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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
ZAMBOANGA DEL SUR 1st DISTRICT ENGINEERING OFFICE
Rizal Avenue, Balangasan District, Pagadian City, Region IX

BAGONG PILIPINAS

TERMS OF REFERENCE
FOR THE SUB-SURFACE EXPLORATION THRU CALYX DRILLING AND LABORATORY WORKS/ANALYSIS FOR CONSTRUCTION OF FLOOD CONTROL STRUCTURE ALONG SALUG DAKU RIVER, BARANGAY UPPER SANTO NIÑO, MAHAYAG, ZAMBOANGA DEL SUR

I. INTRODUCTION

A. Abstract

The Department of Public Works and Highways (DPWH) is primarily responsible for national roads and bridges of the road network development project of the country. Along with this main thrust, it seeks to improve the road networks that interconnect the province of Zamboanga del Sur.

The DPWH Zamboanga del Sur 1st District Engineering Office has prepared these guidelines to assist the consultancy services in the planning, cost estimating and reporting of geotechnical investigations for projects under the FY 2025 General Appropriation Act (GAA). The specific project will require the services of the Consultant that will conduct detailed geotechnical and geological surveys/investigation thru Calyx Drilling and Laboratory Works for bridge project sites identified by this office listed hereunder;

Name of Project	Location	Depth(m)	No. Of Boreholes
1. Construction of Flood Control Structure along Salug Daku River, Barangay Upper Santo Niño, Mahayag, Zamboanga del Sur	Mahayag, Zamboanga del Sur	20.00	2

B. Objectives

The objectives of this undertaking are:

1. To explore the characterization of the subsurface soil conditions of the area to provide general data relating to the project

2. To be able to evaluate general parameters necessary for analysis and design of needed structure.
3. To give an outline of the surface and subsoil geology
3. To analyse the data obtained and give engineering consideration and recommendation on the selection and design of foundation.
4. To prepare the detailed geotechnical and geological investigation of the proposed flood control projects for the preparation of the foundation.
5. To be able to provide a detailed sub-soil technical report.

II. SCOPE OF CONSULTING SERVICES

A. General

1. The Consultant shall coordinate with the Planning and Design Section (PDS) during the conduct of geotechnical and geological surveys and investigations of all the bridge projects.

2. The Consultant shall be responsible for carrying out the conduct of detailed geotechnical and geological investigations as stipulated in the DPWH Design Guidelines, Criteria and Standards, Volume 2C, 2015 Edition: Geological and Geotechnical Investigations and applicable provisions of existing laws, codes or Department Orders, to minimize changes or modifications in the design plans, substitutions of materials or methods and unnecessary delays in the preparation of final plans and estimates.

3. The Consultant shall identify areas with geological problems and difficulties, and water bearing stratum causing subsurface discharge, which could affect the stability of the proposed bridge projects.

4. In general, the Consultant shall conduct the following:

    4.1. Geological Survey and Investigation, consisting of, but not limited to the following:

        4.1.1. Collection of geological information such as aerial photographs, satellite imagery, relevant geological study reports, documents and maps for the project areas.

        4.1.2. Hydrograph survey of the existing river basin along the project alignment specifically at slope disaster areas by conducting site ocular inspection to determine the bridge's critical elevation.

4.1.3. Identification of materials source areas for borrow, aggregate and other materials necessary for the construction of projects.

4.2. Geotechnical investigation, consisting of, but not limited to the following:

4.2.1. Detailed soil investigations shall be undertaken at bridge abuttment with the purpose of identifying types of sub-grade soils. This should not be confined to centreline and edge of the pavement only, but include side cut sections affected by widening or ROW.

4.2.2. All pits and boreholes shall be properly logged and drawn in A1 size plans showing the thickness of each layer, the color, the type and visual description of each layer, depth below the surface, depth of water level (if encountered), etc. The following laboratory tests and analyses shall be made on the samples taken: Unit Weight, Specific Gravity, Natural Moisture Content, Soil Classification, Combined Sieve and Hydrometer, Atterberg Limits, Unconfined Compression Test, California Bearing Ratio (CBR). Classification of soils shall be made in accordance with AASHTO M145.

4.2.3. In-situ CBR tests should be carried out where overlays or rehabilitation is being proposed without reworking/re-compaction of any remaining pavement layers including the sub-grade layer. On the other hand, proposal for appropriate modulus of resilience (Mr) testing plans complementing or replacing the CBR testing is preferable and would be an advantage.

4.2.4. Sources of construction materials shall be investigated and identified to determine the adequacy of suitable materials. Samples from identified sources shall be subjected to laboratory testing.

4.2.5. At each proposed construction materials source, two (2) test pits shall be made and sufficient samples shall be taken for laboratory testing.

5. The Consultant shall provide all the labor, instrument/equipment materials and supplies, vehicles, bunkhouses, etc., necessary to perform satisfactorily the sub-surface exploration.

6. The consultant must accomplish all obligated tasks without delay, keeping the Department of Public Works and Highways, Zamboanga del Sur 1st District Engineering Office advised of all progress in terms of survey preparation, execution and processing.

7. The Consultant shall be held solely responsible for the result of this boring/drilling exploration and other activities under this Terms of Reference (TOR).

B. DETAILED EXPLORATION REQUIREMENTS/SPECIFICATIONS

1. Site Inspection

The geotechnical site inspection is conducted to acquire first-hand knowledge of the soil and geologic condition of the project area as a basis for review of the geotechnical investigation program and the data included in the geotechnical investigation report.

The site inspection is ideally conducted before or during the conduct of soil exploration of a project (road, bridge, slope protection and structure projects). It should contain among others the description of the site, observations, expected site geology and soil type, topography, vegetation, findings, comments and recommendations. The reason for any significant deviation from the geotechnical program must be addressed in writing to the head of the design office.

2. Borehole Spacing

The geotechnical investigation shall also include a geotechnical assessment of the site with at least one (1) borehole at the proposed location for each pier and one (1) borehole for each abutment.

Additional borings should be provided in areas of complex or variable subsurface conditions. This shall be made upon the instruction of the Geotechnical Engineer.

3. Borehole Location

Borings are to be conducted at a distance of 10m from each other from center of proposed project to cover a circumference of 5m each, or as close as possible if there are obstructions that cannot be removed. The location coordinates shall be recorded to 9.1m accuracy (x,y,z) by global positioning.

4. Borehole Depth

If foundation type has not been specified, boring shall be carried out to a minimum depth of 30m in ordinary soil or to 10m into sound rock if rock is encountered above the depth.

In case bearing layer is not encountered beyond 30m, boring shall be continued until preferred layer is encountered and/or upon the instruction of the geotechnical engineer.

5. Procedure

5.1. Deep drilling with Standard Penetration Test (SPT) shall be conducted at 7.30 meter from centerline of existing bridge left and right at each abutment. Minimum depth shall be determined based on confirmation of hard strata or bed rock. Drilling can be stopped after ten(10) meters minimum penetration into hard strata or bed rock.

5.2. The Consultant shall perform analysis and testing on disturbed and undisturbed soil samples. These analyses and testing shall be performed in accordance with AASHTO and ASTM standards.

5.3. The soil samples for foundation design shall be tested for the determination of the main characteristics (grain size distribution and classification, moisture content, atterberg limits, etc.)

5.4. Submit design recommendations, foundation condition scheme, bearing capacity and settlement, groundwater table, hydrological influences, excavation stability, seismic design consideration and liquefaction potential

5.5. Geological structure, especially active faults which might traverse the area, should be delineated and potential mass movement areas should be identified. Analysis for liquefaction potential during earthquake and consolidation due to soft ground should be included.

6. Handling and Core Samples

The contractor shall provide all the materials, equipment and labor necessary for preserving samples.

Disturbed Samples:

Representative specimen of each sample shall be taken for laboratory tests. Samples shall be properly marked and identified with legible labels as directed by the DPWH authorized representative.

Undisturbed Samples:

Undisturbed samples shall be treated in the following manner:

The ends of the sample tubes shall be filled to the top with wax added in increments to prevent voids, after which they shall be capped with friction tape and dipped in wax. Undisturbed samples shall be labeled and identified by DPWH authorized representative.

Rock Cores:

Rock cores shall be suitably boxed, marked, identified and described. Cores shall be boxed in the same sequence in which they were obtained in the

field. Core from each drilling run shall be clearly, accurately and permanently marked. Cores of soft rock, which may be damaged in the normal course of transporting shall be further preserved by wrapping them in polythene bags. The container itself shall be marked to show the site on the boring/drilling location plan and date sample was taken.

7. EQUIPMENT:

Drilling Machines:
The contractor shall employ at least one (1) drilling machine and set it up at the project site. The drilling machine shall be in good working condition and shall be of such capacity as to maintain satisfactory progress of work.

Bits:
The contractor shall have an ample supply of different types of bits to adopt the varying conditions. Bottom discharge and stepped bits shall also be available.

Core Barrels:
Double tube swivel type core barrels in good condition and capable of obtaining maximum core recovery shall be used. The core bit diameter shall not be less than 67 mm (2-5/8 inches)

Casing:
The contractor shall, at his own expense and responsibility, provide casings as required to ensure the stability of the borehole walls. The casing shall be at least of N-size and shall be in good condition. After a hole has been finished the casings shall be retrieved.

C. LABORATORY TESTING

The preparation of samples for testing shall be made in accordance with AASHTO.

The following tests shall be made on samples obtained from boring and drilling.

1. Standard Penetration Test

SPT indicates that the blow count correlates with the variable density and/or consistency of the material being penetrated thus, probable shear strength and bearing capacity is determined. The result of this test shall be used only to describe granular soil density and clayey soil consistency. When sampling clays, this test can be used in the field in conjunction with the unconfined compression test.

The test shall be carried out through ordinary soil encountered to the depths specified above. Standard penetration test shall be performed using 5.00 cm (2.0 inch) outside diameter split spoon sampler, driven by a 63.60 kg (140 lbs) hammer falling 76.00 cm (30 inch) at 1.50 meter interval or closer if necessary.

2. Moisture-Density Rotation

This test method determines the relationship between the moisture content and the density of soils compacted in a mold. The contractor shall conduct this procedure according to ND T 99 or ND T 180.

3. Bearing Capacity Test

The test method covers estimation of the bearing capacity of soil in place by means of field loading tests. This test method can be used as part of a procedure for soil investigation for foundation design. It gives information on the soil only to a depth equal to about two diameters of the bearing plate, and takes into account only part of the effect of time.

4. Sieve Analysis

To determine the percentage of various grain sizes. The grain size distribution is used to determine the textural classification of soils (i.e., gravel, sand, silty clay, etc.) which in turn is useful in evaluating the engineering characteristics such as permeability, strength, swelling potential, and susceptibility to frost action.

Sieve analysis determines the gradation or distribution of aggregate particles within a given sample in order to determine compliance with design and production standards.

The contractor shall conduct this test in accordance with AASHTO T 27 and materials finer than No. 200 (75 µm) in accordance with AASHTO T 11. The procedure combines the two test methods.

Accurate determination of material smaller than No. 200 (75 µm) cannot be made with AASHTO T 27 alone. If quantifying this material is required, it is recommended that AASHTO T 27 be used in conjunction with AASHTO T 11. Following AASHTO T 11, the sample is washed through a No. 200 (75 µm) sieve. The amount of material passing this sieve is determined by comparing dry sample masses before and after the washing process. This procedure covers sieve analysis in accordance with AASHTO T 27 and materials finer than No. 200 (75 µm) in accordance with AASHTO T 11. The procedure includes two method choices, A and B.

5. Liquid Limit

Liquid Limit test shall be performed on material passing the 0.425 mm (No. 40) sieve. AASHTO T 89 & T 90 27. There are two methods approved by AASHTO, any of the two method can be used by the contractor. Blow count must be within 22-28 blows. Liquid Limit is a calculation based on moisture content and number of blows to closure.

6. Soil Classification

This standard classifies soils from any geographic location into categories representing the results of prescribed laboratory tests to determine the particle-size characteristics, the liquid limit, and the plasticity index.

III. DELIVERABLES

The Consultant shall prepare the following reports and deliverables:

1. Final Report

The Consultant is required to prepare and submit the final Geotechnical report in two (2) bound copies to the DPWH Zamboanga del Sur 1st District Engineering Office, Pagadian City, Zamboanga del Sur, within Fourteen (14) calendar days from the commencement of work. The final report shall not be limited to the following:

1.1. Field Investigation and Methodology
1.2. Borehole Drilling and Sampling
1.3. Laboratory Testing
1.4. Final Boring Logs (BL)
1.5. Final Laboratory Tests Results (FLTR)
1.6. Borehole Location Plan

1.7. Soil Profile along structures showing boring/drilling logs
1.8. Soil Liquefaction Investigation Report
1.9. Soil Bearing Capacity
1.10. Recommendation if called for such as type of measure/structure of work

2. Other Data to be Submitted

2.1. Boring Logs

2.1.1. Job, boring, hole number, date, time, boring/drilling, foreman, supervisor
2.1.2. Weather condition
2.1.3. Depth of boring at start of day
2.1.4. Water level in casing at start of day
2.1.5. Method of penetration and flushing system
2.1.6. Description of soil strata encountered
2.1.7. Depth of soil boundaries
2.1.8. Size, type and depth of samples and sample number
2.1.9. Type and depth of in-situ tests
2.1.10. Standard Penetration Tests Resistance, "N" Value
2.1.11. Recovery ratios of samples
2.1.12. Detailed notes on boring/drilling procedure, casing sizes and resistance to driving, description of wash water or spoil from boring/drilling tools
2.1.13. Depth of boring at end of day
2.1.14. Other relevant information such RQD, percent core recovery, angle of friction etc.

2.2. Photographs

Photographs showing the borehole drilling and sampling at each proposed sites shall be taken by the Contractor and incorporated in the report. Photographs (use of GeoCam Application) shall be taken at each borehole location depicting the following:

2.2.1. Longitude/Latitude Coordinates
2.2.2. Date photograph was taken
2.2.3. Equipment used
2.2.4. Core drilling operation
2.2.5. Water level measurements
2.2.6. Performance of SPT and Shelby tube sampling
2.2.7. All cores in the core boxes, SPT and Shelby tube samples

3. Duration of Consultancy Services

The Consultant's contract period for undertaking the geological and geotechnical investigation is Fourteen (14) calendar days and the Consultant shall commence work upon receipt of Notice to Proceed (NTP).

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