45	131.45				6.3	13.2
-141.00	CLAY	22	22	14.67	0.420	9.0	135.35	133.35				6.3	13.2
-143.00	CLAY	22	22	14.67	0.420	9.0	137.25	135.25				6.3	13.2
-145.00	CLAY	22	22	14.67	0.420	9.0	139.15	137.15				6.3	13.2
-147.00	CLAY	22	22	14.67	0.420	9.0	141.05	139.05				6.3	13.2
-149.00	CLAY	22	22	14.67	0.420	9.0	142.95	140.95				6.3	13.2
-151.00	CLAY	22	22	14.67	0.420	9.0	144.85	142.85				6.3	13.2
-153.00	CLAY	22	22	14.67	0.420	9.0	146.75	144.75				6.3	13.2
-155.00	CLAY	22	22	14.67	0.420	9.0	148.65	146.65				6.3	13.2
-157.00	CLAY	22	22	14.67	0.420	9.0	150.55	148.55				6.3	13.2
-159.00	CLAY	22	22	14.67	0.420	9.0	152.45	150.45				6.3	13.2
-161.00	CLAY	22	22	14.67	0.420	9.0	154.35	152.35				6.3	13.2
-163.00	CLAY	22	22	14.67	0.420	9.0	156.25	154.25				6.3	13.2
-165.00	CLAY	22	22	14.67	0.420	9.0	158.15	156.15				6.3	13.2
-167.00	CLAY	22	22	14.67	0.420	9.0	160.05	158.05				6.3	13.2
-169.00	CLAY	22	22	14.67	0.420	9.0	161.95	159.95				6.3	13.2
-171.00	CLAY	22	22	14.67	0.420	9.0	163.85	161.85				6.3	13.2
-173.00	CLAY	22	22	14.67	0.420	9.0	165.75	163.75				6.3	13.2
-175.00	CLAY	22	22	14.67	0.420	9.0	167.65	165.65				6.3	13.2
-177.00	CLAY	22	22	14.67	0.420	9.0	169.55	167.55				6.3	13.2
-179.00	CLAY	22	22	14.67	0.420	9.0	171.45	169.45				6.3	13.2
-181.00	CLAY	22	22	14.67	0.420	9.0	173.35	171.35				6.3	13.2
-183.00	CLAY	22	22	14.67	0.420	9.0	175.25	173.25				6.3	13.2
-185.00	CLAY	22	22	14.67	0.420	9.0	177.15	175.15				6.3	13.2
-187.00	CLAY	22	22	14.67	0.420	9.0	179.05	177.05				6.3	13.2
-189.00	CLAY	22	22	14.67	0.420	9.0	180.95	178.95				6.3	13.2
-191.00	CLAY	22	22	14.67	0.420	9.0	182.85	180.85				6.3	13.2
-193.00	CLAY	22	22	14.67	0.420	9.0	184.75	182.75				6.3	13.2
-195.00	CLAY	22	22	14.67	0.420	9.0	186.65	184.65				6.3	13.2
-197.00	CLAY	22	22	14.67	0.420	9.0	188.55	186.55				6.3	13.2
-199.00	CLAY	22	22	14.67	0.420	9.0	190.45	188.45				6.3	13.2
-201.00	CLAY	22	22	14.67	0.420	9.0	192.35	190.35				6.3	13.2

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# Appendix I

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## Pictures of Field Testing

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# Content

	Page
Content	I-2
1. Picture of Field Testing	I-3
1.1 Soil boring for BH-1	I-4
1.2 Soil boring for BH-2	I-5
1.3 Soil boring for BH-3	I-6
1.4 Soil boring for BH-4	I-7
1.5 Soil boring for BH-5	I-8
1.6 Soil boring for BH-6	I-9
1.7 Soil boring for BH-7	I-10
1.8 Soil boring for BH-8	I-11
1.9 Soil boring for BH-9	I-12
1.10 Soil boring for BH-10	I-13

## 1. Picture of Field Testing

### 1.1 Soil boring for BH-1



1.2 Soil boring for BH-2



1.3 Soil boring for BH-3



1.4 Soil boring for BH-4



1.5 Soil boring for BH-5



1.6 Soil boring for BH-6



1.7 Soil boring for BH-7



1.8 Soil boring for BH-8



1.9 Soil boring for BH-9



## 1.10 Soil boring for BH-10



## ภาคผนวก 1-5

สำเนาหนังสือนำเสนอรายงานผลการปฏิบัติตาม  
มาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม  
และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม  
ฉบับที่ 1 ระหว่างเดือนกรกฎาคม ถึง เดือนธันวาคม พ.ศ. 2564

ที่ 80001404/20/2565

26 มกราคม 2565

เรื่อง ขอส่งรายงานผลการปฏิบัติตามมาตรการที่กำหนดไว้ในรายงานการประเมินผลกระทบสิ่งแวดล้อม  
โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ ของ  
บริษัท ปตท. จำกัด (มหาชน)

เรียน เลขาธิการสำนักงานคณะกรรมการกำกับกิจการพลังงาน

สิ่งที่ส่งมาด้วย 1. รายงานผลการปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตาม  
ตรวจสอบผลกระทบสิ่งแวดล้อม (ระยะก่อสร้าง) โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้า  
อุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ ฉบับที่ 1 ระหว่างเดือนกรกฎาคมถึงเดือนธันวาคม  
พ.ศ. 2564 จำนวน 3 ชุด

2. แผ่นซีดีรอมที่บรรจุไฟล์รายงานผลการปฏิบัติตามมาตรการฯ จำนวน 3 แผ่น

ตามที่คณะกรรมการผู้ชำนาญการพิจารณารายงานการประเมินผลกระทบสิ่งแวดล้อม ได้มีมติเห็นชอบต่อ  
รายงานการประเมินผลกระทบสิ่งแวดล้อม (EIA) โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคม  
อุตสาหกรรมเกตเวย์ ซิตี้ ของบริษัท ปตท. จำกัด (มหาชน) (ปตท.) โดย ปตท. ต้องปฏิบัติตามมาตรการป้องกันและแก้ไข  
ผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ที่กำหนดไว้ในรายงาน EIA อย่างเคร่งครัด  
รวมทั้งจัดทำและเสนอรายงานผลการปฏิบัติตามมาตรการฯ ต่อหน่วยงานของรัฐซึ่งมีอำนาจอนุญาตตามกฎหมายให้ดำเนิน  
โครงการ โดยปัจจุบัน โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้  
อยู่ในระยะก่อสร้าง ซึ่งได้รับใบอนุญาตประกอบกิจการพลังงานดังหนังสือเลขที่ กกพ 01-8/52-001

ในการนี้ ปตท. ได้ปฏิบัติตามมาตรการฯ ในระยะก่อสร้าง ตามที่กำหนดไว้ในรายงาน EIA ของโครงการดังกล่าว  
อย่างครบถ้วน จึงใคร่ขอส่งรายงานฯ ดังรายละเอียดปรากฏในสิ่งที่ส่งมาด้วย มายังสำนักงานคณะกรรมการกำกับ  
กิจการพลังงานเพื่อพิจารณา และเสนอต่อสำนักงานทรัพยากรธรรมชาติและสิ่งแวดล้อมจังหวัดฉะเชิงเทรา ซึ่งเป็นที่ตั้ง  
โครงการ พร้อมนี้ ปตท. ได้เสนอรายงานฯ ต่อกรมธุรกิจพลังงานเพื่อทราบด้วยแล้ว และขอมอบหมายให้นายฉัฐวัฒน์  
วิทยาคณสถิต เบอร์โทรศัพท์ติดต่อ 081-585-4142 เป็นผู้ประสานงานในรายละเอียดต่อไป

จึงเรียนมาเพื่อโปรดพิจารณา จักขอขอบคุณยิ่ง

ขอแสดงความนับถือ



( 10.00 น. )



ผู้จัดการส่วน

รักษาการ ผู้จัดการฝ่ายจัดการสิ่งแวดล้อมโครงการ



ที่ 80001404/21/2565

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เลขที่รับ	๐1372
วันที่รับ	28 มี.ค. 2565 เวลา

26 มกราคม 2565

เรื่อง ขอส่งรายงานผลการปฏิบัติตามมาตรการที่กำหนดไว้ในรายงานการประเมินผลกระทบสิ่งแวดล้อม  
โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ ของ  
บริษัท ปตท. จำกัด (มหาชน)

เรียน อธิบดีกรมธุรกิจพลังงาน

สิ่งที่ส่งมาด้วย 1. รายงานผลการปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม และมาตรการติดตาม  
ตรวจสอบผลกระทบสิ่งแวดล้อม (ระยะก่อสร้าง) โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้า  
อุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้ ฉบับที่ 1 ระหว่างเดือนกรกฎาคมถึงเดือนธันวาคม  
พ.ศ. 2564 จำนวน 1 ชุด

2. แผ่นซีดีรอมที่บรรจุไฟล์รายงานผลการปฏิบัติตามมาตรการฯ จำนวน 1 แผ่น

ตามที่คณะกรรมการผู้ชำนาญการพิจารณารายงานการประเมินผลกระทบสิ่งแวดล้อมได้มีมติเห็นชอบต่อ  
รายงานการประเมินผลกระทบสิ่งแวดล้อม (EIA) โครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคม  
อุตสาหกรรมเกตเวย์ ซิตี้ ของบริษัท ปตท. จำกัด (มหาชน) (ปตท.) โดย ปตท. ต้องปฏิบัติตามมาตรการป้องกันและแก้ไข  
ผลกระทบสิ่งแวดล้อม และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม ที่กำหนดไว้ในรายงาน EIA อย่างเคร่งครัด  
รวมทั้งจัดทำและเสนอรายงานผลการปฏิบัติตามมาตรการฯ ต่อหน่วยงานของรัฐซึ่งมีอำนาจอนุญาตตามกฎหมายให้ดำเนิน  
โครงการ โดยปัจจุบันโครงการท่อส่งก๊าซธรรมชาติไปยังกลุ่มลูกค้าอุตสาหกรรมภายในนิคมอุตสาหกรรมเกตเวย์ ซิตี้  
อยู่ในระยะก่อสร้าง ซึ่งได้รับใบอนุญาตประกอบกิจการพลังงานดังหนังสือเลขที่ กกพ 01-8/52-001

ในการนี้ ปตท. ได้ปฏิบัติตามมาตรการฯ ในระยะก่อสร้าง ตามที่กำหนดไว้ในรายงาน EIA ของโครงการดังกล่าว  
อย่างครบถ้วน จึงใคร่ขอนำส่งรายงานฯ ดังรายละเอียดปรากฏในสิ่งที่ส่งมาด้วยมายังกรมธุรกิจพลังงานเพื่อทราบ  
พร้อมนี้ ปตท. ได้เสนอรายงานฯ ต่อสำนักงานคณะกรรมการกำกับกิจการพลังงานเพื่อพิจารณา และเสนอต่อสำนักงาน  
ทรัพยากรธรรมชาติและสิ่งแวดล้อมจังหวัดฉะเชิงเทรา ซึ่งเป็นที่ตั้งโครงการด้วยแล้ว และขอมอบหมายให้นายฉัตรวัฒน์  
วิชาคุณสถิต เบอร์โทรศัพท์ติดต่อ 081-585-4142 เป็นผู้ประสานงานในรายละเอียดต่อไป

จึงเรียนมาเพื่อโปรดทราบ

ขอแสดงความนับถือ

[Redacted Signature]

[Redacted Name]

ผู้จัดการส่วน

รักษาการ ผู้จัดการฝ่ายจัดการสิ่งแวดล้อมโครงการ