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Landslide Mitigation of Jaweh Dam Project

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Abstract: Jaweh project is a dam construction project. Jaweh is a major tributary of Gheshlagh originating from Jaweh. Its confluence with Gheshlagh is just above the Gheshlagh reservoir. Landslides are aggravated by human activities. Deforestation, cultivation and construction. In this paper, different methods, which are used for landslide controlling in Jaweh dam construction sites, are presented. The findings show that best mitigation methods for Jaweh dam site are concrete diaphragm walls, shooting concrete walls and dynamic compaction.

Key words: Jaweh dam · Landslide · Concrete diaphragm · Shooting concrete

INTRODUCTION

Generally, risk controlling is the process of measuring, or assessing risk and then developing strategies to manage the risk. It is followed by coordinated and economical application of resources to minimize, monitor and control the probability and/or impact of unfortunate events [1] or to maximize the realization of opportunities. Risks can come from uncertainty in project failures, accidents, natural causes and disasters [2, 3]. Once risks have been identified and assessed, all techniques to manage the risk fall into one or more of four major categories: Avoidance, Reduction, Sharing and Retention [4].

Megaprojects are extremely large scale investment projects. Megaprojects include bridges, tunnels, airports, power plants, dams, etc. Megaprojects have been shown to be particularly risky in terms of finance, safety and social and environmental impacts. Risk management is therefore particularly pertinent for megaprojects and special methods and special education have been developed for such risk management using different methods such as information technology [5-8].

A landslide is a geological phenomenon which includes a wide range of ground movement, such as rock falls, deep failure of slopes and shallow debris flows, which can occur in offshore, coastal and onshore environments. Although the action of gravity is the primary driving force for a landslide to occur, there are other contributing factors affecting the original slope stability [9-11].

Landslide is one the most important problems that can harm site mobilization. Thus, it should be identified in a large project such as dam construction. Jaweh dam project is a project which is held in Iran. Jaweh is a major tributary of Gheshlagh originating from Gheshlagh. In this paper, the Jaweh dam project's major risky zones involved in landslide are identified and presented to reduce the site mobilization risks.

Site Mobilization Management: Site mobilization management is an interdisciplinary field primarily devoted to optimize facility placement. Risk reduction can be achieved by optimizing the place of facilities such as batching plants and crushing plants. It causes to minimize noise pollution which improve the health of workers. The duty includes managing the facilities placement to keep risks down using the best arrangement of facilities. This duty can be assisted by computer programs.

Risk Management: Risk management is very often applied in engineering, but all sciences have risk management. In ideal risk management, a prioritization process is followed whereby the risks with the greatest loss and the greatest probability of occurring are handled first and risks with lower probability of occurrence and lower loss are handled later [12].

In practice the process can be very difficult and balancing between risks with a high probability of occurrence but lower loss vs. a risk with high loss but lower probability of occurrence can often be mishandled.

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Fig. 1: Zone 1 landslide risky zones

Fig. 2: Zone 2 landslide risky zones

There are different methods to control a project risk such as risk avoidance, risk reduction, risk retention and risk transfer [13-15]:

Landslide: Humans have historically used soil as a material for flood control, irrigation purposes, burial sites, building foundations and as construction material for buildings. First activities were linked to irrigation and flood control, as demonstrated by traces of dykes, dams and canals [16].

Landslides occur when the stability of a slope changes from a stable to an unstable condition. A change in the stability of a slope can be caused by a number of factors, acting together or alone [17]. Natural causes of landslides include, groundwater pressure acting to destabilize the slope, erosion of the toe of a slope by rivers or ocean waves, weakening of a slope through saturation by snowmelt, added earthquakes loads, volcanic eruptions and loss or absence of vertical vegetative structure, soil nutrients and soil structure [18].

Landslides are aggravated by human activities. Human causes include, deforestation, cultivation and construction. Main human causes include, vibrations from machinery, blasting, earthwork which alters the shape of a slope, removal of deep rooted vegetation and construction.

Fig. 3: Zone 3 landslide risky zones

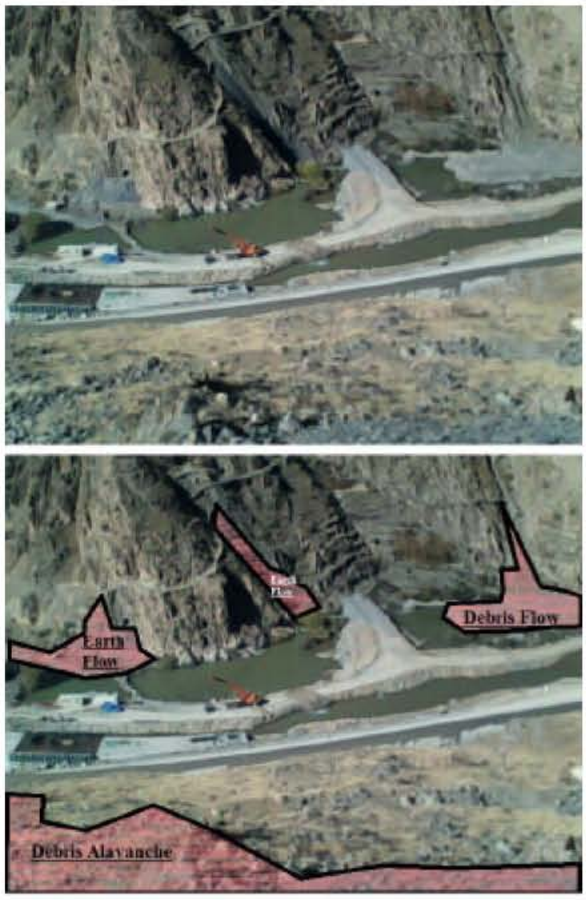

Fig. 4: Zone 4 landslide risky zones

Jaweh Dam Landslide Types: Jaweh dam construction site is involved with three different types of landslide. They are listed below (Figures 1 to 4).

Debris Flow: Slope material that becomes saturated with water may develop into a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses and cars, blocking bridges and etc.

Earth Flow: The main causes of earth flow can be fine aggregates such as clay, fine sand and silt. The earth flow which is usually caused by fine grained materials, moves in downward direction at any speed varying from very slow to fast rate. Typically, the speed is from 0.17 to 20 km/h. The earth flow is look like a mudflow and carries solid materials within flow. The velocity of the earth flow is depending on amount of water. Thus, when there is more water content in the flow, the velocity will be higher.

Debris Avalanche: A debris avalanche is a type of slide characterized by the chaotic movement of rocks soil and debris mixed with water or ice (or both). They are usually triggered by the saturation of thickly vegetated slopes which results in an incoherent mixture of broken timber, smaller vegetation and other debris. Debris avalanches differ from debris slides because their movement is much more rapid. This is usually a result of lower cohesion or higher water content and commonly steeper slopes.

Jaweh Dam Landslide Mitigation: Landslide controlling is soil improvement and all geotechnical applications in the construction area. Target project list includes subway stations, railroads, bridges, tunnels, expressways, dams, etc. as well as industrial facilities, power plants, petrochemical complexes, refineries and others. Landslide controlling can be achieved by many different ways. However, there are useful methods which are used in Jaweh dam and are listed below:

Concrete Diaphragm Walls: There is many different types of concrete diaphragm walls. They may or may not be a structural member. These retaining walls mainly used to fill the excavated soil. Generally the nonstructural walls are used for the containment of water flows and for protecting contaminated zones.

The concrete diaphragm walls can be constructed from the surface by means of an excavation clamshell, in thickness that goes from 0.50 m to 1.50 m. As far as the depths, they can constructed up to 50 m.

In order to guarantee the stability of the structural walls, anchors are installed, in anticipated soldiers as the soil excavation process is made. The anchors can be provisional or definitive, depending on the later use of the wall (Figure 5).

Fig. 5: Concrete Walls

Fig. 6: Shooting concrete Wall

Shooting Concrete Walls: These are retaining structures, which can be used for slope protection, or as support for the excavation of structures under earth (basements, underground stations such as subways, etc). Depending on the use, the screens can or cannot contain anchors and these can be provisional or definitive according to the case. The first step in construction of screens is the soil excavation proceeds and the second step is outlining and combing. After that, the wall is reinforced by means of meshwork or steel skeleton. It is followed with the shooting concrete over the surface until the required thickness is reached, this technique prepare the surface allowing variable shapes (Figure 6).

Dynamic Compaction: This is a technique that improve the soil in different depths. It is especially useful for industrial and commercial developments.

The procedure used, consists on dropping great weights of several dozens of tons, repeatedly towards the soil from a high altitude.

Fig. 7: Dynamic compaction

Before getting to work, a complete study of the soil is made, where the weight and the height of the load are determined, as well as the location of each point of compaction (Figure 7).

Grouting: This technique is used to improve the ground capacity (especially of highly saturated sands, mud and clays).

This method is used in the same cases of compaction columns, nevertheless, those are used previous to the construction time when more efficient - and the compaction grouting, when the construction has already taken place.

The methodology consists in making the soil perforation, using drill bits and water, leaving the casing tube. When the design depth is reached, the injection of the mortar begins, which must be solid enough, but plastic simultaneously.

The mortar, which is pumped through the casing left in the perforation, makes the soil compaction by the pressure practiced against it.

CONCLUSION

There are four different ways to risk controlling. For the purpose of Jaweh project landslide risk control, the first step is to find the risky zones. In other word, the risk controlling is achieved using risk avoidance.

As it can be seen from results the main risky zones are located at high levels of the site. It is clear from results that about 30% of the site zones involved in risky landslide. In addition, about 60%, 35% and 15% of all risky zones are involved in Debris Avalanche landslide, Earth Flow landslide and Debris Flow, respectively.

In this paper, different methods, which are used for landslide controlling in Jaweh dam construction sites, are presented. The findings show that best mitigation methods for Jaweh dam site are concrete diaphragm walls, shooting concrete walls and dynamic compaction.

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