# Ground Motions And Soil Liquefaction During Earthquakes Engineering Monographs On Earthquake Criteria Structural Design And Strong Motion Records

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**CEEN 545 - Lecture 23 - Soil Liquefaction (Part 1) CEEN 545 -**

Lecture 24 - Soil Liquefaction (Part 2) Soil Liquefaction Soil liquefaction due to earthquake. UTHM GEOFEST'14 2018 H. Bolton Seed Lecture: Performance-Based Design for Soil Liquefaction CEEN 545 Lecture 6 - Ground Motion Parameters and Signal Processing Ground Liquefaction Caught on Video Amplification and Liquefaction Animation (Educational) ~~CEEN 545 - Lecture 25 - Soil Liquefaction (Part 3)~~ CEEN 545 - Lecture 20 - Linear Site Response Soil Liquefaction 2015 Seed Lecture - Evaluation of Soil Liquefaction How Far Have We Come in the Past 30 Years? ~~See the ground actually open up and move!~~ ~~Soil liquefaction in Japan~~ ~~Demo Likuifaksi~~ ~~The Quick Clay Landslide at Rissa - 1978 (English commentary)~~ Liquefaction Simulation

Liquefaction demo illustrating buildings toppling

What Is Liquefaction?Formation of Tsunami (3D Simulation) The

Science of Geography - Liquefaction Liquefaction of Soil soil liquefaction effects and remedies in English CEEN 545 - Lecture 7 - Attenuation Relationships Liquefaction Mitigation 5 Ground Liquefactions Caught on Video Geomechanical Numerical Modeling of a Wharf Subjected to Ground Liquefaction

Soil LiquefactionExtreme Soil Liquefaction Ground Motions And Soil Liquefaction

Ground Motions and Soil Liquefaction During Earthquakes (Engineering Monographs on Earthquake Criteria, Structural Design, and Strong Motion Records) [H. Bolton Seed, I. M. Idriss] on Amazon.com. *FREE* shipping on qualifying offers. Ground Motions and Soil Liquefaction During Earthquakes (Engineering Monographs on Earthquake Criteria

Ground Motions and Soil Liquefaction During Earthquakes ...

Seed, H.B. and Idriss, I.M. (1982) Ground Motions and Soil Liquefaction during Earthquakes. Earthquake Engineering Research Institute Monograph, Oakland.

Seed, H.B. and Idriss, I.M. (1982) Ground Motions and Soil ...

On the reclaimed land, the soil liquefaction occurred at the peak acceleration of 200250 gal and the period elongated about twice, which means the stiffness decreased to 1/4 of the original. (3) Repeated property c w of the ground motions was studied using the 32 sets of records observed in the 2011 Great East Japan Earthquake. The repeated property is similar to those of past interplate earthquakes.

Effect of earthquake ground motions on soil liquefaction ...

The next day, the Superstition Hills (M6.6) earthquake produced surficial evidence of liquefaction in the area of the strong motion instruments. Recorded pore pressure measurements, however, were considered by some to be inconsistent with the recorded ground motion measurements leading to published discussions that described significant technical disagreements in the geotechnical earthquake engineering literature.

Liquefaction, Ground Motions, and Pore Pressures at the ...

H. B. Seed and I. M. Idriss, "Ground Motions and Soil Liquefaction during Earthquakes," Monograph Series, Earthquake Engineering Research Institute, Oakland, 1982, p. 134. has been cited by the following article: TITLE: An Improved Method for Seismic Site

Characterization with Emphasis on Liquefaction Phenomena

H. B. Seed and I. M. Idriss, "Ground Motions and Soil ...

mitted to the ground surface as well as soil liquefaction assessments. Ground motion analyses require the seismic input at the bedrock, thickness of each soil layer, density of soil, shear wave velocities of each soil layer, and dynamic properties of soil (shear modulus and damping). In this study, the soil data

CASE STUDY OF THE GROUND MOTION ANALYSES AND SEABED SOIL ...

An assessment of the liquefaction potential at soil sites based on peak ground motion parameters observed at the surface during earthquakes is proposed. By performing parametric studies using one-dimensional seismic response analyses, an expression for the maximum earthquake-induced shear stress incorporating both peak ground acceleration (PGA) and peak ground velocity (PGV) was formulated.

Assessment of liquefaction potential based on peak ground ...

Soil Liquefaction During Earthquakes. by I. M. Idriss and R. W. Boulanger. This 237-page monograph updates a subject area covered in the 1982 classic text used around the world, Ground Motions and Soil Liquefaction During Earthquakes, by H. Bolton Seed and I.M. Idriss. The new publication will fills a need for a thorough synthesis  in one accessible resource for students, practicing engineers, and other professionals  of progress in the study of liquefaction since 1982.

Soil Liquefaction During Earthquakes

Soil liquefaction, also called earthquake liquefaction, ground failure or loss of strength that causes otherwise solid soil to behave temporarily as a viscous liquid. The phenomenon occurs in water-saturated unconsolidated soils affected by seismic S waves (secondary waves), which cause ground vibrations during earthquakes. Although earthquake shock is the best known cause of liquefaction, certain construction practices, including blasting and soil compaction and vibroflotation (which uses a ...

soil liquefaction | Definition, Examples, & Facts | Britannica

cyclic shear stresses (CSR) due to the ground motion. The latter is, of course, a function of the design earthquake parameters, while the former depends on the soil shear strength and can be computed using results from SPT data. In fact, one of the most common parameter for estimating soil resistance to liquefaction is the number of blows N. SPT

SPT-Based Evaluation of Soil Liquefaction Risk

Beneath gently sloping to flat ground, liquefaction may lead to ground oscillation or lateral spread as a consequence of either flow deformation or cyclic mobility. Loose soils also compact during liquefaction and reconsolidation, leading to ground settlement. Sand boils may also erupt as excess pore water pressures dissipate.

LIQUEFACTION RESISTANCE OF SOILS:SUMMARY REPORT FROM THE ...

horizontal ground motions within the soil column (i.e. acceleration, stress, strain time histories) are often computed using dynamic soil response models such as SHAKE (Schnabel et al 1972), ProShake 2004, DESRA (Lee and Finn 1978) and SUMDES (Li et al 2000). The input, or bedrock, ground motions required for these numerical models are

## RECOMMENDED GUIDELINES FOR LIQUEFACTION EVALUATIONS

Soil liquefaction is the phenomenon in which the stiffness and the strength of the soil are lost under the action of earthquake force or due to rapid loading conditions. Soil liquefaction occurs in a fully saturated soil. To read more, please click here.

How to Evaluate Liquefaction Potential of Soils in the Field?

Soil liquefaction occurs when a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress such as shaking during an earthquake or other sudden change in stress condition, in which material that is ordinarily a solid behaves like a liquid. In soil mechanics, the term "liquefied" was first used by Allen Hazen in reference to the 1918 failure of the Calaveras Dam in California. He described the mechanism of flow liquefaction of the embankment

Soil liquefaction - Wikipedia

As the profession moves toward a performance-based methodology in assessing and mitigating the liquefaction hazard, the integrated response of the soil-foundation-structure system needs to be...

Effects of Ground Motion Intensity Measures on ...

Ground improvement methods have been used for over 70 years to densify loose sands prone to liquefaction. Although these methods reduce liquefaction triggering potential and settlement in densifiable soil, such as loose clean sand, their impacts on soils that are difficult to densify, such as silty soils, are not well understood.

Rammed Aggregate Pier Ground Improvement as a Liquefaction ...

This monograph updates a subject area covered in the 1982 classic text used around the world, Ground Motions and Soil Liquefaction During Earthquakes, by H. Bolton Seed and I.M. Idriss. The new publication will fill a need for a thorough synthesis in one accessible resource for students, practicing engineers, and other professionals of progress in the study of liquefaction since 1982.

Soil Liquefaction During Earthquakes (Engineering ...

The occurrence of liquefaction, however, can also affect ground surface motions, and hence the seismic response of structures founded at or near the ground surface. This paper reviews the process of liquefaction and the manner in which its occurrence is typically detected.

Effects of Liquefaction on Ground Surface Motions ...

Soil Liquefaction. Fundamentals of soil liquefaction Liquefaction triggering analysis using simplified SPT-and CPT-based procedures Ground mitigation techniques for liquefaction mitigation. Geotechnical Earthquake Engineering. Response spectra

Probabilistic and deterministic seismic hazard analysis Effects of site conditions on ground motions

Soil Liquefaction during Recent Large-Scale Earthquakes contains selected papers presented at the New Zealand  Japan Workshop on Soil Liquefaction during Recent Large-Scale Earthquakes (Auckland, New Zealand, 2-3 December 2013). The 2010-2011 Canterbury earthquakes in New Zealand and the 2011 off the Pacific Coast of Tohoku Earthquake in Japan have caused significant damage to many residential houses due to varying degrees of soil liquefaction over a very wide extent of urban areas unseen in past destructive earthquakes. While soil liquefaction occurred in naturally-sedimented soil formations in Christchurch, most of the areas which liquefied in Tokyo Bay area were reclaimed soil and artificial fill deposits, thus providing researchers with a wide range of soil deposits to characterize soil and site response to large-scale earthquake shaking. Although these earthquakes in New Zealand and Japan caused extensive damage to life and property, they also serve as an opportunity to understand better the response of soil and building foundations to such large-scale earthquake shaking. With the wealth of information obtained in the aftermath of both earthquakes, information-sharing and knowledge-exchange are vital in arriving at liquefaction-proof urban areas in both countries. Data regarding the observed damage to residential houses as well as the lessons learnt are essential for the rebuilding efforts in the coming years and in mitigating buildings located in regions with high liquefaction potential. As part of the MBIE-JSPS collaborative research programme, the Geomechanics Group of the University of Auckland and the Geotechnical Engineering Laboratory of the University of Tokyo co-hosted the workshop to bring together researchers to review the findings and observations from recent large-scale earthquakes related to soil liquefaction and discuss possible measures to mitigate future damage. Soil Liquefaction during Recent Large-Scale Earthquakes will be of great interest to researchers, academics, industry practitioners and other professionals involved in Earthquake Geotechnical Engineering, Foundation Engineering, Earthquake Engineering and Structural Dynamics.

Soil liquefaction during past earthquakes has caused extensive damage to buildings, bridges, dam, pipelines and other elements of infrastructure. Geotechnical engineers use empirical observations from earthquake case histories in conjunction with soil mechanics to predict the behavior of liquefiable soils. However, current empirical databases are insufficient to evaluate the behavior of soils subject to long-duration earthquakes, such as a possible Mw = 9.0 Cascadia Subduction Zone earthquake. The objective of this research is to develop insight into the triggering and effects of liquefaction due to long-duration ground motions and to provide recommendations for analysis and design. Recorded ground motions from 21 case histories with surficial evidence of liquefaction showed marked differences in soil behavior before and after liquefaction was triggered. In some cases, strong shaking continued for several minutes after the soil liquefied, and a variety of behaviors were observed including dilation pulses, continued softening due to soil fabric degradation, and soil stiffening due to pore pressure dissipation and drainage. Supplemental field and laboratory investigations were performed at three sites that liquefied during the 2011 Mw = 9.0 Tohoku earthquake. The recorded ground motions and field investigation data were used in conjunction with laboratory observations, analytical models, and numerical models to evaluate the behavior of liquefiable soils subjected to long-duration ground motions. Observations from the case histories inspired a framework to predict ground deformations based on the differences in soil behavior before and after liquefaction has triggered. This framework decouples the intensity of shaking necessary to trigger liquefaction from the intensity of shaking that drives deformation by identifying the time when liquefaction triggers. The timing-based framework promises to dramatically reduce the uncertainty in deformation estimates compared to conventional, empirically-based procedures.

Earthquake-induced soil liquefaction (liquefaction) is a leading cause of earthquake damage worldwide. Liquefaction is often described in the literature as the phenomena of seismic generation of excess porewater pressures and consequent softening of granular soils. Many regions in the United States have been witness to liquefaction and its consequences, not just those in the west that people associate with earthquake hazards. Past damage and destruction caused by liquefaction underline the importance of accurate assessments of where liquefaction is likely and of what the consequences of liquefaction may be. Such assessments are needed to protect life and safety and to mitigate economic, environmental, and societal impacts of liquefaction in a cost-effective manner. Assessment methods exist, but methods to assess the potential for liquefaction triggering are more mature than are those to predict liquefaction consequences, and the earthquake engineering community wrestles with the differences among the various assessment methods for both liquefaction triggering and consequences. State of the Art and Practice in the Assessment of

Earthquake-Induced Soil Liquefaction and Its Consequences evaluates these various methods, focusing on those developed within the past 20 years, and recommends strategies to minimize uncertainties in the short term and to develop improved methods to assess liquefaction and its consequences in the long term. This report represents a first attempt within the geotechnical earthquake engineering community to consider, in such a manner, the various methods to assess liquefaction consequences.

Recent earthquakes in Chile, New Zealand, and Japan have re-emphasized the damaging consequences of liquefaction on infrastructure. Due to the complexity of the problem and limited well-documented field case histories, liquefaction-induced building settlements are often estimated using empirical correlations developed for free-field sites on level ground that account for post-liquefaction volumetric strains only. Additional effects due to the presence of a structure are not accounted for with these procedures. The earthquake performance of structures founded on liquefiable ground depends on a complex interaction between the soil properties, the ground motion characteristics, and the structural properties. This thesis presents three related research projects that address aspects of the effects of soil liquefaction including near-fault sites. This research thesis is focused on characterizing and selection of near-fault ground motions, geotechnical centrifuge testing of model buildings affected by liquefaction, and the development of field case histories in Chile following the 2010 Maule, Chile earthquake. Earthquake ground motions are important in liquefaction-induced building performance. Ground motions in the near-fault region frequently have intense, double-sided pulses in the velocity-time series that can be very damaging to structures; forward directivity is a leading cause of these pulses. However, pulses do not always occur in the forward directivity region, and some pulses are not caused by forward directivity. The present study used a new, automated algorithm to classify a large database of records as pulse or nonpulse motions. A straightforward model was developed to estimate the proportion of pulse motions as a function of closest site-to-source distance and epsilon of the seismic hazard. Geotechnical centrifuge tests provide valuable insight into the performance of structures affected by liquefaction. An area particularly lacking understanding is the interaction of closely spaced structures subjected to liquefaction. Two well-instrumented centrifuge tests were performed to investigate the response of three types of model structures founded on liquefiable ground in isolated and adjacent configurations. Acceleration, pore water pressure, and settlement measurements indicated that liquefaction-induced settlement of structures depends on a complex interaction of ground motion, soil, and structural characteristics. For the particular scenarios examined in this study, adjacent structures experienced moderately lower foundation accelerations, tended to tilt away from each other, and settled less than isolated structures. The 2010, MW = 8.8, Maule, Chile earthquake caused substantial damage, including liquefaction-induced damage to infrastructure and provides an important opportunity to learn from these field case histories. This project focuses on improved characterization of the subsurface conditions using penetration testing (i.e., SPT and CPT) at a hospital and two bridges that suffered liquefaction-induced damage. The recently constructed hospital has 10 structurally isolated wings varying in height from one to six stories, which provides a unique opportunity to examine the differing response of varying wings. Liquefaction of plastic, silty soils at the hospital resulted in differential settlement, whereas liquefaction of clean, medium-dense sandy soils resulted in lateral spreading and damage to bridge piers.

This book presents comprehensive hazard analysis methods for seismic soil liquefaction, providing an update on soil liquefaction by systematically reviewing the phenomenon's occurrence since the beginning of this century. It also puts forward a range of advanced research methods including in-situ tests, laboratory studies, physical model tests, numerical simulation, and performance-based assessment. Recent seismic liquefaction-related damage to soils and foundations demonstrate the increasing need for the comprehensive hazard analysis of seismic soil liquefaction in order to mitigate this damage and protect human lives. As such the book addresses the comprehensive hazard analysis of seismic soil liquefaction, including factors such as macroscopic characteristics, evaluating the liquefaction potential, dynamic characteristics and deformation processes, providing reliable evaluation results for liquefaction potential and deformation in the context of risk assessment. p>

This book contains the full papers on which the invited lectures of the 4th International Conference on Geotechnical Earthquake Engineering (4ICEGE) were based. The conference was held in Thessaloniki, Greece, from 25 to 28 June, 2007. The papers offer a comprehensive overview of the progress achieved in soil dynamics and geotechnical earthquake engineering, examine ongoing and unresolved issues, and discuss ideas for the future.

The specialty section Earthquake Engineering is one branch of Frontiers in Built Environment and welcomes critical and in-depth submissions on earthquake ground motions and their effects on buildings and infrastructures. Manuscripts should yield new insights and ultimately contribute to a safer and more reliable design of building structures and infrastructures. The scope includes the characterization of earthquake ground motions (e.g. near-fault, far-fault, short-period, long-period), their underlying properties, their intrinsic relationship with structural responses, and the true behaviors of building structures and infrastructures under risky and uncertain ground motions. More specific topics include recorded ground motions, generated ground motions, response spectra, stochastic modeling of ground motion, critical excitation, geotechnical aspects, soil mechanics, soil liquefaction, soil-structure interactions, pile foundations, earthquake input energy, structural control, passive control, active control, base-isolation, steel structures, reinforced concrete structures, wood structures, building retrofit, structural optimization, uncertainty analysis, robustness analysis, and redundancy analysis. This eBook includes four original research papers, in addition to the Specialty Grand Challenge article, on the critical earthquake response of elastic-plastic structures under near-fault or long-duration ground motions which were published in the specialty section Earthquake Engineering. In the early stage of dynamic nonlinear response analysis of structures around 1960s, a simple hysteretic structural model and a simple sinusoidal earthquake ground motion input were dealt with together with random inputs. The steady-state response was tackled by an equivalent linearization method developed by Caughey, Iwan and others. In fact, the resonance plays a key role in the earthquake-resistant design and it has a strong effect even in case of near-fault ground motions. In order to draw the steady-state response curve and investigate the resonant property, two kinds of repetition have to be introduced. One is a cycle, for one forced input frequency, of the initial guess of the steady-state response amplitude, the construction of the equivalent linear model, the analysis of the steady-state response amplitude using the equivalent linear model and the update of the equivalent linear model based on the computed steady-state response amplitude. The other is the sweeping over a range of forced input frequencies. This process is quite tedious. Four original research papers included in this eBook propose a new approach to overcome this difficulty. Kojima and Takewaki demonstrated that the elastic-plastic response as continuation of free-vibrations under impulse input can be derived in a closed form by a sophisticated energy approach without solving directly the equations of motion as differential equations. While, as pointed out above, the approach based on the equivalent linearization method requires the repetition of application of the linearized equations, the method by Kojima and Takewaki does not need any repetition. The double impulse, triple impulse and multiple impulses enable us to describe directly the critical timing of impulses (resonant frequency) which is not easy for the sinusoidal and other inputs without a repetitive procedure. It is important to note that, while most of the previous methods employ the equivalent linearization of the structural model with the input unchanged, the method treated in this eBook transforms the input into a series of impulses with the structural model unchanged. This characteristic guarantees high accuracy and reliability even in the large plastic deformation range. The approach presented in this eBook is an epoch-making accomplishment to open the door for simpler and deeper understanding of structural reliability of built environments in the elastic-plastic range