I J R B A T, Special Issue (X), March 2022: 01-06
A Double-Blind Peer Reviewed & Refereed Journal

OPEN ACCESS

e-ISSN 2347 – 517X
Original Article

Reg. No.: MH-NGP/00001

INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY

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EXPERIMENTAL STUDY OF STABILITY OF SLOPE UNDER DYNAMIC LOADING

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ABSTRACT:
The purpose of this research work is to investigate the effects of dynamic loading on soil slope. The Shake table was used to conduct the research, which provides a one-dimensional constant state of motion.vibrations. The following are the specifications utilised in the experiment Shaking acceleration (g), frequency (Hz), and dynamic loading, length of time (Cycles). The collapse of a slope is investigated using time-dependent crest settlement and toe displacementSlope profile at the start. The test was carried out on the frequency of 1 Hz, 1.2 Hz, and 1.4 Hz The acceleration range that was used was 15 mm, 20 mm, and 25 mm are the three sizes available. It was discovered that the soil mass had shifted.

Key words: - Dynamic loading, Shake table, Soil slope, Amplitude, Frequency.

INTRODUCTION:

In the subject of geotechnical engineering, the most hotly debated problem is determining the slope's safety under earthquake loading conditions. Because of the strong ground motion caused by the earthquake, the slope is severely damaged. To understand the behaviour of soil slopes under dynamic stress, it was necessary to examine the slope using several methodologies. However, due to a variety of obstacles, equipmenting the slope in the field is not always practicable, and slope stability is determined using displacement criteria that take the displacement time function into consideration. The conviction permits the use of complicated building soil models that take into account a variety of geotechnical factors.

TESTING EQUIPMENT AND MATERIAL:

Shake Table: The experimental work was done on a shake table which operates in only one direction (Figure 1). The size of the shake table top is 1.5m x 1.5m. It has a maximum load carrying capacity of 2000 kg. The maximum frequency is 10 Hz and maximum displacement is ±50 mm theroretically.

Soil container: For the experiment, we used a solid type container. The inside dimensions of the shake table were 1.0 m x 1.0 m x 1.0 m. It was made with 18 mm thick acrylic glass and flat and angle structural steel parts for reinforcement (Figure 1a). The inner limit of the container, perpendicular to the direction of shaking table movement, was lined with expanded polyethylene (EPE) foam. Strong industrial adhesives were used to adhere sand to the base, making it rough.

Absorbing Boundary: If a container's artificial borders aren't created properly, they can alter the soil's dynamic reaction. To reduce the boundary impact, an absorbing material was used on the boundary. In the current tests, the absorbing border was an EPE foam panel that was readily available. These foams were installed perpendicular to the shaking direction on both inner sides of the end walls. Lombardi et al. recommended a foam thickness of 25 mm (2015).

Material Properties: Two different types of material were used as a fill material i.e. fine sand and coarse sand (Figure 2).

SHAKING TABLE TEST RESULTS AND DISCUSSIONS:

Shaking table tests of model slopes are used to see how the slope reacts to changes in base shaking frequency and amplitude under dynamic loading. For all slope models, a 45-degree slope angle is used. Slope fill is made up of dry fine and coarse sand that has been tamped to achieve optimum compaction. Throughout all of the experiments, the slope height is kept at 300 mm. The finished slope of the models is shown in [figure 3], and the soil slope model is shown in [figure 4]. All of the slope models were evaluated with varying amplitudes of 15, 20, and 25 mm at frequencies of 1, 1.2, and 1.4 hertz.

The crest settlements and toe displacements are seen in shake table tests done on slope models at various frequencies and amplitudes, as indicated in table 1. The deformed slope of all 9 slope models is shown in [Figure 5], and it can be seen that the bulging occurs near the toe of all the soil slope models.

The crest settlement and toe displacement rise with the increase in frequency from 1 Hz to 1.4 Hz, according to the test results (Figure 6). The stability of slopes is also affected by the frequency's amplitude. The crest settlement and toe displacement rise as the amplitude increases.

CONCLUSIONS:

As the frequency rises, the crest settlement and toe displacement rises as well.

The crest settlement and toe displacement increase as the amplitude increases.

It is determined that as frequency and amplitude rise, the slope's stability decreases.

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Table1: Crest settlement and toe displacement after shake table test

Sr. No.	Frequency (Hz)	Amplitude (mm)	Time (sec)	Crest Settlement (mm)	Toe Displacement (mm)
1	1	15	8.52	26	36.66
2	1.2	15	6.88	36.66	65
3	1.4	15	6.23	53.33	95
4	1	20	7.44	28.33	55
5	1.2	20	6.54	45	95
6	1.4	20	5.83	61.66	106.66
7	1	25	7.92	32.33	65
8	1.2	25	6.95	56.66	103.33
9	1.4	25	6.41	68.33	136.66

Figure 1: Shake table and control panel

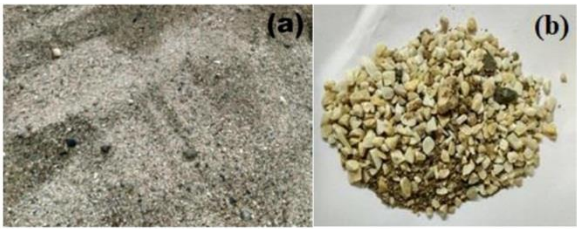

Figure 2: Material used (a) fine sand and (b) coarse sand

Figure 3: Finished slope model

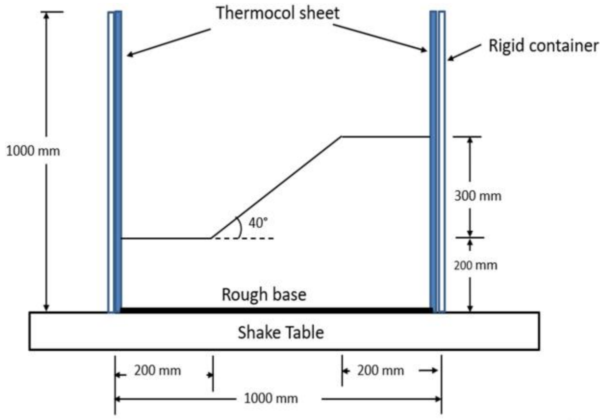

Figure 4: Schematic diagram of soil slope model.

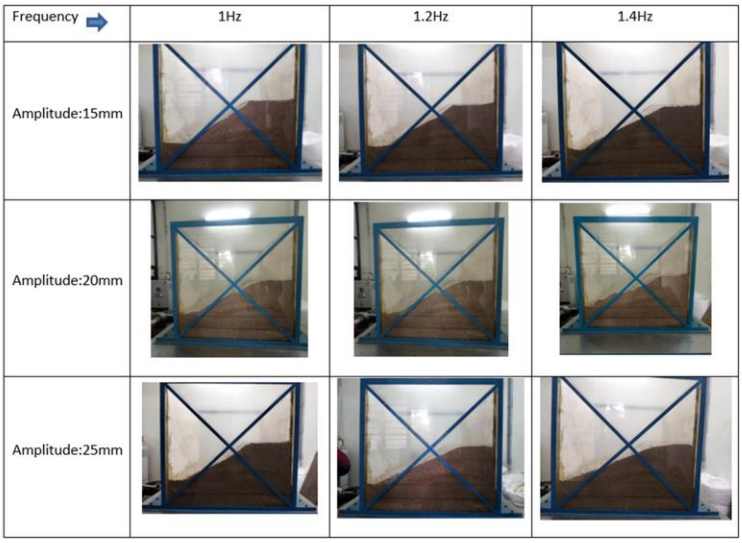

Figure 5: Deformed slope profile after application of dynamic loading.

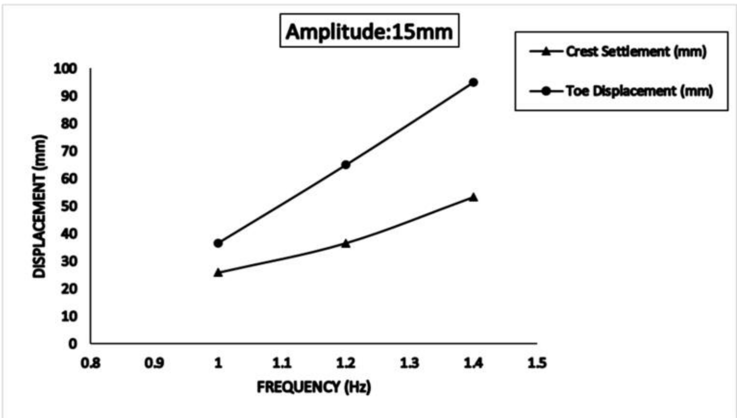

Figure 6 (a): Effect of frequency with amplitude of 15 mm on slope models

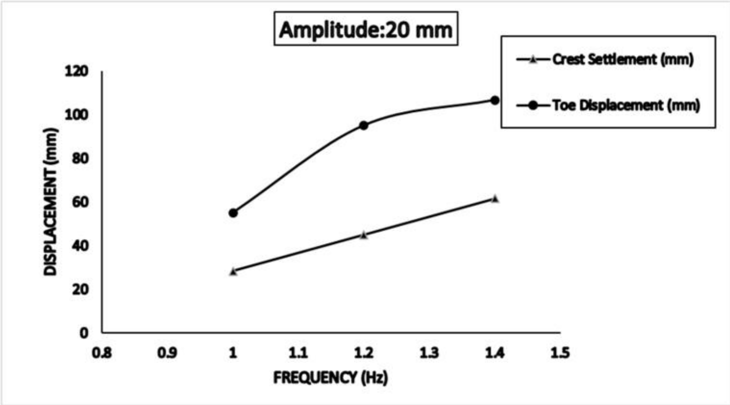

Figure 6 (b): Effect of frequency with amplitude of 20 mm on slope models

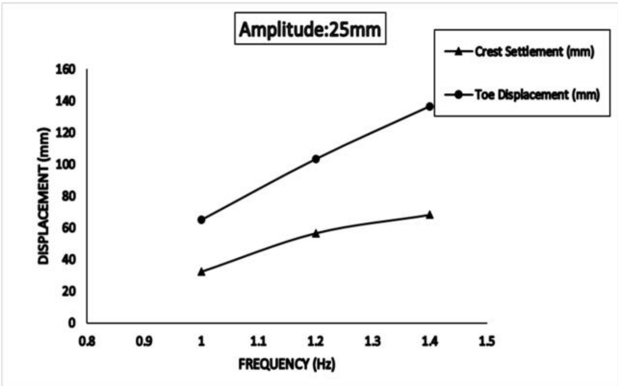

Figure 6 (c): Effect of frequency with amplitude of 25 mm on slope models.

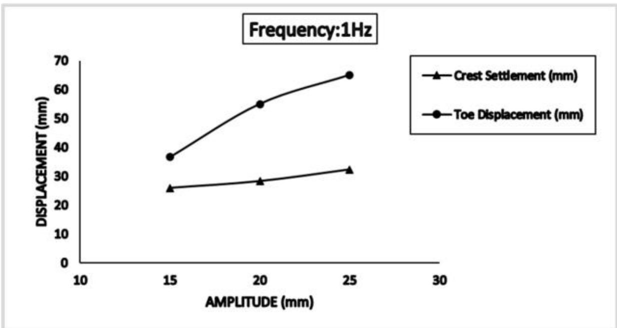

Figure 7 (a): Effect of amplitude with frequency of 1 Hz on slope models

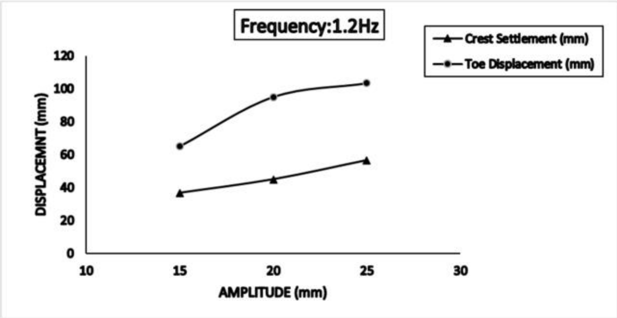

Figure 7 (b): Effect of amplitude with frequency of 1.2 Hz on slope models

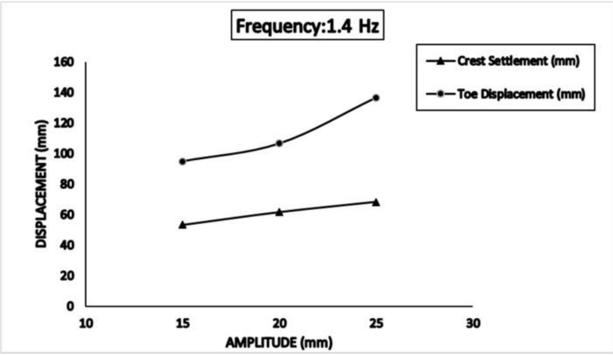

Figure 7 (c): Effect of amplitude with frequency of 1.4 Hz on slope models