Concept of applied geology

Introduction

The concept of Applied Geology to investigation of the ground for construction, hydrogeology, environmental geology and mining, is fundamental and it is a prerequisite for a durable result in any geological and engineering scheme. The timeline and strength with cost effectiveness and the knowledge of the geology of a terrain in any engineering, mining and geological schemes; roads, borehole drills, bridges, seismic operation, building of factories etc, are fundamentals that a contractor or an organisation embarking on either geological or engineering projects should be equipped with . The need for an established scrutiny and evaluation of geological features in any project sites hold the key for efficacious results in terms of its durability and efficiency. The main criterion for ground investigation varies with the magnitude and scope of a proposed engineering project; the appropriateness of the site, the site conditions, ground properties, and ground data for analysis aims. Ground investigation is the more restrictive phase of specialist intrusive investigation on a site with the associated monitory test and reporting designed to obtain data from three different aspects of the ground conditions, which are drift and soil condition, with laboratory test and application of soil mechanics technique, rock head, whose depth is commonly significant to excavation and foundations; bedrocks, strength and structural variation.

The Concept of Ground Investigation (GI)

Ground investigation is the concept of providing geotechnical data which are representative of the ground conditions and relevant to the scheme considered. This includes surface and subsurface investigation, laboratory

work and factual reporting. When embarking on ground investigations these are some of the ground conditions needed:

- Fracture conditions of the rocks, with respect to the rock mass strength it determines.
- Geological history, and stress conditions in the ground, critical to underground engineering, such as mining and tunnels.
- Ground conditions and slope stability, with regards to pore and joint water pressure.
- Quaternary evolution, mainly rock weathering and deterioration by erosion.
- Man made impacts on the ground, which includes contamination of Brownfield sites.
- Nature and strength of rocks and soil, and the difficulties that these may pose in construction.

In attaining the right data for an engineering or geological project, Ground investigation must surpass all the ground conditions for proper established analysis and the geological principles mentioned should be incorporated properly regardless of any unseen circumstances that may arise. Carrying out field assessments through ground investigation at an early stage in a project is very relevant in order to attain a preferred means of accessing the choice of techniques that can be used in preliminary ground investigation. The topography of a terrain is an essential factor for determining a preferential route, which in some cases may need to be modified depending on the nature of the terrain. Access route with low ground and shallow depth to water table which may be subjected to flood with thick organic deposits,

such as peat, unstable ground and areas exposed to severe weathering conditions are one of the features in the topography of an area. Nature is the most complex barrier in ground investigation with defining features like deep valley, steep hill side, rivers, and huge rock outcrop, such as batholite.

However, ground investigation outlines areas where the ground has adequate capacity in strength to sustain weight; most rocks or soil usually take the form of pad especially for construction purposes and mining. One of the major factors in the geological approach is the need to formulate ways of addressing issues that are of great concern in a topographic terrain.

Concept for Construction

The geological model in ground investigation has been formulated so as present a clearer picture of ground conditions. The concept of these views is presented in 3-D of geological features which are integrated into independent components of ground conditions. These are;

- Tectonic – that outline the background data
- Geological – to provide the broad ground picture
- Geomorphologic – with the near/surface details

In order to expose deficiencies of ground condition on site, and focus attention on potential engineering issues the model drawing must be well detailed with required artistic ability.

The concept of a geotechnical investigation model is prefer construction model through ground investigation that will provide useful information and detailed design and layout for project managers and some contractors who do not posses geological or geotechnical know how. It has also gone a long

way in identifying areas of difficulties, and the scale of potential geo-hazards that may occur and preferred solutions on them.

These are the geological model reports that are carried out during ground investigations;

- Factual data with geological records
- Interpretation of the ground properties and conditions related to the construction projects, potential problems and the limitations of data.

Furthermore, trial pits including headings (horizontal or with slight inclination) and shaft (vertical or with steeps inclination) drill and so called small-scale drill are direct investigation methods which allows an inspection of soil and rock, their sampling and their performance evaluation in the field gives an overview of the suitability of some direct investigation methods for soil and rocks in construction processes.

The Concept for Hydrogeology

Geology and hydrogeology are used to investigate lithological structures in determining the homogeneity of rocks in locating fractures and understanding the permeability of a rock with regards to water, gas and various contaminants underground in order to assess the mechanical stability and gather data from the groundwater system. In ground investigations, groundwater transport flow can be highlighted in such a manner that aquifers can be estimated and potential contamination analysed. The purpose of geological and hydrogeological surveys is to gain direct information by outcrop examination; digging trenches, boreholes drilling, conducting hydraulic test, such as (pumping test analysis and tracer

tests) in wells to determine the situ hydraulic properties of that well. This process has been accomplished by field mapping, drill cores examination, construction and expansion of a network of groundwater observation wells. Sampling of rocks, soil and groundwater are taken, in order to determine the physical, chemical, petrographic and mineralogical parameters in laboratory to analyse the texture of the rock and soil sample.

The Concept for Environmental Geology

Modern landfill disposal facilities require detailed investigations, in order to ensure that appropriate designs and safety precautions are put in place. Legislations generally require that those responsible for waste disposal facilities to guarantee that the sites are suitably contained as to prevent harming the environment and this can only be carried out by the assistance of the geologists to conducting detailed site investigation. In some cases, this may require that investigations may continue during and after construction of a landfill site, depending on the geological parameters of the environment and the construction mechanism, which may require adequate attention from time to time. Selection of a landfill site for a particular waste or a mixture of wastes involves a consideration of economic and social factors, as well as geological and hydrogeological conditions.

A geophysical method was introduced to develop a model to detect and analyse abandoned landfill and contaminated plume in the environment. It is also use in locating fractured zones and obtaining other vital lithologic information from the ground. There are other Valuable ways for a meaningful use of the geophysical methods, such as electrical resistivity method,

magnetic, seismic and gravity method; depending on the physical parameters in ground investigation. Geophysical methods supplement each other because they are sensitive for various physical parameters. Ground penetration radar is used in places with low and dry conductivity rock and also to check for contaminants from these landfill areas penetrating through a rock fault to the ground water. Seismic methods are used to investigate structures and lithology. Magnetic and electromagnetic surveys are very helpful in locating concealed landfill sites. These methods are easy and fast to conduct and can cove vast area in a short time. Electromagnetic, seismic, gravity and resistivity methods are used for ground water geophysical investigation on a regional scale. Geophysical surveys helps to obtain subsurface data on the possible location of groundwater aquifer and the area where a drill borehole can be located.

The Concept for Mining

In mining, geologist monitors the rock mass behaviour in ground excavations and tunnels. This rock mass behaviour forms the basis for determining the excavations and its support methods as well as assisting in evaluating and monitoring data during the overall processes.

Ground investigation for an underground structure is a difficult task which in many cases does not get a proper analysis. The basic aspect of ground investigation is to develop a consistent ground modelling which includes all the geotechnical and hydraulic aspect necessary for the underground structures as the major concept of the construction contract. Rock geometry modelling and mechanical behaviour of rock masses depends on the

understanding of the geological processes and their complex interactions such as deformation, weathering and metamorphosis (Steidl 2003). The correct transfer of the geological to geotechnical rock mass model and its implications into a proper design is one of the most challenging tasks in underground design project. The purpose of a comprehensive mining investigation as a sound geological modelling is for careful selection of rock mass parameters beneath the earth; geologic singularity of rock mass model such as lithological boundaries, faults and aquifers which have significant effects on underground mining, such as tunnel. Singularity data in underground mining or tunnel appear in procedures which can be either measured in boreholes, outcrops, aerial and satellite image in a statistical distributions, sometimes roughly estimated. The rock mass behaviour is as a result of a failure of the rock mass surrounding the underground wall. Each failure mechanism can be computed with appropriate analytical model and classified into defined Behaviour Types (Goricki 2003). Different failure mechanisms can be classified into gravity controlled failure of highly fractured rocks mass, stressed induced failure such as shear failure, key blocks, rock burst, buckling, spalling and plastification and some other failure geologic models.

Conclusion

Ground investigation, topographical surveys are essential part of the design process for any major infrastructure development. They reveal information about the ground conditions in any given area and even indicate whether the location can support any major structures. Their findings of these surveys not only inform the alignment of the scheme but also construction technics.

During ground investigation issues like complex conditions on the ground may arise within a project area. The findings or results after the ground investigation has been finalised will gives a possible means of addressing its causes and prefer ways to minimize its effects by indicating the no go zones. The most common ground condition issues are:

- Flowing groundwater or methane gas
- Natural or artificial cavities within bedrock
- Soil and variable drift materials
- Weathered, weak or fractured bedrock
- Active or potential failure and landslide
- Compressive landfill, with or without soft spots

In ground investigation the equivalence of ground features with geological maps are very essential for proper geological details and soil profile.

The ground investigation team are primarily made up of geotechnical engineers, geologist and grillers who are accompanied by an archaeologist and ecologist during survey works.