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Risk Factors in Geotechnical Works

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Abstract: ***In early days, the construction projects were of short duration and it was in a stable environment. And in modern days projects are becoming large with the globalization of market. The stability and effectiveness of modern projects depends on the risk management at construction site. This paper focuses on geotechnical risk management at construction site. It involves identifying hazards, analyzing or evaluating the risk associated with that hazard and to determine appropriate ways to eliminate or control the hazard that may harm people and property during each stages of work.***

Keywords: Risk Management, Globalization, FMEA analysis, Geotechnical hazards, Bayesian Bellief Network

1. Introduction

The risk assessment process of construction projects involves the determination of likelihood of occurrence of all the failures in the construction site and then evaluating the consequences of each failures. Soil conditions at subsurface have lead to risks in all geotechnical works. The soil conditions beneath the surfaces are difficult to predict. And the risk occurring during the construction works may lead to increase in estimated costs, delay in construction schedules, and disputes between involved parties. The best site investigation should be carried out to taken into account all the uncertainities related to each risk at construction site. From the investigation of soil conducted at the construction site, the type of the ground, cohesion of soil, depth of the water table etc can be obtained. With the help of proper geotechnical study the ground condition to be used in construction, load bearing capacity of the ground, flooding of water during excavation etc. The present study aims to identify the risk factors involved in geotechnical works at construction sites such as foundations, excavations, slope stability etc. Questionnaire survey is done to identify and ranking of risk by experts judgment.

2. Motivation

Several foundations related engineering problems are observed nowadays due to varying soil conditions at different construction sites. The study is to minimize the risks at construction site during geotechnical works. The risks can be occurred due to different layers of soil, levels of water table in ground, variations in climatic conditions, use of different machines at sites etc. Unforeseen geological conditions and the associated geotechnical problems have contributed to increase in cost of the projects and leads to changes in schedule of that project. And for minimizing both predictable and unpredictable risk, the risk should be identified and quantified.

Hence the current study is based on identifying risks, assessing risks and analyzing the risks. For this different geotechnical site should be visited and by experts judgment the risk factors can be obtained.

3. Literature Review

Risk assessment of underground mining process by using geotechnical Risk Assessment Scale and scope of the hazards and a particular tool is selected for identification of risk[1]. Slope failure is modeled using reliability based approaches. Considered all uncertainties related to natural variability's. Evaluates the risk associated with levee safety[2]. Combines fuzzy inferences with FMEA analysis for accurate risk assessment in pipe jacking process. Risk factors are scored using Delphi method[3]. Random field with finite element method is used for modeling slope stability problems[4]. Probabilistic analysis of seismic stability of underwater slope hazard and risk assessment of quick clays. Different tools such as Monte Carlo simulation, Event tree analysis are used for each case studies[5]. Measured the financial risk of a foundation design project. The risk is analyzed using numerical simulation model and it is incorporated in to a Monte Carlo framework[6]. Considered the safety of tanks and dams and event tree analysis is used for decision making for evaluating the risk[7]. Implemented a first order probability analysis of the ordinary method of slices. Uncertainties in pore water pressure, cohesion are considered. Normal and log normal models have used to compute the associated risk of failure[8]. Stability of embankments is assessed using conventional limit equilibrium methods. Integrated finite element method and limit equilibrium methods for probabilistic analysis of embankments[9]. Uncetainity and risk in geotechnical risk using a methodology in Euro code 7. Characteristic value of soil parameter is provided to achieve target probability of failure[10]. Developed a model for assessing the risk associated with various pile foundations. Used Bayesian Belief Network to model the risk during piling[11]. Introduced Bayesian Belief Network approach to identify, understand and quantify the risks[12]. Discussed large engineering project risk management using a Bayesian Belief Network and it is applied to Korean ship building industry[13]. Unforeseen geological conditions and the associated geotechnical problems which leads to cost and schedule overruns. Preparation of the contract is main step in minimizing cost and schedule overrun[14]. Organized an approach for effective risk measures for specific risks. Developed a risk model to represent risk factors and carrying out analysis to identify critical factors. Bayesian belief network is used to quantify the risk[15]. Causes of delays in construction projects are identified from questionnaires and it is ranked. Relative importance factor of each causes of delay

is calculated[16]. Identifying and categorizing factors causing delay in construction industry into nine. Quantifying the risk factors and suggesting measures to control the risk[17]. Risks in construction sites identified and it is ranked using five scales and relative importance factor is calculated using SPSS[18].

4. Methodology

Literature reviews was done based on the journals related to risk assessment in geotechnical works. Selection of construction sites undergoing geotechnical works. Identifying the risk factors at construction sites and questionnaire is prepared. Conducting questionnaire survey at selected sites. By experts judgment the severity of risk at construction site is obtained.

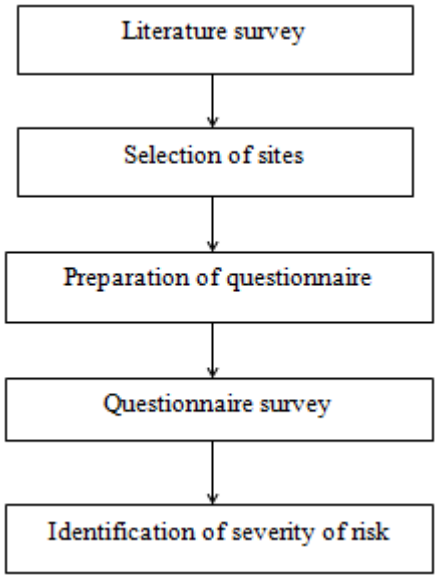

Figure 1: Methodology

5. Survey

The data were collected through questionnaire survey from the engineers and workers at different sites who have experiences in geotechnical works. Risk factors that can be observed at site are selected from the journals. The questionnaire survey was based on degree of impact in the scale (3- High risk, 2- Medium risk, 1- low risk). A different construction site at Ernakulam is selected.

Table 1: Risk factors related to piling

Sl. No.	*Risk factors*
1	Breakage of DMC rod
2	Breakage of chisel due to hard layers
3	Cave in due to loose soil at different layers
4	Collapsing of land fills
5	Damage to adjacent structures due to vibration
6	Damage to adjacent structures due to settlement
7	Due to presence of decayed wood at higher depth.
8	Excess consumption of concrete because of bore hole enlargement.
9	No return of bentonate clay due to presence of underground streams
10	Obstruction to boring due to buried cables
11	Pile not reaching to required depth.

The risk factors such as cave in happens at site at different depths of boring due to the presence of loose soils, occurring of seasonal variations such as raining, leaving the borehole for more than 2 days without concreting.

In piling works, two different methods are used in boring such as rotary drilling and DMC piling. In both methods during boring vibrations are occurred and it causes damage to adjacent structure such as cracks etc. and during vibrations settlement to adjacent structures is also occurred.

In some soils, the pile is not reached to required depth due to the presence of hard layers. In these cases extra time for boring is required.

In some sites extra consumption of concrete is happened due to the presence of old structures, when loose layer underling hard layers etc. The leakage of concrete is happened through pores in the loose soil. In some sites there is no return of bentonite slurry due to presence of underground streams.

In industrial sites there is obstruction during boring due to buried cables such as gas lines, electric lines, water lines etc. And there are obstructions due to presence of decayed wood at higher depths.

In some sites there is breaking of DMC rod, chisel etc due to the presence of hard layers, due to ageing of the rod and safety rope etc. At greater depths it will be difficult to take the broken chisel and rods.

In some sites such as bridge constructions' filling of land is made and collapsing of sand fills is happened due to movement of heavy machineries.

In some sites of greater depth heavy reinforcement is needed and during insertion of reinforcement cage, breaking of hook is happened.

Excavations at site for basement floors and for tanks are done by sheet piling. Because cave in is observed due to loose soils at different layers. Due to the presence of water table level beneath the land surface lead to inflow of water during excavations and it leads to collapsing of landfills. The sheet piling is done by hammering and it causes vibration and settlement to adjacent structures. Obstruction is observed during excavation due to decayed wood, buried cables etc. Risk factors related to excavation is listed in Table 5.2.

Table 2: Risk factors related to excavation

Sl. No.	*Risk factors*
1	Cave in due to loose soil at different layers
2	Collapsing of land fills
3	Condition of inflow
4	Damage to adjacent structures due to vibration
5	Damage to adjacent structures due to settlement.
6	Due to presence of decayed wood at higher depth
7	Obstruction to excavation due to buried cables
8	Ground settlement
9	Noise during operation

6. Conclusion

Questionnaire survey is conducted at different construction sites. Risks involved in different geotechnical works are taken and risk factor affecting pile foundation and excavations is collected. Different conditions causing risk in construction sites is identified from expert's judgment.

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