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Soil Improvement using 6 Sided Impact Roller

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Abstract

One group of devices for soil compaction are rollers. Static, Vibratory and impact rollers have the most practical applications among them. The latter has the greater depth of influence in comparison with the others. Hence, it has more effect in soil improvement than other traditional vehicles with fewer number of passes. So, numerical simulation of roller is suitable for recognizing its significant components. At to now, different shapes of rollers are examined in practice that have some problems in soil rehabilitation. In this paper, a new 6 sided impact roller is introduced and simulated with "F.E.M" based software "ABAQUS". Furthermore, its similarity with hammer in "W.A.K" test is studied. Results show that with increasing the faces of roller, impact surface of roller is increased and depth of improvement will be greater than ever.

Keywords: 6 Sided Impact Roller, ABAQUS, WAK, Soil improvement.

1. INTRODUCTION

The impact roller, as a relatively new earth compactor can improve soil behavior by low energy dynamic compaction. There is an interesting history behind the current shape of this compactor. A Swedish designer patented a towed impact roller of hexagonal cross-section in 1935, and his patent covered any form of non-circular towable mass. The description of the system in the patent still applies to all impact rollers today [1]. A brief history of the works done on roller impact compaction for improvement of soil characteristics have been proposed by Avalle, in 2004. In that literature, various experimental tests for monitoring and verification of impact rolling effects have been proposed. In 2005, Avalle and McKenzie, used Continues Surface Wave System for study of economical aspect of compaction by square impact roller and results showed that it is sustainable, environmentally acceptable and cost-effective solution [2]. Avsar et al., in 2006, showed that the average in-situ dry density increased by 8% after the compaction. They compared impact mechanism with traditional systems that is shown in Figure1 [3].

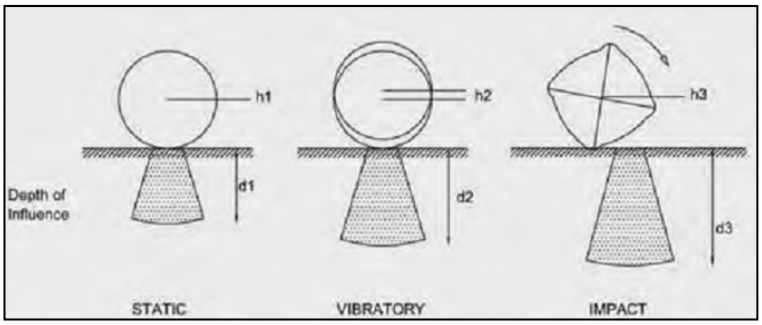

Figure 1. Mechanisms of static, vibratory and impact compaction [3]

In 2008, Scott and Jaksa tried to quantify influence zone of impact roller on clayey soil by measuring impact signals. They mentioned this zone is between 1m to 1.5m [4]. Jaksa et al., in 2009 in relatively high accuracy research quantified the energy delivered to ground after each impact of square roller that is approximately 137kN. Their research result is shown in Figure 2 [5]. In 2010, Bierbaum et al., in Adelaide University tried to determine the influence zone of impact roller by numerical method using Midas GTS software. They applied 137 kN or 91.3 kN/m force (from Fig. 2) over 1.5 m for 0.1 seconds to represent the