Testing For Strength and Vibration of Rocks in Quarries using Geophone

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***Abstract*— Drilling and Blasting during tunneling may generate vibrations causing architectural or structural damages to adjacent structures. These vibrations may also cause disturbance to nearby residents. Thus the vibration cause concern to Engineers and developers aiming to ensure an environment-friendly construction advance. At times, the construction works at sites have been found to end in disputes due to either drilling and blasting during tunneling activities crossing permissible limits of vibration or false complaints from nearby residents. This leads to the stoppage of construction activity causing delay and monetary losses. To obtain a warrented solution for this and to avoid cracks that may occur to the building near to the tunnel, a proper vibration measurement and monitoring system needs to be employed at the location of dispute. Based on the maximum vibration intensity, isolation of building from the effect of vibration can be done. The transducers currently available for the evaluation of vibratory motion include velocity pickups, Geophones and accelerometers. Present techniques are very expensive making them rather uncommon in practice. There is a need for an economic and reliable alternative system for vibration measurement of ground and design of isolation system.**

Keywords: Brazilian test, Point load index test, Geophones

I.INTRODUCTION

The ability of rock to sustain significant loads gives a general Impression that it is an excellent material from the construction point of view. This is true for a rock mass often. But defects are present in rocks, resulting in the strength of rock mass being considerably less than that of intact rock. Defects may be jointing, bedding on microscopic, macroscopic or megascopic depending on the scale of the project. The large number of hydroelectric and other projects in Himalayas have provided a good opportunity to study challenging problems in rock engineering. Recent and proposed projects in the Malabar region in the neighborhood of Western Ghats have brought about a demand for the study of rock properties and their behavior under engineering loads. This project is a step in that direction. Design and construction in rock requires an understanding and estimates strength in compression, tension and the anisotropy of rock which plays a major role in the engineering response behavior under expected loading conditions. Various studies based on vibrations are done by different researchers. Kahriman. A and Gorgun.S. (2000) studied to determine the maximum amount of explosive per delay and also Estimated the Peak Particle Velocity and other components of ground vibration. They found that for 149 blast events the determined frequency values are 7% less than 10 Hz,63% between 10–30 Hz,12% between 30-50 Hz and 18% bigger than 50 Hz respectively and Low frequency vibration is more damaged than high frequency vibrations. Tobita Jun and Fukuwa Nobuo(2009) they Clarifies the characteristics of vibrations transmitted to the soil and effects of vibrations on nearby buildings and effect of vibration on a typical high-precision instrument and to determine ways in which vibrations can be mitigated. They found that 5 Hz was the natural frequency of the HVEM isolation table, it was predicted that the HVEM would be disturbed by vibration while excavations were conducted within 60m and 40m ie; main tunnel and drifts respectively. Amick Hal and Gendreau(2000)They study reviews and compares several forms of vibration limits applicable to construction vibrations and It includes a methodology for calculating the propagation of spectral data. They used different types of vibrators for compaction and they obtained the result that The three vibratory compactors produced nearly the same vibration amplitude at 15 m and the attenuation with distance was dramatically different because of the frequency-dependence of the soil's damping and also the minimum buffer distance for the 12.5 Hz compactor was 2.5 times that for the 40 Hz compactor.

T T Balaje(2004) defines the instrumentation to measure responses of a wide variety of structural effects due to vibrations and discusses as how sophisticated instruments were used to measure the ground vibration induced by pile driving. He found that the typical impact load is maximum at ten second with an impact load of 2800 Kg and horizontal acceleration of particle is more during impact. Adhilla Ainun Musir and Abdul Naser Abdul Ghani (2013) had study to identify the various physical parameters involve in the propagation of vibration energy that affect surrounding building or structure by means of laboratory model. They found that the Maximum vibration level that obtained by 7.5 X 7.5 mm piles at the top and bottom of building model is 4394 mV/g and 5656 mV/g respectively and maximum vibration level that obtained by 10 X 10 mm piles at the top and bottom of building model is 5061 mV/g and 6241 mV/g respectively. J.R. Dungca and D.Y. Acosta(2016) determine the different levels of risks that neighbouring structures that may exposed to ground vibrations at different distances away from the vibration source. He found that the highest vertical PPV value obtained in medium dense silty sand layer situated 0-1.75 m below the ground surface and Decline of the vertical PPV was in stiff clayey silt layer and the frequencies of the vertical PPV measurements ranged from 6 Hz to 15 Hz, having an average frequency of 9.33Hz.Dong-SooKima and Jin-Sun Lee(2000) study the ground vibrations induced by train loading, blasting, friction pile driving, and hydraulic hammer compaction is done and the attenuation characteristics of vibration sources were investigated considering the source characteristics and the geotechnical properties of the sites. They found that the most of the energy in the blasting induced vibration exists at frequencies below about 50 Hz and the PPV has range of 1.5 to 2.5 cm/s for a horizontal distance of 32 m. Then the train induced frequency measured on the ground was widely distributed in the ranges from 7 to 70 Hz. Mark R. Svinkin(2004) done mitigation measures for structural vibrations and to find alternate construction procedure and also to find the important role of instrumentation. They found that the most Peak Particle Velocities of ground vibrations higher than about 51mm/s for frequencies of 2-30 Hz and all PPV obtained in the frequency range of 30-450 Hz.

II. SCOPE AND OBJECTIVE

The development of an economical wireless triple-axis vibration measurement system using piezoelectric accelerometers has been the primary motive of this study. The system is used to take the vibration intensity during the time of blasting. The attenuation properties of different vibration characteristics have been studied in the peak velocity and acceleration criteria, as well, into the triple-axis component levels. The vibrations at sites have been examined for conformance to the safety standards with regard to the building damages as well as human response caused by the levels of vibration and if it is crossing the vibration limiting value, then to avoid cracks that may occur to the building near to the quarries, a proper Isolation methods can be used to protect the buildings near the quarrying areas.

III METHODOLOGY

A. *Preperation of rock samples for Brazilian test*

Cutting, grinding and polishing of natural stones are done by grinding mechanism developed using different abrasive grains (mostly diamond and silicon carbide). Cutting ,abrasing or polishing depends on the speed, chip size and situation of obtained surfaces. Rock samples are cut into desired shape and size using the cutting machine. Rock samples with 54 mm diameter and 27 mm thickness prepared for Brazilian test.

Fig. 1. Rock samples for Brazilian test

TABLE I . ROCK TEST RESULTS

Brazilain Tensile strength	6.02 MN/m^2
Uniaxial compressive strength from correlation	63.88 MPa
Uniaxial compressive strength from point load index test	66.53 MPa
Pore volume,V_V	6x10^{-4} cm^2
Porosity,n	0.097 %
Dry density,P_d	27.36 KN/m^3

TABLE II . CORRELATIONS BETWEEN UCS AND TENSILE STRENGTH

References	Correlation	R or R^2	Rock Type
Kahraman et al(2012)	$UCS_{(MPa)}$=10.61*BTS	R^2 =0.5	Different rock types including limestone
Farah(2011)	$UCS_{(psi)}$=5.11*BTS-133.86	R^2=0.68	Weathered limestone
Altindag and Guney(2010)	$UCS_{(MPa)}$ =12.38*$BTS^{1.0/25}$	R=0.89	Different rock types including limestone

A critical review on the degree of accuracy of recent correlations between UCS and BTS shows that apart from Kahraman`s correlation, other correlations either overestimate or under estimate UCS of rock samples to a significant amount.

UCS obtained is 63.88 MPa and it is between 50-100 MPa ,and if the value is between these range then it is strong rock.

B. Preperation of rock samples for Point load Index test

Rock samples with 45 mm diameter and 63cm height is used for the point load test

Fig. 2. Rock samples for Point load Index test

The point load strength index of the rock was calculated from failure load, by the following formula:

$Is(50) = f.F/D_e^2$

f = size correction factor

F = failure load

D_e = Equivalent core diameter

If the dry density of a rock is between 26.5 and 27.5 KN/m^2 , then the rock type is granite which is a strong rock ie.,Drilling and Blasting is the only method that can be used for Tunneling in Kuthiran Hills.

C. SOIL

The soil is collected from the Kuthiran Tunnel site at a depth of 10 cm from the ground. The field density of the soil is 1.28 g/cc.

V. CONCLUSION

Due to the increase in population and rapid urbanisation of India have resulted in increased vehicle usage and transportation facilities that causes traffic congestion and problems. A case study of prominent urban intersection – Baker junction Kottayam was taken as a case study to propose the methodology for solving traffic problems in in developing countries. Field survey were conducted and pedestrian movements and traffic volumes were collected. Analysis of the collected data shows that improper markings, signals were the reason for the traffic congestion at Kottayam baker junction.

VI. REFERENCES

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