

**LIQUEFACTION POTENTIAL IN SRI LANKA-  
PREPARING A LIQUEFACTION HAZARD MAP  
USING GEOTECHNICAL INVESTIGATION DATA**

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Master of Engineering

Department of Civil Engineering

University of Moratuwa  
Sri Lanka

February 2013

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Thesis submitted in partial fulfillment of the requirements for the degree Master of  
Engineering in Foundation Engineering and Earth Retaining Systems

Department of Civil Engineering

University of Moratuwa

Sri Lanka

February 2013

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## **Dedication**

Initially this thesis is dedicated to project supervisors, Dr. L.I.N.De Silva and Prof. S.B.S. Abayakoon, who guided till successful completion.

This thesis is dedicated to my parents and sisters who have supported me all the way since the beginning of my studies.

Also, this thesis is dedicated to my classmates who have been a great source of motivation and inspiration.

Finally, this thesis is dedicated to all those who believe in the richness of learning.



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## **Acknowledgement**

Prof. S.B.S. Abayakoon helped by overseeing the research activities. Mr. A. Withanage (ELS) and G.P. Gunarathne (Foundation and Waterwell Engineering Ltd) helped during this research project by providing geotechnical investigation data. Mr. K. Weerasooriya assisted by providing Sri Lanka's map (Digital Edition). The Director General, NBRO, Manager-Laboratory, (CECB) and Head / Department of Civil Engineering, University of Peradeniya were authorized to use some site investigation data. Academic staff of Master of Engineering/PG Diploma in Foundation Engineering and Earth Retaining Systems was guided to complete the project successfully. Non academic staff of Faculty of Engineering, University of Moratuwa was contributed to the project by giving their assistance when required.



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## Abstract

Soil Liquefaction is a process, where granular soils below the ground water table temporarily lose its strength due to cyclic loading created by an earthquake. Liquefied soil behaves as a viscous fluid rather than a solid. During liquefaction, porewater pressure is suddenly increased, forcing the soil particles to suspend in water. As a result, the buildings, utility services, natural substances and other structures are collapsed causing severe damage to the people and the nature. In some cases, the destruction due to liquefaction is not repairable. Therefore, the mitigation measures are essential to prepare for liquefaction. In Sri Lanka, it is rare to find the historical data of liquefaction or related incidents. Recent studies demonstrated that there is a potential for liquefaction in some places of the island. It could be evaluated by using the basic geotechnical investigation data, according to the simplified procedure proposed by Seed and Idriss (1971). This study is intended to prepare a liquefaction hazard map for Sri Lanka by identifying the hazard zones, using an extensive geotechnical investigation data base. As per the analysis 218 locations were identified as susceptible for liquefaction during an earthquake of magnitude 6.0 out of 3282 locations analyzed. Further, the research has given a special attention to the variation of ground water table and the maximum possible ground acceleration.

Keywords: liquefaction, ground acceleration, magnitude, earthquake



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## List of abbreviations

$U$	Pore water pressure
$\sigma'$	Effective stress
$\sigma_{ov}$	Total overburden stress
$SPT$	Standard penetration test
$CPT$	Cone penetration test
$CSR$	Cyclic stress ratio
$CRR$	Cyclic resistance ratio
$a_{max}$	Peak horizontal acceleration at ground surface generated by the earthquake
$\sigma_{vo}$	Total vertical overburden stress
$\sigma'_{vo}$	Effective vertical overburden stress
$r_d$	Stress reduction factor
$g$	Gravitational acceleration
$z$	Depth below the ground surface in meters
$N$	No of blows in standard penetration test
$M$	Magnitude of the earthquake
$FC$	Fines content
$CRR_{7.5cs}$	CRR value for earthquake magnitude of 7.5 and to the clean sand base curve
$(N_1)_{60}$	SPT blow count corrected to an effective overburden pressure 100 kPa and to a hammer energy efficiency of 60%
$(N_1)_{60cs}$	Equivalent clean sand value of $(N_1)_{60}$
$C_N$	Correction factor for effective overburden pressure
$C_E$	Correction factor for hammer energy ratio
$C_B$	Correction factor for borehole diameter
$C_R$	Correction factor for rod length
$C_S$	Correction factors for samplers with or without liners
$\sigma'_o$	Effective overburden pressure
$P_a$	Atmospheric pressure in the same unit as $\sigma'_o$
$(q_{c1N})_{cs}$	Corrected CPT tip resistance
$MSF$	Magnitude scaling factor
$t$	Layer thickness below Ground water level



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