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Risk Analysis of Slaving Floor in Construction Sites

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Abstract: This study allows the application of tools for the analysis and prevention of natural risks of a real project. The importance of introducing the actors and the main stages of risk management and the difference between risk and uncertainty are emphasized. The aim of the study is to detect the risk and its location diligently, and determine if there is a risk of slippery ground on the site. In this study, Ghandouri project is described around a geotechnical analysis that confirms the existence of different stages and the risk of slippage in a practical situation. Current paper attempts to eliminate the risk by analyzing the soil and using Talren and Slop programs and offers a solution to ensure the stabilization of the site found.

Keywords: *Risk analysis, construction site, geotechnical analysis, slippery ground.*

İnşaat Şantiyelerde Kaygan Zeminin Risk Analizi

Öz: Bu araştırmada, hakiki bir projenin doğal risklerinin analizi ve önlenmesi için araçların uygulanmasına izin verildi. Aktörlerin ve risk yönetiminin ana aşamalarının tanıtılması ve risk ile belirsizlik arasındaki farkın önemi vurgulandı. Çalışmanın amacı, riski ve yerini netleştirerek dikkatle hazırlanması ve inşaat şantiyede kaygan zemin riski bulunduğunun keşfedilmesidir. Bu araştırmada, Ghandouri projesi pratik bir durumda farklı aşamaların varlığını ve kayma riskini doğrulayan bir jeoteknik analiz etrafında tanımlanmaktadır. Daha sonra, toprağı analiz ederek ve Talren ve Slop programlarını kullanarak, risk atlatılmaya çalışıldı ve sitenin dengelenmesini sağlamak için bir çözüm bulundu.

Anahtar Kelimeler: *Risk analizi, inşaat şantiyesi, jeoteknik analizi, kaygan zemin.*

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1. Introduction

The construction projects in Morocco often suffer from delays or over budgeting due to costs and deadlines not being properly implemented, mismanagement and disregard of risks in the project.

Corrective and preventive measures should be taken against certain risks in the workplace. Taking correct measures can only be possible with accurate and complete identification of hazards and the risks that may arise as a result. Risk assessment should not be expected to destroy the hazards in a workplace in a short time. Risk is a concept that eastern culture is not familiar with; to the point that there is no equivalent word in related languages. It is often confused with the concept of uncertainty. Corporate risk management is a set of activities that can be summarized as the recognition of existing risks of institutions, measuring their risks, prioritizing them, deciding the methods of responding to risks, reporting their activities related to risks and taking measures for continuous review.

The gravity, slope, water and similar value of a slope of ground cause serious damage to the structures due to the forces and outward movements. In addition, these factors have effects in terms of economy, all of which lead to loss of money and even lives. The movements affecting the slopes are extremely diverse in terms of their size, morphology and kinematic yield, they cause not only the superficial movements on the road, but also in part or in total destruction.

2. Risk analysis safety coefficient and balance calculation

The present analysis of the stable condition of the soil is regulated by looking at the two dimensions of the slope to examine the equilibrium conditions of the monolithic soil mass confined to the surface of a soil gap and the slits formed due to interstitial pressures and possible external loads along the tearing surface formed by the mass of the massive mass.

Table 1: Values related to safety coefficient:

Method	Hypotheses	Balancing Calculations	Unknown Calculations
Unending slit	• Infinite extent; • The fracture surface is parallel to the surface of the base of the slope	∑ Forces perpendicular to the slope. ∑ forces parallel to the slope.	• Coefficient of safety • The normal force at the base
Fellenius Method	-The breaking surface is circular. -The forces on the side of the slices are neglected.	∑ Central moment force of slipping.	• Factor of safety
Bishop simplified	• The power of soil collapse • The strength of the side sections is horizontal. (There is no break between the sections).	∑ moments from the center of the slip circle. ∑ Horizontal power	• Factor of safety • The normal force (N) at the base of the fracture surface.

Fellinus Method: This method is the first advanced soil partitioning calculation method. The simplicity of this method is that the safety coefficients can be calculated by the hand measure (Meter Accounting).

Bishop Method (1955): A method of calculating the type of landslide on a given line.
Unending slit: The area of the slit is parallel to the collapse area. The safety coefficient is normal power.

3. Implementation example

This problem is located in the north-west of Tangier in Morocco, spread over 60 hectares of land, this is a coastal strip in an unstable sea. This area is located 3 km from the city center and 15 km from TANGIER Airport. Based on the geological maps in the TANGIER region, we can see the predominant facies are clays and gray schistose marls, yellow in weathering, dated Senonian, but we also find Paleocene in comparable facies, white marl Eocene, and Oligo-Miocene marly facies and horizons of sandstone.

In order to determine the soil type of the study area, we carry out the tests with the presyo metric tests in place. Tangier has a semi-humid climate, with a rainfall of 800 mm and an approximate temperature of about 17.5 ° C. Rainfall varies over time from 500 to 1200 mm, and in the space from 750 to 1000 mm. Winter months (rainfall over 100mm) continue from November to March. Average number of rainy days per year is 90, equivalent to 3 months. Prolonged precipitations (24-hour sequence) are exceptional, often lasting only a few hours, and short showers may be relatively severe (more than 100mm / s for 15-minute showers).

- These conditions can cause significant leakage which may impair the stability of the land.
- The concise tests indicate the presence of water in the finished boreholes from the surface circulation of the source rain water.

4. The Encountered Risks in the Project

There were landslides during the site investigation, and the effect of this phenomenon can be observed on the land in the field of study. The first constraint encountered in the investigated land is that it consists of two slopes that are connected to each other by a small platform.

As can be seen, various risks were encountered and prioritized at this construction site and the region was geo-technically studied in order to identify and prevent these risks. In addition, the geological and hydrogeological studies of the site are known; comfort modalities that are most suitable for the site to stabilize the existing structures are required to be proposed and also an investigation of the slope is needed.

5. Laboratory Tests

Identification tests were performed on the ground in a private construction laboratory.

The results of the tests are given in the tables below:

Table 2: Determination of the water content and density of soils

Reference Sample	Sampling Method	Preservation Condition	Steaming Temperature	Water Content	Density ρ (kg /m^3)
SP01 (1,50 to 2,00) m	Intact	box	105°C	21	
SP01 (5,00 to 5,20) m	Intact	box	105°C	16	
SP01 (9,5 to 10,0) m	Intact	box	105°C	15	
SP01 (11,0 to 11,50) m	Intact	box	105°C	11	2201

Table 3: Cone Liquidity Limit, Roll Plasticity

Reference Sample	Sampling Method	Preservation Condition	Limit of Liquidity WL(%)	Limit of Plasticity WP(%)	Index of Plasticity IP(%)
SP01 (1,50 to 2,00) m	redesigned	box	47	26	21
SP01 (5,00 to 5,20) m	redesigned	box	46	24	22
SP01 (9,5 to 10,0) m	redesigned	box	41	21	20
SP01 (11,0 to 11,50) m	redesigned	box	42	21	21

Table 4: Particle size analysis by dry sieving after washing

Reference Sample	D max (mm)	>50 mm	>2mm	2mm to 80 µm	<80µm
SP01 (1,50 to 2,00) m	63,0	0	2	2	96
SP01 (5,00 to 5,20) m	31,50	0	8	3	89
SP01 (9,5 to 10,0) m	40,00	0	13	5	82
SP01 (11,00 to 11,50) m	12,50	0	1	3	96

Table 5: Determination of soil moisture content and density

Reference Sample	Sampling Method	Preservation Condition	Steaming Temperature	Water Content	Density ρ (kg /m^3)
SP3 (3,50 to 4,00) m	Intact	box	105°C	19	2140
SP3 (8,00 to 8,50) m	Intact	box	105°C	22	2048

Table 6: Cone Liquidity Limit, Roll Plasticity

Reference Sample	Sampling Method	Preservation Condition	Limit of Liquidity WL(%)	Limit of Plasticity WP(%)	Index of Plasticity IP(%)
SP3 (2,00 to 2,50) m	redesigned	box	41	23	18
SP3 (3 ,50 to 4,00) m	redesigned	box	47	25	22
SP3 (8 ,0 to 8,5) m	redesigned	box	41	23	18

Table 7: Particle size analysis by dry sieving after washing

Reference Sample	D max (mm)	>50 mm	>2mm	2mm to 80 µm	<80µm
SP3 (2,00 to 2,50) m	6,30	0	0	2	98
SP3 (3,50 to 4,00) m	6,30	0	0	1	99
SP3 (8,0 to 8,5) m	14,00	0	2	0	98

Table 8: CD Shear Test

Reference Sample	C’	φ’	Cr’	φr’
SP01 (5,00 to 5,20) m	20	24	20	24
SP01 (8,00 to 8,50) m	23	26	23	26

Table 9: CD Shear Test

Reference Sample	C’	φ’	Cr’	φr’
SP3 (3,50 to 4,00) m	22	24	22	24

Table 10: Odometric Test

Reference Sample	Internal	Pc(Kpa)	Ig	Pg(Kpa)
SP3 (3,50 to 4,00) m	0,096	45	0,042	20
SP3 (8,0 to 8,5O) m	0,142	220	0,06	28,33

6. Definition of Talren Logistics with Soil Gravity Balance Calculation

The analysis of the equilibrium calculation of the soil gravity processes was conducted to determine the centralized soil displacement. The analysis of the irregularly three-zone landslide analysis is very important. Talren geo is a balance control logistics operation used in technical studies. This arrangement is defined as strengthening or non-reinforcement [11]; Talren interface; the Talren 4 method has two important organizational distinctions: Data type: All elements used in describing our project should be: Geometric data, ground data, soil loading data and soil strengthening. Phase calculation method: All phases and calculations to be used in construction and account arrangement results should be seen.

7. Account and control

Three calculations are divided into three parts on the construction site by using three separate calculations in each section of the earthquake effect and whether the security coefficient is calculated and the safety coefficient in three parts is lower than 1.5.

The following table shows the properties of the modeling:

Table 11: properties of the modeling

References	Top side	Definition
1 – FILLING	0.00 m	Volumetric weight: 18.0 kN / m³ Non-measurable volumetric weight: 10.0 kN / m³ Internal friction angle: 20 degrees Combination: 0.00 kN / m²
2 – CUTTING FROM THE TOP SOIL	-3.49 m	Volumetric weight: 18.0 kN / m³ Non-measurable volumetric weight: 10.0 kN / m³ Internal friction angle: 16 degrees Combination: 4.00 kN / m²
3– Stone sedimentation content	-11.10 m	Volumetric weight: 18.9 kN / m³ Non-measurable volumetric weight: 10.0 kN / m³ Internal friction angle: 27 degrees Joint angle: 15.00kN / m²

8. Regulation Methods Application

Retaining wall pre-measurement methods

After the risk analysis and calculation of our site, the risk ratio of slippery ground seems high and we suggested a solution and we could reduce the risk by holding the retaining wall. The retaining wall should be constructed to carry out three-zone research at a height of approximately 11.1 m to prevent water leaking from the soil. This level should be constructed by taking the necessary precautions for the landslides and sewing the concrete piles. The length of the concrete pile to be drilled into the soil should be 11,5 m. The retaining wall cannot be used if it does not exceed 7 m. Following are the measurements of the Retaining Wall: B = 5,12 m, b = 0,15 m, e = 0,92 m, a = 0,64 m, h = 0,925 m, L = 7 m, H = 11,5 m

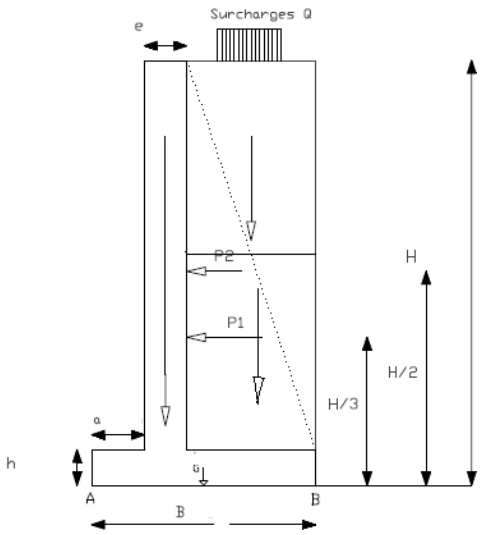

Figure 1: Retaining wall pre-measurement

As a result of this study, a long height should be given for vertical measurement of the retaining wall constructed, a very wide threshold and water pressure and terracing in the soil should be made. This can happen because the soil structure has deteriorated since the soil is already in the flood layer. Large risks can be avoided by using other methods.

In this case, only two solutions should be considered:
Solution: It is necessary to measure the terracing of the ground hole, the perforated wall side section and the soil gold. All hitting soils must be fixed with iron poles.

Note: A drainage system should be established when there is soil movement. In this case, the hole must be drilled in the soil. Protective measures should be taken when necessary.

9. Concrete pile

In this case, after making the risk analysis and calculation of our site, which should be (25 m in depth) and (150 cm in diameter) and should have a load capacity of 15 tons and 1000 tons, it is necessary to excavate and lay out the deep foundation necessary for the iron pile driving to a field.

In this project, we proposed a solution to the concrete pile and the analysis, control, and stakes were performed on the ground using the SLOP program to implement it.

10. SLOPE / W Computer program presentation:

SLOPE / W is a computer program that is performed by GEO-SLOPE International Canada for the analysis of the land grab calculation. This computer program is a method of measuring the controversial final balance limits mentioned in the previous sections. In this program, you can use the arrangements of the finished works but the modeling can be done with the help of SIGMA W. This computer program also calculates the safety coefficients of, for example, planar or non-planar samples of terracing methods. In contrast, planar terracing methods are automatically investigated in the mentioned program.

SLOPE / W computer calculation has many methods of calculation, Normal, Bishop, Janbu general, Spencer, Morgenstern, Price, Winding, and Lowe Karafiath which are used in the calculation methods of security coefficient. SLOPE / W Geostudio 2002 program is integrated with various other programs. The final equilibrium theory of the slope safety coefficient is calculated here. With the use of this program simple and complex slope security coefficient problem resolution methods and Microsoft Windows XP program graphics and calculation programs can be discussed.

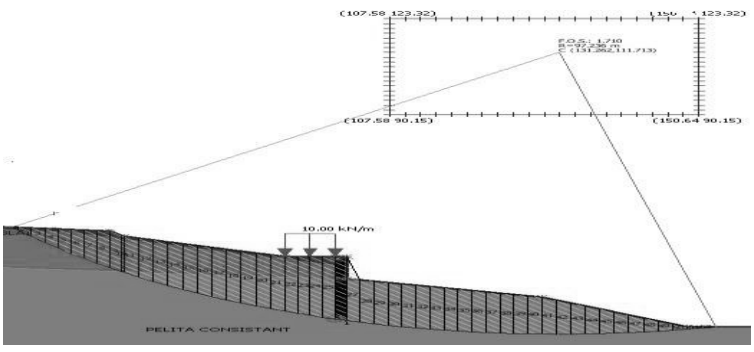

Figure 2*:* SLOPE model in

11. Comparison of risk rates before and after implementation of the solution:

Table 11: Risk rates before applying the solution in three areas

	Constant Coefficient	Ground cover when there is no earthquake effect		Ground cover when there is earthquake effect	
		Coefficient	Risk ratio %	Coefficient	Risk ratio %
Area 1	1,5	0,878	42%	0,592	60%
Area 2	1,5	0,84	44%	0,56	62%
Area 3	1,5	1,25	16,66%	0,73	42%

In the above table, we have found the coefficient and the rate of risk in the construction site. The table shows the risk of high landslide in all regions. A test which was conducted with sloppy program was applied to reduce the rate of concrete piles, after the application the risk has fallen as follows:

Table 12: Risk rates after the implementation of the solution

	Constant Coefficient	Safety coefficient	Risk ratio%
Region 1	1,5	1.710	0%
Region 2	1,5	1.822	0%
Region 3	1,5	1.541	0%

According to the results, the safety coefficient is higher than the constant coefficient, reducing the risk, and in this case, the risk is reset. To this date, concrete pile continues to be the best solution to reduce landslide despite its expensive cost, and it is recommended to be used as a solution for large projects located in slippery areas (coastal or mountainous areas etc.).

12. Conclusion

In order to overcome the risk of soil slippage, two solutions are suggested, retaining wall and bored pile application, but in this project concrete pile is preferred because after the analysis it was determined that the retaining wall is reversed.

After making two different designs, the financial cost difference between the retaining wall and the concrete pile is compared. In order to do this, all measurements of the retaining wall and the concrete pile were taken and the costs of both concrete and steel was calculated for each cubic meter. The results showed that the total cost of retaining wall was € 123.347, and the total cost of concrete pile was 188.559 €.

The cost of concrete pile is higher compared to that of the retaining pile, however in order to ensure the safety of the tourism project as well as the lives of the tenants and protect them from any future danger, the owner deemed it necessary to apply the concrete pile technique.

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