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**EFFECTIVENESS OF USING ROLLER-BIT BUCKETS
TO MINIMIZE GROUND VIBRATION GENERATION
IN BORED PILING**

By

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Abstract

Ground vibration induced during the construction work becomes annoying for the neighboring community and eventually a great headache for the project management team due to continues complaints from the community. This study focused on the ground vibration generation during in-situ cast bored piling, since bored piling is becoming popular and mainly going on in highly urbanized areas. Effect of vibration to public can identify in two different ways as perception levels of vibration to human body and the effect of vibration to dwellings or any other structures, which cause public alert on vibration. The defined levels for either case is taken from the "Transportation and construction vibration guidance manual" released by California Department of Transportation in 2013 and ISO 4866:1990 (E) standards which also accepted by the Central Environmental Authority of Sri Lanka.

Generally, in bored piling, the ground vibration is generating when drilling through rock layers, especially in hard rock layers. A tool called core barrel is used to cut the perimeter of the rock. To cut the rock a special part is attached to the core barrels called a "Bullet teeth" which is consisted with tungsten carbide tip. Another option available for bullet teeth is called the "Roller bits" which consists of Tungsten carbide tips and use a different mechanism from bullet teeth. This study focused on the comparison of the effectiveness of tools with "Roller bits" and tools with "Bullet teeth" in terms of cost and time consumption and in terms of minimization of public nuisance. In this study a construction site was identified which adopted both types of tools in two different phases of the same project. It was observed that the other factors were same for both phases and the comparison was mainly on the two tool types used.

Based on the vibration levels obtained through site vibration measurements, it is found that the levels of vibration generated during piling operation has affected human perception levels which make them annoying according to "Transportation and construction vibration guidance manual" released by California Department of Transportation in 2013. And the level of vibration generated has exceeded the level stipulated by the Central Environmental Authority of Sri Lanka for Category 4 structures and Category 3 structures for certain occasions.

From the study it is found that the penetration rates are almost same for both cases but the difference in cost for pile shows apparently higher in the case 1, which was done with "Bullet teeth". The difference in cost is about 3.9% approximately. It is found during the cost analysis that the difference is mainly due to the cost of rectification work in the case which used "Bullet teeth" tools for pile boring. And the summary of field vibration monitoring also shows a reduction of about 20% in the average of maximum values, in the case which used "Roller bit" tools for boring work. Based on above findings it is beneficial to use "Roller bit" buckets for bored in-situ cast piling operations instead of "Bullet teeth" tools, especially in highly urbanized areas with sensitive buildings.

From the data obtained in this study based on the consumption and unit price, it is noted that the difference in the cost of Bullet teeth and the Roller bit is about 15.1% higher in using Roller bits. Hence it is important to monitor the performance of operation closely with the consumption of "Roller bits" since the consumption may vary with the operating skill of Rotary drilling machine.

Key words: Ground vibration, Piling, Bullet teeth, Roller bit, Public nuisance

Acknowledgement

This research is about the ground borne vibration during bored piling activities, which using most of the construction projects in urban areas with the boost in infrastructure development in the country in post war period. outcomes of the study will be helpful for the developers, contractors and specially the project management teams who engage in piling activities in construction projects.

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List of Abbreviations

CEA : Central Engineering Authority

ISO : International Standards Organization

BSI : British Standards Institute

UK : United Kingdom

ANSI : American National Standards Institute

US : United States of America

CECB : Central Engineering Consultancy Bureau

PPV : Peak Particle Velocity

RCD : Reverse Circulation Drilling

VdB : Velocity level in decibels

UCS : Unconfined compressive strength

Sec : Seconds

Rms : Root-mean-square

R-wave: Rayleigh wave

S-wave: Shear wave

Hz : Hertz

in/sec : inches per second

mm/sec: millimeters per second

MPa : Mega pascal



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