

THE NHA BE NEW URBAN DEVELOPMENT PROJECT
IN
THE SOCIALIST REPUBLIC OF VIETNAM

**CONTRACT OF SOIL INVESTIGATION AND TOPOGRAPHICAL
SURVEY WORKS**

THIS CONTRACT is entered into on this 10th day of November, 2007 by between the **Kunhwa Co., Ltd.** (hereinafter referred to as the "KH") registered under the laws of the Socialist Republic of Vietnam and the **Transport Engineering Design Incorporated South** (hereinafter referred to as the "Contractor") duly organized and existing under the laws of the Socialist Republic of Vietnam.

WHEREAS, the KH requested the Contractor to perform the soil investigation and topographical survey works which is outlined in the Annex-1 (hereinafter referred to as the "Work"). WHEREAS, the quotation for the Work submitted by the Contractor dated 23rd August 2007 (Annex-2), has been accepted by the KH.

WHEREAS, the Contractor has accepted to perform the Work in accordance with the specifications and conditions set forth in this Contract and Terms of Reference for the Work (Annex-1).

THEREFORE, based on and in consideration of the foregoing premises and of the terms and conditions hereinafter provided both parties here to agree as follows:

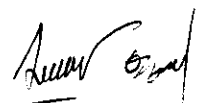
Clause 1: WORK

The Contractor shall implement the Work as hereinafter defined under the terms and conditions of the Contract and Annex-1.

Clause 2: REPRESENTATION AND WARRANTIES

The Contractor hereby represents and warrants to the KH as follows:

1. The Contractor is a corporation duly organized, validly existing and in good standing under the laws of the Socialist Republic of Vietnam, and full corporate power to conduct the business presently being conducted by it and is duly qualified to transact business with the KH.
2. The execution, delivery and performance of this Contract by the Contractor have been duly authorized and approved by requisite corporate action of the Contractor.
3. The person signing this Contract is fully authorized to represent the Contractor. This Agreement when signed, shall be binding on the Contractor.



Clause 3: KH REPRESENTATIVE

The KH shall assign a representative for the full term (hereinafter referred to as the "Representative") of the Work. The Representative shall have the right to supervise, inspect and give approval for the work when the Contractor conducts the Work.

Clause 4: PREPARATION FOR THE WORK

The Contractor shall mobilize all necessary highly-skilled personnel and all of the required materials, facilities and equipment for the performance of the Work at the job site. The Representative shall have the right to check and review such materials, facilities and equipment at any time during the execution of the Work.

Clause 5: PROGRESS REPORTS

Unless otherwise stated in the mentioned anywhere in the Contract, daily progress reports shall be prepared by the Contractor and submitted to the KH. Contents of the report shall be acceptable to the KH and would vary to enhance fluent progress of the works upon prior approval of the KH. The report shall includes the status of works as work-done, planned works, personnel, equipment, as well as the status of safety statistics of any potential hazardous incidents and activities relating to environmental aspects and public relations, so forth and must have affirmation of Project Manager. Also, the Contractor is obliged to prepare and submit interim report which would affect to plan and design works upon request of the KH. Any interim report prepared by the Contractor is deemed to be a part of final report and shall include necessary information instructed by the KH for plan and design. Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Work.

Clause 6: INSPECTION OF RESULTS

The Contractor shall submit a notice of completion of each item of the Work within seven (7) days after its completion. If such results are not accepted by the KH, the Contractor shall redeem those works as soon as possible to the satisfaction of the KH, and the Contractor shall once more submit the results to the KH for inspection. The KH shall, however, not refuse the results unless there are sound reasons to do so.

Clause 7: TIME FOR COMPLETION

Commencement of the works is 10th December 2007. The Contractor shall complete all the Work within one hundred and fifty (150) calendar days after the Contract has been signed.

Clause 8: CONTRACT AMOUNT

The Contract amount shall be Three Billion and Seven Hundred Fifty Seven Million Vietnamese Dongs (VND 3,757,000,000) including Value Added Tax. The Contractor shall be responsible for the payment of all taxes, levies, and dues incurred to the Contractor in Vietnam in connection with performance of the Work.

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Clause 9: METHOD OF PAYMENT**(a) First Payment**

The KH shall pay twenty percent (20%) of the Contract amount to the Contractor within seven (7) calendar days after the KH approves the interim report submitted upon the completion of Phase 1 works.

(b) Second Payment

The KH shall pay ninety percent (90%) of the Contract amount by cumulatively to the Contractor within seven (7) calendar days after the KH approves the final report and the related documents.

(c) Final Payment

The KH shall pay the remaining balance of the Contract amount to the Contractor upon the approval of technical design of Nha Be New Urban Development Project from the relevant authorities. If Contractor manages to receive the confirmation of the final report and related documents from the relevant authorities as the valid documents to the Project, the KH shall make the final payment to the Contractor prior to the approval of technical design.

Clause 10: DELAY DAMAGES

Delay damages of five/one thousand (5/1,000) of the Contract amount shall be imposed upon the Contractor per day by the KH, with a maximum of ten (10) percent of the total Contract amount for a delay in the performance of the Work for which the Contractor is responsible to complete within the period as set forth in Clause 7.


The amount of delay damages shall be deducted from the final payment amount to be made to the Contractor.

Clause 11: FORCE MAJEURE

The Contractor shall not be responsible for any delay caused by Force Majeure such as natural disasters, declared or undeclared war, blockades, revolutions, and natural calamities beyond the control of the Contractor. If it appears that such Force Majeure continues to the end of the Contract period mentioned in Clause 7, the KH shall have the right to terminate this Contract at any time.

Clause 12: LIABILITY

The Contractor shall be fully liable and shall pay to the KH and the parties working with it full compensation for all losses, damages or injuries (including death) which it causes to persons (including but not limited to the parties working with the Contractor) or properties (including but not limited to the properties of the Contractor or any of the parties working with it) which may totally or partially arise or occur in connection with the performance of the services by the Contractor under this Contract, or the execution or performance thereof, and its failure to execute or perform its other obligations under this Contract or which the Contractor or any of its workers



contributed to their occurrence.

Clause 13: TERMINATION OF CONTRACT

The KH has the right to terminate the Contract by giving a written prior notice to the Contractor, in case of any following cases;

- (a) Due to cause attributable to the Contractor, if the KH judges that completion of the Work cannot be expected within the time set forth in Clause 7, and in accordance with the detailed time schedule submitted by the Contractor and approved by the KH.
- (b) If the Work is not fully performed by the Contractor in accordance with the Contract and specifications without (at the KH's discretion) justified reasons.
- (c) If the Contractor does not commence the Work or if the Contractor suspends the Work for a certain period without (at the KH's discretion) justified reasons after the effective date of this Contract.
- (d) If the Contractor violates any provision of this Contract and does not rectify it within ten (10) days after the Contractor has received notice of breach of contract from the KH.

Clause 14: ASSIGNMENT AND/OR SUBCONTRACT

Without prior written consent of the KH, the Contractor shall not assign any or this entire Contract to a third party.

Clause 15: EFFECTIVE DATE OF THIS CONTRACT

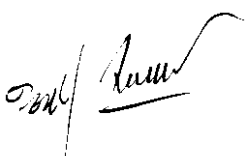
This Contract shall become effective on the day and year first above written.

Clause 16: CHANGES IN WORKING PROGRAM

The KH has the right to change the contents of the Work, if modifications are necessary. In case of such change, the time for completion and the Contract amount may be modified by mutual agreement in writing of both parties hereto. However, if extension of Contract period or increase in Contract amount is required due to reasons attributable to the improper execution of the Work by the Contractor, such request from the Contractor shall not be approved by the KH. Should the KH order additional works, an additional fee shall be paid to the Contractor; however, the Contractor shall not refuse to carry out the additional works without satisfactory reasons.

Clause 17: DOUBTS OR UNSPECIFIED ITEMS

Any doubts in connection with this Contract or anything not specified in this Contract shall be determined amicably by mutual agreement between both parties.

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Clause 18: MAINTENANCE OF SECRECY

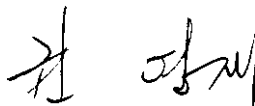
Without obtaining the KH's prior written approval, the Contractor shall not disclose, not only during the effective period of this Contract but also after the termination or completion of the Contract, any information and/or date etc., which has been made known to the Contractor in executing the Work.

Clause 19: EVALUATION OF ADDITIONAL AND OMITTED WORK

All work added or omitted under the instructions of the KH shall be evaluated at rates and prices set out in the Contract and accepted tender documents of the Contractor. If no applicable rates or prices are set out in these documents, then suitable rates or prices shall be agreed upon between the KH and the Contractor. In the event of disagreement, the KH shall determine such rates or prices as shall, in his opinion, be reasonable and proper.

IN WITNESS WHEREOF; the parties hereto have executed this Contract by the duly authorized representatives in the Socialist Republic of Vietnam as of the date first above written.

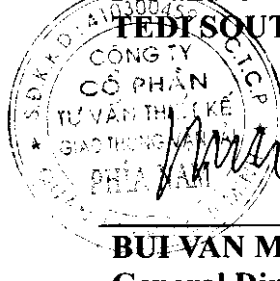
**For and On Behalf of
KUNHWA Co., Ltd**



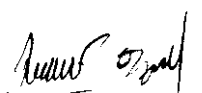
**KWON, YOUNG JAE
General Director**



**For and On Behalf of
FEDI SOUTH**



**BUI VAN MOC
General Director**



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PREFACE

1. Purpose

The purpose of the Soil Investigation and Topographical Survey are to provide geotechnical engineering information for design works in Nha Be area.

2. Project Information

The following is the project information:

- Project Name: Soil Investigation and Topographical Survey for Nha Be New Town Development
- Name of Client: Kunhwa Co., Ltd.
- Term of Project: 18 months

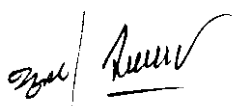
The following Terms of Reference (TOR) applies to soil investigation and topographical survey for the Nha Be New Town Design Works.



Soil Investigation

Paul Smith

Table of Contents

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Annex-1

**TERMS OF REFERENCE
FOR
THE SOIL INVESTIGATION AND TOPOGRAPHICAL
SURVEY SERVICES TO KUNHWA
FOR THE
NHA BE NEW TOWN PROJECT**

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1. Overview of Soil Investigation

The following Terms of Reference (TOR) applies to soil investigation for the Nha Be New Town Design Works.


Items of Soil Investigation and Quantity

- Boring Investigation
 - Soft ground: 60 holes(40m average, checking depth for soft ground improvement)
 - Bridge: 38 holes (80m average, included in riverbed boring)
- In-Situ Test
 - Standard Penetration Test: 1,800 times (3m apart)
 - Vane Test: 600m (30 holes, 20m/hole)
 - Undisturbed Soil Sampling: 68 times (soft ground 30 times, bridge 38 times, NX Size; Piston Sampler)
 - In-Situ Permeability Test
 - Borehole Load Test: 36 times(DMT.PMT/GJ each 12times, 2times/bridge 6 locations)
 - Down Hole Exploration(PS Logging): 6 times (each abutment of bridge, Down Hole Test or Hole Test)
 - CPTu Test: 30 locations (penetration test, dissipation test 2 times per location)
 - Water Quality Test 1 LS(considering possibility of groundwater developing)
- Lab Soil Test
 - Basic Physical Test: 60 times (moisture contents/specific gravity/liquid limit/plastic limit/sieve analysis)
 - Compaction/Lab CBR Test: 5 times (to in-situ sample)
 - Standard Consolidation Test: 120 times (soft ground 2 times/hole)
 - Tri-axial Compression Test: 42 times (UU, one test for soft ground per 2hole, 2 tests for bridge per location, CU if necessary)
- Lab Rock Test
 - Basic Physical Test: 6 times (specific gravity/absorption ratio/poison's ratio/modulus of elasticity/elastic wave velocity)
 - Axial Test: 12 times (2 tests for bridge per location)

The soil investigation services will be performed into two phases,

Phase I

- Twenty percentages (20%) of total quantities for six (6) weeks from 10th November 2007



Phase II

- Remaining quantities of total quantities, lab test and reporting for 14 weeks after 3 weeks posterior to the end of Phase I

2. General Information

2.1 THE CONTRACTOR shall conduct soil test based on Terms of Reference (TOR) and official regulations and laws of the Ministry of Construction of Vietnam, American Society for Testing and Material (ASTM), International Society for Rock Mechanics (ISRM) and other organizations. Any contents does not indicated in this TOR shall be performed after having consent of KH and Client based on mutual discussion along submission of the opinion thereon in written by the Engineer in charge on the field.

2.2 Any cost associated with additional soil investigation instructed in written or approved by KH or Client would be settled based on reasonable price and quantities thru mutual discussion of KH and THE CONTRACTOR.

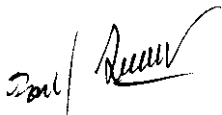
2.3 THE CONTRACTOR is responsible for obtaining permits and approvals (use/possession of necessary land, access road, utilization of any facilities and so forth) required for soil investigation and is liable for solving the matters arising out thereof at his own cost..

2.4 THE CONTRACTOR is required to have soil investigation again at his own cost when consequence of the soil investigation is differ with actual ground condition or defects occurs onto any investigated contents. When the contents and the results of soil investigation are insufficient or inappropriate, Contractor shall revise and/or redo the analysis according to the requests of KH or Client.

2.5 THE CONTRACTOR shall immediately respond in any emergency medical situations for surveyors or property damage situations during soil investigation as well as any personal and property damages for third party. THE CONTRACTOR shall report the incidents to the supervisor and relevant organizations. THE CONTRACTOR shall provide appropriate measures in response to the incidents.

3. Plan of Investigation

THE CONTRACTOR is obliged to prepare and submit Performance Progress Plan for Soil Investigation which is comply with goal of the project after execution of prior site visit, topographic and geological survey and commence the soil investigation by getting prior approval of KH. The Performance Progress Plan for Soil Investigation shall be prepared referring to the contract, performance guide line and any related. However the followings shall be included:



- Investigation contents (purpose and work scope)
- Procedures and method of investigation
- Programme of Works
- In-situ test and lab test plan
- Organizational chart
- Status of equipment (type, name, function, etc.)
- Other required elements

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INVESTIGATION AND TEST

1 Investigation of Existing Information

THE CONTRACTOR shall collect and review previously conducted soil investigation results, topographical map, geological map and so forth and include them in the report as appendices. THE CONTRACTOR shall establish soil investigation scheme through sufficient understanding on topographical and geological characteristic and plan for structures of the area.

THE CONTRACTOR is required to check developed geological map onto stratum structures of the area for the purpose of reflecting planned items and contents of soil investigation into soil investigation scheme, if necessary.

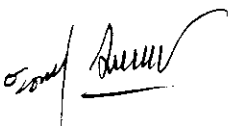
2 Boring Investigation

A. Boring Test

- 1) THE CONTRACTOR shall conduct Boring Investigation using boring method by NX(3") boring hole which standard penetration test and sampling are conducted in parallel. Then, THE CONTRACTOR may use hydraulic boring machine which maintains constant pressure and rotating velocity. THE CONTRACTOR may change diameter of boring hole and boring method after getting approval from KH or the client onto in-situ test and sampling of undisturbed sample, if necessary.
- 2) Distance and depth of In-Situ Test are basically determined by the items and quantities identified in the bill of quantities for soil investigation. However, it may be adjusted after getting approval of KH or the client where requires detail stability review and design as severe vary in geological status, major structures needs stability or has possibilities of occurring crucial ground disaster.
- 3) When boring in soft ground, THE CONTRACTOR shall apply a method preventing inter collapse, as casing pipe, of exploratory hole. However, it should never be applied beyond the digging depth.
- 4) Boring should not oversight any thin layers of geological stratum.
- 5) THE CONTRACTOR shall measure groundwater level from investigation completed boring hole and apply treatment of abandoned well. The bore-hole should be marked with its number[0.5m width X 0.3m depth X 2.0m height] and manage it until the end of completion of the project.

B. Sampling

- 1) All samples should be collected in the sampling bottle. The bottle should be labelled with information of bore-hole number, sampling depth, N value, soil colour, and soil type.
- 2) Samples for physical test should be collected in air-tight sealed plastic bottle to prevent changes of water contents and transported it to lab.



3) Dynamics test of Undisturbed Sample

- THE CONTRACTOR have to have approval of KH or the client regarding the methodology, location, number of sites and other sampling methodology for collecting undisturbed sample.
- THE CONTRACTOR shall follow ASTM D1587, Thin-Walled Tube Sampling of Soils, standards (sampling instruments, sealing material, sampling method, transportation, etc.).
- At soft ground in parallel with in-situ test, THE CONTRACTOR shall collect undisturbed sample using paraffin (silicon powder, etc.) to prevent changes in water contents and shall be more careful not to disturb the sample during transportation.

4). Measurement of Groundwater

- THE CONTRACTOR shall measure, measuring after removal of used water, groundwater level 72 hours after sampling.

3 Field Tests

Standard Penetration Test (ASTM D1586)

- THE CONTRACTOR shall conduct test every geological stratum and every 3.0m depth in the same stratum layer. When penetration depth is less than 10cm even N value reaches 50, stop hammering and record penetration depth and number of hits.
- Contractor shall record number of hits every 15cm when hammer (weights $63.5 \pm 0.5\text{kg}$) freely drops 30cm in the falling height of $76 \pm 1\text{cm}$ for ASTM D1586. It is very important to maintain constant drop height by installing iron hook at drop rod for the purpose of keeping same drop height in case of manual drop equipment.
- Collected sample with treatment of no change in water content, one shall be stored by information as boring number, depth, N value, soil classification and so forth attached air-tightened bottling with in sample container and other shall be used for soil characteristic test purpose.

Field Hydraulic Conductivity Test (BS 5930)

- Measurement of coefficient of permeability in soft layers is conducted with either Constant Head or Falling Head approaches.

Field Vane Test (ASTM D 2573)

- After cleaning exploratory hole before vane insert, it shall be inserted with very care to avoid any rotation of vane without any stoppage.
- When rotating vane, rotating speed should not exceed 0.1 degree per second and depth of vane shall be maintained with care. Automatic measuring equipment shall be used.

Piezococone Penetration Test (CPTu) (ASTM D 3441)

The followings shall be applied.

- Cone shall be enough saturated before testing.
- Slope of Cone penetration is not allowed to exceed 2%.
- Check penetration ability using 45-50mm dummy cone.
- Set initial correction value to each measured value at automatic data logger.
- Check system operation condition and comply penetration velocity at 2cm/sec. \pm 10%.
- Conduct pore water pressure dissipation test in the centre depth of the cohesive soft ground layer when thickness of ground is considered to be greater than 10m. In that case, vertical drain method may be considered.

Pressure Meter Test (DMT, PMT, GJ) (ASTM D 4719)

- This is to measure displacement quantity of sub-grade using hole-diameter measuring instrument attached in test equipment after giving hydraulic or water pressure to inner wall by inserting test equipment in the hole.
- Displacement modulus shall be calculated thru preparation "pressure-displacement curve" based on pressure onto inner wall and sub-grade displacement.

Borehole Elastic Wave Exploration (Down Hole or Cross Hole Test) (ASTM D 4428)

- Select either Down Hole Test or Cross Hole Test.
- Vertical spacing for elastic wave exploration to be 1.0m apart, and testing depth to be adjusted with KH or the client.

Other Field Test

When other or additional test are identified to be necessary due to the area characteristics or design specification, prepare a field test plan to the supervisor with the justification of the additional tests and submit it with the advisory statements by professionals. After the approval by KH or the client, test can be conducted.

4 Soil Test

- All tests of this soil investigation shall be performed by indicated method of ASTM and ISRM and also any tests do not indicated would be tested by similar regulation.
- Soil test shall be done before changes in soil property by disturbed sample and Mechanical property test shall be executed by undisturbed sample with undisturbed state.
- Record of test result and its submission shall include test log and its calculation.



- Soil classification shall be written in both of Unified Soil Classification Method (U.S.C.S.) and ASSHTO Classification Method:

Test items should include the following:

- Physical Test
 - moisture contents (ASTM D 2216, AASHTO T 265)
 - specific gravity (ASTM D 854)
 - liquid limit (ASTM D 423, 4318, AASHTO T89)
 - plastic limit (ASTM D 424, 4318, AASHTO T 90)
 - grain size analysis (ASTM D 421, 422, AASHTO T27, 88)
- Mechanical property Test
 - Lab Compaction (ASTM D 698, 1557, AASHTO T 99, 180)
 - Lab CBR (ASTM D 1883, AASHTO T 193)
 - Axial Compression (ASTM D 2166)
 - Tri-axial Compression (UU, CU) (ASTM D 2850)
 - Standard Consolidation (ASTM D 2435)
- Rock Test
 - Specific gravity and absorption ratio (ISRM)
 - Compression strength, elastic factor, and poison ratio. (ASTM D 2938, 3148)
 - Elastic wave velocity (ASTM D 2845)

5 Photography and Sample Box Control

Sample box should be marked with the following information:

- Project name
- Date of investigation
- Name of investigator
- Bore hole number
- Box number

Soil or rock core in the box shall be stored separately by each collected depth and colour photography of sample box shall be attached in the report.

Colour photography of whole progress investigation shall be taken and submitted for any parts which are difficult to inspect and affirm during in-situ test scene and before/after soil investigation.



6 Post Soil Investigation

1) Abandoned well treatment

Upon completion of soil investigation, bore-hole needs process of abandoned well in accordance with law and regulation of Vietnam with attendance of KH. Booklet of photography for all procedures for abandoned well treatment shall be submitted.

2) Check and supplement after soil investigation:

- THE CONTRACTOR is required to check whether design criteria and site condition are inconsistent or not when soil investigation result have been specifically reflected in the design.
- THE CONTRACTOR is obliged to perform additional soil investigation and design reinforcement upon instruction of KH or the client in case of investigated and design contents are remarkably inconsistent based on site inspection. The cost for this shall be borne by THE CONTRACTOR.
- THE CONTRACTOR requires to immediately report thereon to KH and the client when design content have changed due to made additional soil investigation and design reinforcement.



PROJECT OUTPUTS

1 Report

a. Preparation of Report

- (1) Report preparation shall be by computer in principal and shall be submitted in one set by being computerized of all information in the report.
- (2) Report is required to clearly describe any necessary soil engineering items (as soil constant value, settlement characteristic for design and construction management) which necessitate to design/construction and possible troubles during general construction in accordance with determination on investigation result by Engineer in charge of Soil Engineering. Whenever KH or the client asks explanation on any contents in the report, THE CONTRACTOR is required to explain on it. In addition, THE CONTRACTOR is responsible for all of soil investigation, its analysis and its result.:

b. Preparation of Report

- Title
- Commentary
- List of participated engineers
- Table of Contents
- Preface (name of investigation, area, purpose, term of investigation, equipments, etc.)
- Methodology
 - Site selection
 - Soil investigation
 - Standard Penetration Test
 - Sample Collection
 - Measurement of groundwater level
 - Soil Test
 - Etc.
- Investigation Results
 - Topographic and geographic features
 - Site condition
 - Ground layer feature
 - Field test
 - Underground water level in situ hole
 - Soil test



- Conclusion and Proposal
- Appendix
 - Investigating location map
 - Layer cross section
 - Soil Hyetograph
 - Soft ground contour map
 - Soil test result
 - Final result table of surveying

1 Preparation of CD-ROM

CD-ROM should include original data, all drawings, and photographic book and organize them in the following order:

- Make a single file by PDF file of the printed report in same order.
- Appendix should include the original files presented in the report. (000.doc, 000.xls, 000.dwg, 000.jpg, 000.pdf, etc.)
- Photographic album

2 Photographic Album

Photographic album shall include the following contents:

- Scene of instalment and transporting equipments
- Scene of boring
- Scene of standard penetration test
- Scene of each field test
- Scene of sample collection (undisturbed sample, SPT sample, etc.)
- Scene of sealing undisturbed sample and transporting process
- Scene of abandoned well
- Scene of lab test (categorize by each test)
- Sample Boxes (each box and scene of sample storage)

3 List of Outputs

Constructor shall submit the following outputs upon the completion of the project.

- Soil Investigation Report
 - Korean Report Nil
 - English Report 5 copies
 - Vietnamese Report 20 copies
- CD-ROM 3 copies



- Album of Soil Investigation 1 unit
- Sampling Box 1 each

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Topographical Survey

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1. GENERAL

- a. THE CONTRACTOR shall conduct surveys based on appropriate surveying techniques and the laws and standards. Survey is generally divided into the following seven categories:
 - Control point surveying,
 - Levelling,
 - Topographic surveying,
 - Stone marker,
 - Survey on current facilities and utilities,
 - Land records.
- b. THE CONTRACTOR shall submit the detailed work plan to the client.
- c. THE CONTRACTOR shall have function and calibration report of the equipment from authorized firms. After that, all equipments have to have regular inspection and calibration.
- d. THE CONTRACTOR shall take measures to record work details in the log book for inspection purpose if necessary.
- e. THE CONTRACTOR shall take all safety measures during surveying works.
- f. THE CONTRACTOR is obliged to immediately clear any necessary required process to related authorities at his own cost during the works.
- g. THE CONTRACTOR shall submit detailed work plan and should include the following items:
 1. Description of survey types and details
 2. Field work plan and schedule (indoor and outdoor)
 3. Name of surveyors and staff organization
 4. Surveying instruments and equipments
 5. Special elements (e.g., safety supervision, quality control, etc.)
 6. Survey area map (or drawing)
 7. Other necessities

The topography survey services will be performed into two phases,

Phase I

- Finding and buying Bench Mark Data from Department of Natural Resources and Environment.



- Mobilization of Equipments and Staffs to site
- Preparing to make and measure GPS (Class IV Coordinate Control)
- Preparing to make Bench Mark (Grade 2 traverse line net)
- Measuring Grade 2 traverse line net.

Phase II

- Levelling (IV class levelling and technical levelling net)
- Surveying the plan on scale 1/500
- Process data in office
- Final report

SURVEYS

1 Triangulation and Control Point Survey

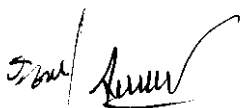
Contractor shall prepare detailed work plan of triangulation and control point survey according to the following guidelines in below.

- Contractor shall conduct Triangulation and Control Point Surveying based on the triangulation points determined by the Ministry of Construction or other relevant government authorities.
- In principle, Contractor shall conduct triangulation and control point surveying using the traverse method. According to survey location and scale of area, triangulation is possible to apply if it is more effective than trilateration method.
- Installation of survey mark shall be followed standard dimension and burying method. Installed survey mark shall be located at rigid point for permanent maintenance and shall be kept in photography for utilizing further works.
- In observation, TS and GPS can be run parallel and observation method with accuracy check calculation need to comply within allowable tolerance.
- Control point might be installed as many as possible to utilize at topographical survey of the area.

2. Levelling

For levelling, THE CONTRACTOR shall conduct survey (back and forth to get an average data) using bench mark of horizontal control datasheet determined by the Ministry of Construction or other relevant government units.

THE CONTRACTOR shall use standards of burying method to the standard of survey marker and installation methodology.



THE CONTRACTOR shall make observation according to the direct levelling method. Other methodologies, measurement, inspection, adjustment calculation, horizontal control data summary shall follow the relevant survey standards.

3. Topographic Survey

The following lists the key guidelines of topographic survey for Contractor to consider in the preparation of the detailed work scope.

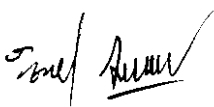
- The scale of topographic survey shall be 1/500.
- Range of topographical survey considering no interference to design requires 10% more of the project area taking account surrounding conditions and to do precisely to recognize adjoining major landmark easily.
- The basis for cadastral map shall be from the cadastral records by GDLA and control points of cadastral map and topographic surveying shall be checked frequently.
- Detailed survey should use T.S and RTK-GPS.
- Sounding for the surrounding swamps and rivers should be conducted. For bridge location, sounding shall be executed along bridge centre starting at 100m apart upstream to 100m apart downstream by 20m intervals.
- Contour interval shall use the following ranges:
 - 5 m intervals for valley line
 - 1m interval for half interval contour line
 - 0.5m supplementary contour line
- Contractor shall comply with the standards of digital mapping in preparation of digital map and standard codes.
- Topographic surveying map shall have the following items:
 - map title,
 - scale,
 - azimuth,
 - legend,
 - date and year,
 - client name,
 - surveying company, and
 - signature of the person-in-charge.



IMPEDIMENT SURVEY

Contractor shall incorporate the following guidelines in the detailed work plan:

- With the cooperation from the related authorities, THE CONTRACTOR shall identify impediments or barriers within the survey area and collect accurate information which to be reflected in design works.
- THE CONTRACTOR shall coordinate with the related authorities regarding the cost required for relocating barriers on ground such as trees, telegraph pole, man-hole, water pipe, sewerage pipe, city gas pipe, communication line, steel tower, oil pipeline, etc. The cost should be incorporated into the total construction cost.
- THE CONTRACTOR shall accurately mark any impediments or barriers in the survey area in the existing condition map.
- THE CONTRACTOR shall calculate the volume of construction waste which to be incorporated into the construction waste management in design.
- THE CONTRACTOR shall conduct accurate surveys and observation of land and impediments (barriers) and maintain high quality of the survey results. Contractor should have high awareness of the importance of accurately recording the current condition of the study area and shall continue efforts in avoiding the occurrence of unforeseen compensation.
- Drawings of land shall be drawn with parcel number and owner information by land and impediment/barrier categories.
- THE CONTRACTOR shall submit the drawings of land representing existing condition with the details of land certifications and land-book as well as details of the existing impediments/barriers.
- Districts shall be planned in details so that districts can be applied in the land registration map as well as directly applied on site during the construction phase.
- Survey results shall provide accurate information in the process of obtaining permissions/approvals, coordinating among institutions and organizations, and the executing tasks.
- Prepare possible areas and issues for civil dispute and mitigation measures regarding the project and the project area.



OUTPUTS

Contractor shall submit hard copies and CD-ROM containing the following information:

- Horizontal control datasheet,
- Control point map,
- Level route map,
- Observation records,
- Records of surveying points,
- Digital map data 3D (1/500),
- Report of land and impediments/barriers surveys, and
- Etc.

