Comparison with standing wave and progressive waves induced liquefaction on seabed

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1 Introduction

The wave induced liquefaction has been taken into consideration as one of the major reasons for the damage of coastal structures In order to find the constructive methods for the structures safety design. It is necessary to get better understanding on the mechanisms of the wave induced liquefaction on sandy seabed. In this paper, laboratory tests have been carried out on two types of wave's behaviors on the seabed and results have been analyzed to make the comparison with the two different types of wave's effect on seabed.

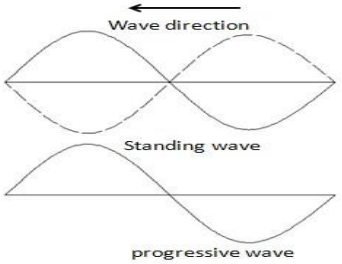

Fig 1. mechanisms of standing waves and progressive waves

2. Outlines of laboratory Tests

2.1 Flume waves for two types of waves

Fig 1 shows the two types of wave's mechanisms which are the standing waves effects on the seabed on the same position while the progressive wave effects on the seabed by the repeat movements of wave nodes and antinodes.

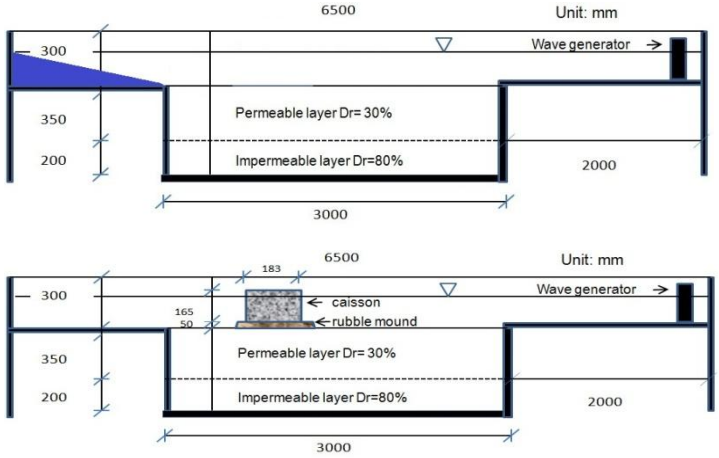

Fig 2. Layout of wave flume of progressive waves (upper)and standing waves(lower)

Fig 2 shows the wave flumes in laboratory condition by different settings, the standing wave is produced by the boundary condition of caisson breakwater and the progressive wave is produced by the wave dissipation slope on the end of wave flume. Fig 3 shows the measure equipments setting in two experiments(Matusmoto,2011). In order to get the changes of pore water pressure in seabed for the liquefaction analysis, pore pressure gauges are set in seabed and data have been collected.

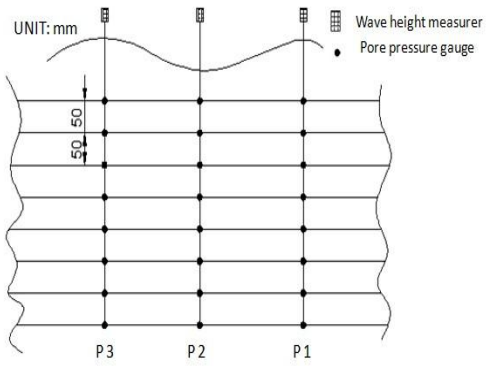

Fig 3. Measuring equipment setting

2.2 Test conditions

Water is applied as the fluid in these tests and Sand samples is Toyoura sand with the e_{max}=0.997, e_{min}=0.606, G_s=2.644. seabed permeability setting is presented by relative density =30% on permeable layer of

seabed(Tomi.2008) .Wave condition is set as wave period T=1.2, wave height H is 5 cm and wave number is 3000.

3. Test results and analysis

The relationships between excess pore pressure and effective stress is the liquefaction criteria (Zen. 1993) $\sigma'_{v0} \le P - P_b$. Where σ'_{vo} is effective stress, P is total stress and P_b is pore water pressure. Therefore, the occurrence of liquefaction can be shown by the excess pore pressure ratio is larger than 1. Pore water pressure are obtained in the tests the calculation results have been compared at location P2 ,where is 2020mm from the wave generator in the layout of wave flume.(Fig2)

Fig4. Shows the excess pore pressure changes depend on time. The excess pressure which are induced by progressive waves (b) is have an obvious changes on the surface of seabed while the excess pressure which are induced by standing waves (a) have the changes occurs in deeper positions.Fig 5 shows the occurrence of liquefaction is significant by standing waves induced than the progressive waves induced.

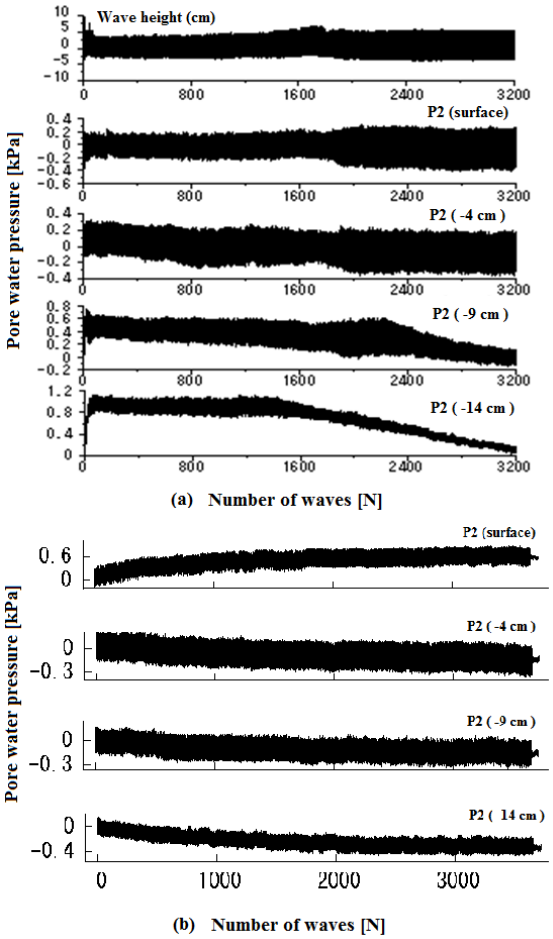

Fig 4.Relationships between Pore pressure and time

4. Conclusions and Suggestions

Three conclusions and suggestions can be drawn from this paper which are given as following: (1)The variation of excess pore pressure by two types of waves shows great difference in this experiment.(2)The standing wave induced liquefaction developed by the depth of seabed while the progressive wave induced liquefaction occurs mainly on the surface of seabed.(3)By protection of the coastal structures, Standing waves should be taken into considerations in the future laboratory experiments and researches.

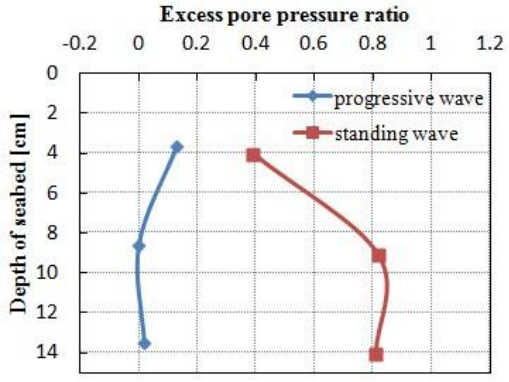

Fig 5.Relationships between excess pore pressure ratio and depth of seabed

References

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