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ASSIGNMENT

GEOTECHNICAL INVESTIGATION REPORT

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INTRODUCTION

AUTHORIZATION AND LIMITATIONS

This report presents the results of a geotechnical investigation performed at Sector 9 KDA Kohat, KPK, Pakistan. This report may not contain sufficient information for other uses or the purposes of other parties.

1.2 PURPOSE AND SCOPE OF WORK

The objective of this investigation was to assess the nature and engineering properties of the encountered subsurface materials and to provide geotechnical design recommendations for the proposed power plant. The scope of work consisted of the following tasks:

- Review available subsurface information for the Site,

• Drill, log and sample eleven test borings,

• Hand dig, map, and sample seven test pits,

• Conduct a geophysical seismic refraction and electrical resistivity study,

• Perform laboratory testing on selected samples,

• Evaluate geotechnical properties of materials encountered pertinent to the design and construction of the project, and

• Develop conclusions and recommendations regarding:

o Foundation recommendations for the proposed buildings and equipment,

o Subgrade preparation beneath new foundations and pavements,

o Fill and backfill materials along with fill and backfill slope placement and compaction criteria,

o Appropriate foundation type(s) for support of new structures along with geotechnical criteria for foundation design,

o Lateral earth pressures for permanent retaining walls,

o New flexible pavement structural sections for driveway areas,

o Corrosivity of Site soils with respect to steel and concrete.

SITE DESCRIPTION

The Site is irregular in shape, approximately 3.9 acres in size, and partially occupied by an existing landfill gas scrubbing and pumping facility. A portion of the site is vacant. The existing facility includes liquid flammable gas compression equipment, a landfill gas flare system, and several small buildings.

PROJECT DESCRIPTION

. The proposed development will consist of a new electric generation power plant consisting of engine or turbine generators utilizing landfill gas as fuel. The power plant will include gas and air compressors, pumps, heat exchangers, electrical equipment, and other systems. Several buildings will also be constructed on the site to house the engine generators, an office, control room, and warehouse.

There were no structural plans or design loads available at the time of this report. Based on our experience with similar projects and the available information, it is assumed that building loads will be relatively light. We understand that the equipment is typically founded on square concrete spread footings approximately two to three feet in width or thickened mat foundations. The foundation loads for the proposed equipment were estimated for the purpose of this report at less than 100 kilopounds (kips) for equipment and less than 3.5 kips per linear foot (klf) for continuous building wall footing loads. If actual design loading conditions differ from those indicated above, the recommendations in this report may have to be re-evaluated.

Grading plans have not yet been finalized. Final grading plan should be reviewed by the Project Geotechnical Engineer. The recommendations in this report may need to be changed based on the final grading plan.

DRILLING

Eleven test borings were drilled with hollow-stem auger equipment at the locations. The borings were logged by a representative who also collected samples of the materials encountered for examination and laboratory testing. Samples were obtained using a 2.5-inch inner diameter (ASTM D3550) and during Standard Penetration Testing (SPT, ASTM D1586). The samplers were driven with a 140-pound hammer falling 30 inches. The blows required to drive the samplers each 6 inches (or less) of an 18-inch derive were recorded and are noted on the boring logs.

The logs of the test borings are in Appendix A. Soils are classified according to the Unified Soil Classification explained in Appendix A. Rock is described in terms of its physical characteristics.

GEOLOGIC TEST PITS Seven geologic test pits (TP-1 through TP-7) were hand excavated at locations on the southern slope and aligned parallel with the face of the slope. The soil trenches were approximately 4 feet long and 4 feet wide and were excavated to depths ranging from 2 to 3.5 feet bgs. The trenches were continuously logged and mapped at locations shown on Figure 2, and slide hammer soil samples were collected for materials laboratory testing.

LABORATORY TESTING

The following laboratory tests were performed on samples collected at the Site

• In-Situ Moisture and Density (ASTM D2216): In-situ moisture and density are calculated by weighing and measuring the drive samples obtained from the borings to determine their in-place moisture and density. These results are used to analyze the density or consistency of the subsurface soils.

• Direct Shear Test (ASTM D3080): The tests were performed on an undisturbed sandy soil sample in order to obtain the soil shear strength values, which are among the basic soil parameters that are used to estimate soil bearing capacity and lateral earth pressures.

• Sieve Analysis (ASTM D422 and ASTM C136): This test is used to evaluate the distribution of soil grain sizes, which constitute the soil fabric and is used in soil classification and assessment of soil engineering behavior.

• Maximum Dry Density and Optimum Moisture Content (ASTM D1557): The compaction curve defines the relationship between water content and dry unit weight of soils compacted soils effort. The maximum dry density and optimum water content are used to determine the relative density of existing soils and to determine the level of compaction during grading activities.

• Chemical Tests for Corrosion Potential (Applicable EPA, ASTM or local test methods): The pH, resistivity, soluble sulfate content, and chloride ion content were evaluated in a near surface soil sample.

CONCLUSIONS

The new structures and equipment can be supported on shallow spread footing or mat foundations with bottom levels in weathered rock. Relatively high bearing pressures can be used. Post-construction total and differential settlements will be small.

Foundations for facilities in the northeastern end of the Site, in the vicinity of boring B8, may need to be deepened to extend into weathered rock. Current plans indicate that 4 to 5 feet of excavation below planned final grade could be needed to reach the rock. Foundations could be constructed in excavations into the rock, or the excavations can be backfilled to typical shallow foundation levels

with sand/cement slurry. Final procedures when final facility types and locations have been determined for this area.

A cut slope 40 to 50 feet high currently is proposed at the northeast end of the project area. At present, the slope is configured at 1.75:1 (horizontal:vertical). Based on the shear wave velocities measured in the geophysical survey (Appendix C), and the materials encountered in the borings, the rock in this area is expected to be rippable with a Caterpillar D9R bulldozer equipped with a multi- or single-shank ripper (Caterpillar, Inc., 2000). Shallower parts of the cut area could expose weathered rock susceptible to erosion. Erosion protection will be needed to reduce the potential for sloughing and raveling from the face of the slope.

QUIZ

GEOTECHNICAL SOFTWARE:

Software is basically designed to make work easier. Geotechnical software is the software which basically helps to deal with geotechnical issue such as seismic analysis, slope stability, foundation etc.

Following software programs are used in geotechnical engineering:.

1. **CAPWAP:** It helps to estimate the total bearing capacity of pile or shaft.
2. **APILE:** This software is used to compute the axial capacity as a function of depth of a driven pile in clay, sand or mixed sand profiles.
3. **CADS Reslope:** It is a leading slope stability software for calculating factorof safety of each slope.
4. **AMRETAIN:** It is a software for checking single or double retaining wall made of ArcelorMittal or sheet piles. It has been designed by Terrsol for ArcelorMittal
5. **DAN-W:** Software used for dynamic run out analysis of rapid landslides and rock avalanches. It accepts user input data in form of path slopes and initial sliding mass geometries and material properties.
6. **All Piles:** It is a software used for pile foundation analysis including uplift, axial, lateral and group piles.
7. **Ce.Ca.P:** It is used for analysis and design of foundation because of its completeness, user friendliness. It is a fundamental and important instrument for any kind of geotechnical project.
8. **GE05 Abutment:** It is used for designing abutments including wind walls. It allows to check abutment for overturning, bearing capacity of foundation and soil and dimensioning of device.
9. **GGU-AXPILE:** It allows calculation of drilled piles or driven piles and graphical presentation of results.
10. **GE05 BEAM:** It helps in analysis of foundation beam that is resting on elastic subsoil.
11. **DynaN:** It is used for dynamic analysis under random or transient loading in the time domain. It is also used for harmonic loading in frequency domain.

12. **D-MOD 2000:** It is software that is used for non-linear seismic response analysis of horizontally layered soil deposits, earth fill dams and solid waste land fills. It is a non-dimensional, non-linear, effective stress site response analysis software.