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Design of Waste Disposal Site and its Management in Marble Quarry Site

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Abstract

The Dichinama marble quarry is one of the largest marble producing sitesTigry in Ethiopia. This research is focused on the designing of the waste disposal site and waste management of Dichinama marble quarry site which is located at the North Western zone of Tigray specifically located at Tahtay Adiabo. Therefore the Dichinama marble quarry waste disposal site and waste management design should follow the basic parameters such as; following a systematic marble cutting method to minimize waste, to reuse the rejected blocks due to fracture, cavity and joints for road construction, for buildings (houses, bridges), for making bricks, concretes, terrazzo's by crushing and used to decorate floor of buildings and for making engineering stones. We use also the powder resulted from drilling and crusher for agricultural purpose to neutralize the acidic soil to increase the fertility of the soil. We can fill using different color chemicals to the fractured part of the rejected block to increase its strength and suitable for Gang saw and Block cutter cuttings. Preparing a waste disposal area out of the mineralized zone, the area should be free of agricultural activities; the waste disposal area should be near to the quarry site and well-studied of Geotechnical properties. By following the above basic points we can design our waste disposal site and we can manage easily the blocks to the current global economy.

Keywords: Dichinama marble quarry; waste disposal;

Introduction

Mining is the process of extracting minerals and dimensional stones that forms and concentrates naturally in the earth. The Dichinama marble quarry is a type of surface mining, it is the predominant exploitation method worldwide. Quarrying is a special type of surface mining used to produce aggregates and dimension stone products. In dimension stone quarries, rock joint fractures are infrequent, and, therefore, the bench faces are vertical (Vinita. K, 1997). Quarry is expensive because a number of workers are employed for cutting the prismatic block. Common dimension stones are Granite, Marble, Limestone, Sandstone and slate in approximate decreasing order of difficult to cut because of difficult and cost associated with cutting stone, quarrying is the most expensive surface mining method and, square set stopping, the most costly mining method. Because of the highly specialized nature of dimension stone quarrying a customized

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cycle of unit operation is employed. Rock breakage is almost always accomplished without blasting, which tend to shatter and spoil the blocks of stone. (Howard L.Hartman, 1987).

Waste rock is hence durably unused extraction products that is generally stored indefinitely in a landfill site which, for economic reasons associated with transport Costs, is located in the immediate vicinity of the main mining center. The quantity of Mining waste that can be stored at a mining centre varies considerably and mainly depends on the selectivity of the mining method. As a rule, quarries generate much more mining waste. The main type of waste rock is generated by surface (or barren rock) stripping to expose the shallow deposit (Morgantown.Wv, 2006). This is rock that is weathered to varying degrees, although increasingly fresh with depth and showing the geological characteristics of the local surrounding material. Its composition is similar to the rocks of the sector. It is hence important to distinguish between harmless impact, or harmful chemical impact or pollution, and harmful physical impact or detriment (Chase.F.E, 2002). Mining-selected waste (or simply mining waste) can be defined as a part of the materials that result from the exploration, mining and processing of substances governed by legislation on mines and quarries. It may consist of natural materials without any modification other than crushing (ordinary mining waste, unusable mineralized materials) or of natural materials, processed to varying degrees during the quarry-processing. Overburden and topsoil are classified as wastes in the following figure 1.The general objective of this research is to design the waste disposal site and its management of the Dichinama marble quarry site.

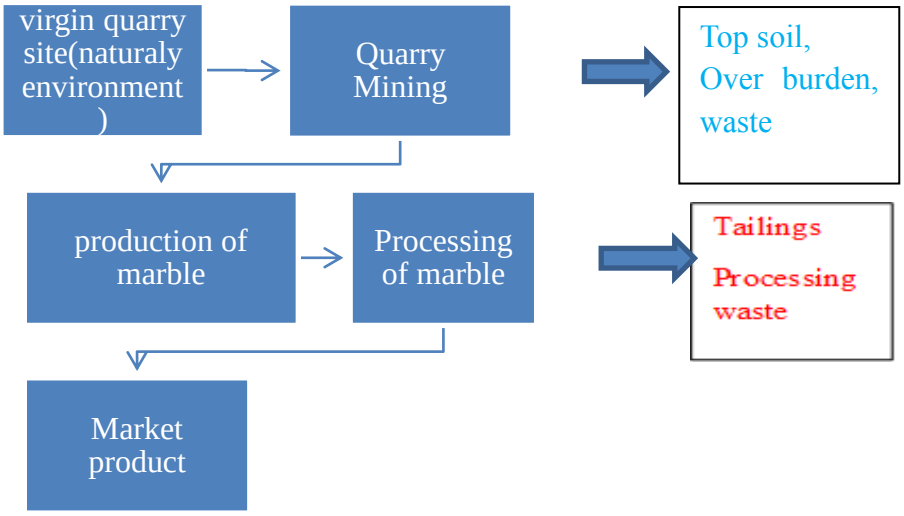

Figure 1: Mining waste types

Geology of Dichinama marble Deposit

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The marble belts of Dichinama Elawedizeray marble deposit is covered with Meta sediments. That is marble bounded by chloritic and phyllitic schists. The Elawedizeray deposit consists of a topography oriented with foliation and litho logical contact in the surrounding rocks dipping to the NW at 60^0.The study area is characterized mostly by the basement complex rocks which are Precambrian metavolcanics (Amphibolites, Chloriteschists, Greenstone etc) and Precambrian Meta sediments (Quartzite, Phylites, slate, marble etc). Those rock units were intruded with syntopost granitoides. The Precambrian Metavolcanic sediments and granitoids are good source of dimensional stones besides hosting precious and base metal minerals. The area is characterized by joints, fractures, cavities, schists, and a mega fold structures in the quarry site. The study area rock units are metamorphic rocks. In the area a quarry surface mining is in progress different drilling methods and cutting techniques, excavating and hauling materials. Rock breakage is occurring usually by drilling, and cutting, following by the material handling operations of excavation and haulage. Quarry is specialized and less frequently used method where breakage is achieved by alternative means of cuttings.

Elawedizeray deposit consists more quartz vein and it has a mountain topography dipping towards north direction. Metamorphism is a mineralogical and textural change that occurs in the rock in the solid state as a response to changes in environmental variables especially temperature and pressure. Metamorphic rocks are rock that developed their mineralogical and structural characteristics by metamorphic processes (Metamorphism). Therefore, the study area found in Dichinama is covered by different degree of weathering and alterations each Metamorphic units have its own color, Metamorphic structure and degree of weathering and alterations.

Mining method of Dichinama marble quarry

The Dichinama marble quarry is a type of surface mining. Surface mining is the predominant exploitation method worldwide. The products of all dimension stone quarries are nonmetallic. Common dimension stones are Granite, Marble, Limestone, Sandstone and slate in approximate decreasing order of difficult to cut because of difficult and cost associated with cutting stone, quarrying is the most expensive surface mining method and, square set stopping, the most costly mining method. Because of the highly specialized nature of dimension stone quarrying a customized cycle of unit operation is employed. Rock breakage is almost always accomplished without blasting, which tend to shatter and spoil the blocks of stone. Dimensional stone quarrying produces from deposit prismatic blocks of mineral which are both roughly sized and shaped. Quarries resemble open pit, but the benches are lower and nearly vertical. Elawedizeray has four benches. But the bench height varies from 4 to 6 meters in figure 2.

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Figure.2. Elawedizeray Quarry site and benches

Methodology

The methods used to conduct the field work are classified as pre field work, during the field work, and post field work. 1. Pre-field work**:** before starting the field work, taking course was not the only thing that was done as preparation. We talked to other followers who just have done the field work a year before us about the place we gathered some information and from our teachers, preparing the instruments which are needed for the field work. 2. During field work**:** during the field work we measure the following: The strike, dip and dip direction. Taking photos and positioning oneself are some of the tasks. The elevation of the waste disposal site. Collecting data's and basic information's about the company. We also measure the areal extent of the marble deposit to decide where the waste disposal area will be designed.

Results and Discussion

Field observations: Elawedizeray marble deposits have two types of colors. These are multicolor and purplish white. These different colors of marble have their own specific gravities.

Multicolor marble: the colored marble at lidge site varieties are usually due to various mineral impurities such as clay, silt, sand, iron oxide which are originally present as grains or layers in the limestone. This multicolor marble is expensive than others. It has 2.73 specific gravity.

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Purplish white color marble: this coloration is often due to the presence of red slate, red iron, red phylites and other type of soil which recrystallized by the intense of high heat and pressure of the metamorphism. It has 2.75 specific gravity.

Design of Waste disposal site

Quarry Waste dump is an area in which a surface mining operation can dispose of low grade and/barren. The first step in designing a dump is the selection of a site that will be suitable to handle the volume of waste rock to be removed during the mine life; site selection will depend on a number of factors, the most important of which are: Quarry location and size through time, Topography, Waste rock volumes by time and source, Property boundaries, Existing drainage routs, Reclamation requirement, Foundation conditions, Material handling equipment

Elawedizeray site is found in remote area and there is no agricultural land around it. Due to these reasons the quarry site have not lease boundary. They can mine all the area whatever they want. The Tigray ministry of mine bureau is not give attention for such quarry mining site. Because if the company did not have mine lease boundary, it can disturb the entire environment near the quarry. The Elawedizeray marble quarry has a poor waste disposal site and waste management. In the site all the wastes are found everywhere mixed the soil, blocks, tress and others. But this is not good for next generation. We understand this problem and we forced to solve it by designing well. Since mining waste is the material which affects the environment. Example: it can pollute the air and the water of surrounding environment. It can change the land, habitat, ecosystem and organisms drastically and disturbs the whole environment near the quarry site. We create awareness to the quarry workers about the effect of waste. We mining engineer students decided to dispose all the quarry waste in a separate waste disposal site. Then we will design the following four independent disposal sites (Vinita, K 1997).

Site-A: Design of stock yard site: As shown in figure-3&4 this is the place where the finished marble blocks or the completely squared blocks are kept. This site cannot keep any other waste material. It must be free of rock fragments to move the trucks and the loaders smoothly. This area has 1055 meter elevation above sea level and has higher elevation than others. Because to make it free of flood during summer time and other wastes of the quarry. This site is also free of streams, water body, fault and other vegetation’s.

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Figure -3. Stock yard

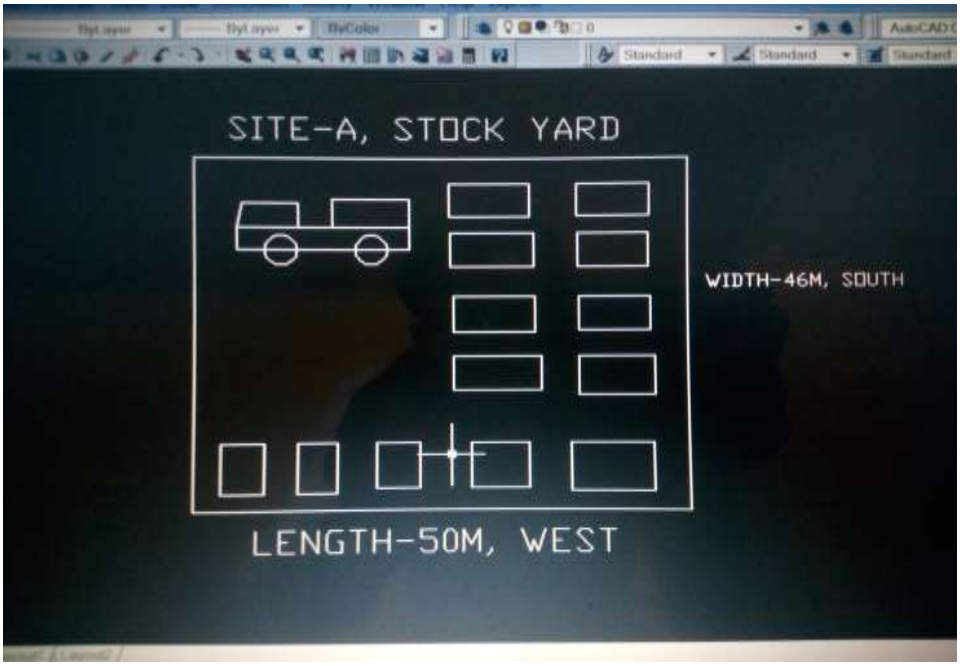

Figure 4. Auto cad Design of quarry stockyard site

Site-B: design of soil and other broken marble fragment particles site: As shown in Figure 5 & 6 this site is found between the stock yard and completely rejected blocks with more discontinuity site. This site keeps spoil soil, broken marble wastes and other waste rocks. It is free of erosion, flood and faults. The elevation of this site is 1039 meter above sea level. This site is found in opposite direction to the quarry face in west direction.

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Figure 5. The selected site for disposal of soil and other broken marble fragment

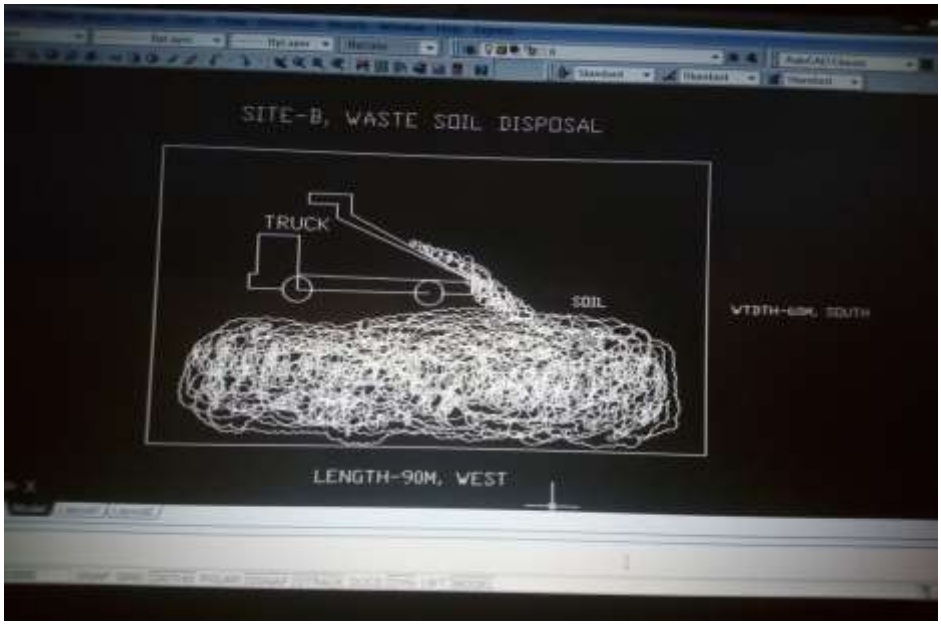

Figure 6. Auto cad design of soil and other broken marble fragment site

The important criteria's to design the waste disposal site are the following:

a. Deck height 30m b. Berm width 30m c. Deck slope $37½^0$ d. Overall slope 28^0

Site-C: Design of completely rejected blocks with more discontinuity site: As shown in Figure 7 & 8 this site keeps the rejected blocks due to more fractures, schists, cavity, intercalation of materials and incorrect spot line. This area is also free of streams, faults and other geological discontinuities. It is found between the Soil and other broken marble fragment particles site and rejected blocks with less discontinuity site. It has 1036 meter elevation above sea level. This site is found in opposite direction to the quarry face in west direction.

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Figure 7. The selected site for the disposal of rejected blocks with more discontinuities

Figure 8. Auto cad Design of rejected blocks with more discontinuities

Site-D: Design of rejected blocks with less discontinuity site: As shown in Figure 7 & 8 this site is found to the north direction of completely rejected blocks with more discontinuity site. It has 1038 meter elevation above sea level and keeps rejected blocks with less discontinuity to use using some advanced technology to increase the recovery of the marble.

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Figure 9. The selected site for disposal of rejected block with less discontinuities

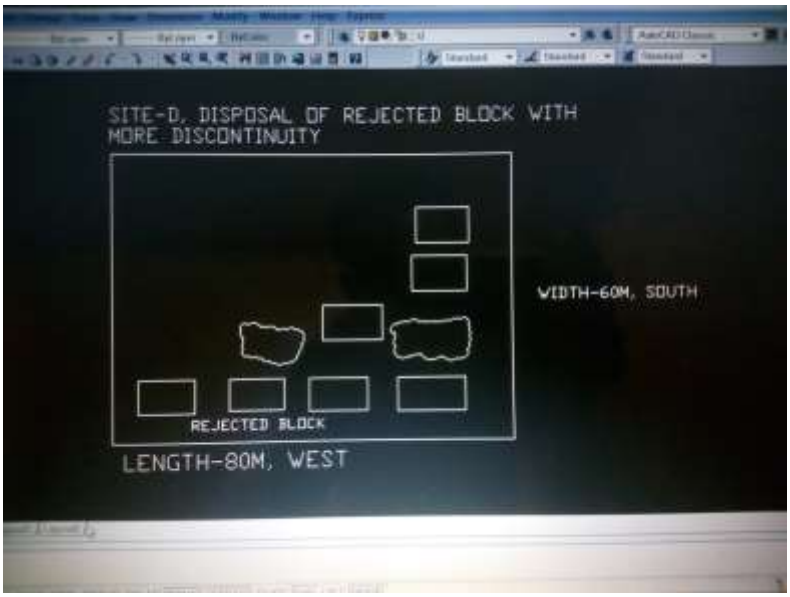

Figure 10. Auto cad Design of rejected block with less discontinuity

Generally, design of the waste disposal site and its management will be provided to develop modern quarry waste management system in the area and this study will have a great role in improving the socio-economic level of the society and enhances the income of the company.

Conclusion

Dimensional stone quarrying produces from deposit prismatic blocks of mineral which are both roughly sized and shaped. Quarries resemble open pit, but the benches are lower and nearly vertical. The uncontrolled disposal of quarry waste can have a major impact on the environment.

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In most quarries waste can be disposed of internally in worked out parts of the site. Proper planning of operations can achieve progressive working and restoration. If wastes have to be disposed of outside the site they should be used to restore adjacent derelict sites, subject to appropriate environmental safeguards and subject to a separate planning permit. Preparing a waste disposal area out of the mineralized zone, the area should be free of agricultural activities; the waste disposal area should be near to the quarry site and well-studied of Geotechnical properties. By following the above basic points we can design our waste disposal site and we can manage easily the blocks to the current global economy.

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