Professional Leave Report Cover Sheet

Name: Arezoo Sadrinezhad

Department: Civil & Geomatics Engineering

College: Lyles College of Engineering

Leave taken: (●) Sabbatical ( ) Difference in Pay ( ) Professional Leave without Pay

Time Period: (●) Fall 2022

( ) Spring

( ) Academic Year

( ) Other

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Sabbatical Report for Fall 2022

Dr. Arezoo Sadrinezhad, Ph.D., P.E.

My sabbatical leave consisted of four tasks:

1. Writing an external grant proposal with the topic of "Seismic Response Evaluation of Geotechnical-Seismic-Isolated Buildings using Sleeved Piles Filled with Alternative Aggregates" to NSF or other funding recourses in collaboration with Dr. Maryam Nazari from CSULA.

2. Developing a new graduate level course, CE291T: Geotechnical Earthquake Engineering.

3. Redesigning the CE134, Foundation Design course to be a CURE (Course-based Undergraduate Research Experience) course.

4. Conducting previous NSF funded project.

Here is the summary of completed tasks:

1. An RUI research proposal titled "Collaborative Research: RUI: Shake Table Study on Seismic Soil-Pile-Structure Interaction of Buildings with Sleeved Piles Filled with Tire-Derived Aggregates in a Liquefiable Soil" was written and submitted in collaboration with Dr. Maryam Nazari from CSULA to the ECI (Engineering for Civil Structure) program (under Division of Civil, Mechanical and Manufacturing Innovation (CMMI)) of NSF on Jan 25th 2023. The proposed project's duration is three years and $317,553 ($165,513 Fresno State and $152,000 CSU LA) was requested. A copy of the proposal is attached to this report.

2. A new graduate course titled "CE291T: Geotechnical Earthquake Engineering" is developed. The Topics Course (T-Course) proposal was submitted to the curriculum committee on Monday Sep 19th 2022. This course is scheduled to be taught in Spring 2023. A copy of the syllabus along with the T-course proposal are attached to this report.

3. A two-week CURE module is added to the CE134, Foundation design course. The revised syllabus along with the research project description, deliverables, and rubrics are attached to this report.

4. I organized and lead two events during fall semester for the KIND program.

    1. The first event was a "Faculty Success Seminar" which was offered to all CSU engineering faculty and lecturers. The event was on Sep 15th 2022. 38 engineering faculty from 13 CSU campuses attended this event. The flyer for this event and the list of all the participants are attached to this report.

    2. The second event was a "Networking event" for all CSU engineering faculty. The event was on Nov 18th. There were 6 mentors and 32 engineering faculty from 15 CSU

campuses attended this event. The flyer for this event along with the name of the mentors and participants are attached to this report.

Two abstracts were submitted to ASEE 2023. The titles of these abstracts are:

1. The Power of Cross-Institutional "Speed" Mentoring and Networking Program in Advancement of Women, URM, and Foreign Born/Trained Engineering Faculty (Work-in-Progress)
2. Using CIP codes to improve multi-institutional analysis of applicant demographics for equity in engineering faculty hiring (Work In Progress)

The abstracts are attached to this report.

I also worked on other aspects of the KIND grant that are led by Drs. Oka and Stillmaker.

Additional Curriculum Activities During Sabbatical:

Besides completing all the tasks that I proposed in my sabbatical applications, I managed to do the following curriculum activities:

1. Presentations: One presentation at the 1st Civil Engineering Conference at CSU Pomona. Projects title: "Application of TDA in Seismic Response of Railway Embankments". Copies of the abstract, conference registration, and the PowerPoint presentation are attached to this report.

2. Publications:
   a. One accepted peer-reviewed conference paper at Geo-Congress 2023 conference proceedings. A copy of the paper and the acceptance letter are attached to this report.

   b. Paper submissions: One abstract was submitted to EURODYN2023 in collaboration with Mr. Mojtaba Ansari and Drs. Nazari and Tehrani. A copy of the abstract and the acceptance letter are attached to this report.

Attachments:

1. Proposal and proof of submission
2. Course syllabus/ T-course proposal
3. Course syllabus/project description/deliverables/rubrics
4. KIND events: Flyers/list of attendees
5. KIND abstracts and the acceptance letter
6. Conference presentation: PPTX file + conference registration
7. Paper acceptance letter + Full paper
8. Abstract + acceptance letter

Attachments: Task 1- NSF Proposal

Project Summary

Overview

The proposed study aims to evaluate the influence of seismic soil-pile foundation-structure interaction (SSPSI) on the seismic response of buildings supported on sleeved piles filled with Tire Derived Aggregates (TDA) in a liquefiable ground. Previous studies have shown the favorable performance of this pile system in seismic areas; however, they did not consider the seismic soil-pile-structure interaction (SSPSI) which is necessary to evaluate the seismic response of the superstructure realistically. The proposed project will consider the SPSI using both experimental and numerical simulations. This project will be done as a collaborative work between CSU Fresno and CSULA. For experimental simulations, a physical model including the superstructure and sleeved piles foundation system will be designed and built by a team of graduate and undergraduate students at CSU Fresno. Three foundation systems will be considered: 1. conventional sleeved piles (the gap between the sleeve and the pile is empty), 2. sleeved piles filled with a mixture of sand and TDA (50-50), 3. sleeved piles filled with 100% TDA. A series of shake table testing will be performed using the shake table facility available at the Lyles College of Engineering at CSU Fresno. Dynamic characteristics and acceleration response of model soil-pile foundation structural systems will be recorded in order to study the influence of SSPSI. For verification purposes, numerical simulations will also be performed at CSULA to capture the behavior of the proposed geotechnical seismic isolation system. For an accurate prediction of the soil response, the results from a series of bi-directional shearing tests on different soil samples, including reconstituted sand (Ottawa sand) specimens will be used in the model simulations. The final findings of this project will be presented as a design guide.

Intellectual Merit

The structural seismic isolation (SSI) system is a structural design that can be used to reduce the destructive effects of earthquakes. On the other hand, geotechnical seismic isolation (GSI) technique is a type of soil improvement around the foundation in which a flexible interface such as geosynthetics layer or soil-rubber mixture (SRM) is added under the foundation or between the soil layers. In order to improve the seismic performance of structures in earthquake prone areas, a novel idea is to combine the two, SSI and GSI, systems. For example, if the soil under the superstructure is weak or susceptible to liquefaction, an SSI method such as sleeved pile system can be used to transfer the load to the deeper soil layer or rock with a higher bearing capacity and also provide proper flexibility to the structure. This type of pile system consists of a cylindrical steel pile within a thin steel sleeve of sufficient diameter. To provide a suitable damping ratio, usually a damper is implemented between the structure and the pile. To reduce the cost of this system and make it more applicable for residential areas and developing countries, instead of using dampers, the sleeve of the pile can be filled with recycled materials that have damping properties, such as TDA, which is considered as a GSI technique. This project will contribute to research in two key areas: (1) to consider the seismic soil-pile-structure interaction (SSPSI) in evaluating the seismic response of sleeved piles filled with TDA and (2) to evaluate the effectiveness of this seismic isolation method in mitigating the earthquake oscillations and damping the structural response.

Broader Impacts

The proposed project advances the seismic design of structures which can reduce the damage caused by earthquakes and enhance human safety. Moreover, using TDA, which is processed waste tires, will reduce the cost of the proposed seismic isolation method and make it more

feasible for the residential areas. Furthermore, the recycled nature of TDA contributes to the sustainability of the proposed system and protects the natural world from pollution. This project is also a good opportunity for undergraduate and graduate students at CSU Fresno and CSULA, of whom 56.4% and 72.1%, respectively, are from underserved minorities, to get familiar with advanced experimental and numerical techniques in geotechnical and structural engineering. The PI and Co-PI are both female and strongly support the advancement of female students in engineering. Involving female and underrepresented students in undergraduate research will motivate these students to pursue advanced degrees and research careers. Additionally, the participating students will run high school outreach workshops on this topic in order to attract underrepresented students in the Central Valley (California) to the engineering program. If funded, the proposed project has a strong potential to make a long-term impact.

Project Description

Project Team

Table 1 includes members of the project team with expertise in (1) Geotechnical Earthquake Engineering and (2) Structural Earthquake Engineering. Each team member leads specific project tasks and contributes to other tasks in a co-leading role. Details of personnel in the proposed project are summarized in the table below.

Table 1. Project Team

Role	Name	Position, Affiliation	Responsibilities
PI	Dr. Arezoo Sadrinezhad	Assoc. Prof., California State University, Fresno (CSU Fresno)	Leading the experimental research at CSU Fresno
Co-PI	Dr. Maryam Nazari	Asst. Prof., California State University, Los Angeles (CSULA)	Leading the numerical research at CSULA

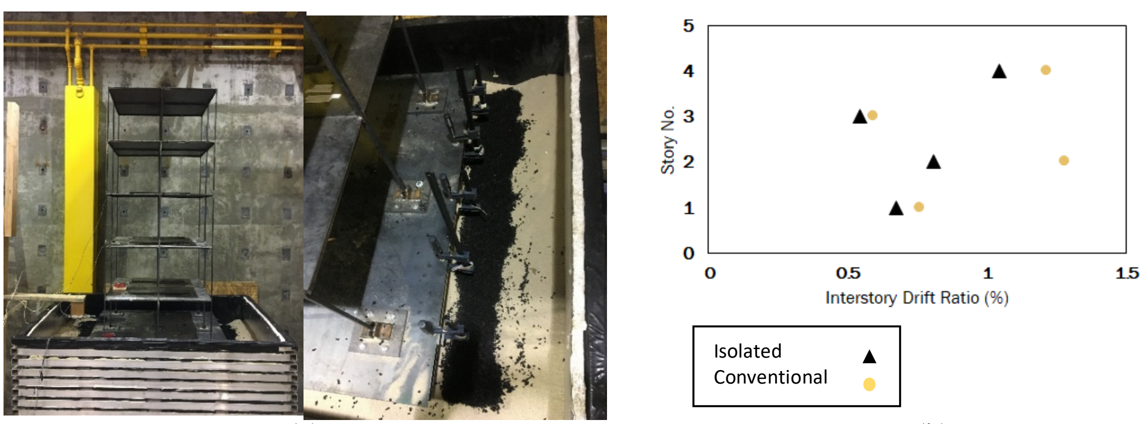
This project will employ two (2) graduate students and four (4) undergraduate students per year during the period of this grant (in both institutions). The students from CSU Fresno will participate in the seismic soil-pile-structure interaction experimental study using shake table tests, while CSULA students will perform the numerical simulations calibrated using the results of a series of bi-directional shearing tests on soil samples, which will be performed at this institution, and validated using the shake table experimental results. These students will collaborate closely with each other and their supervisors.

Overview and Objectives

Earthquakes in populous areas cause severe devastation to lives and infrastructure. Base isolation systems have been widely utilized to minimize the effect of ground excitation without augmenting the reinforcement of the structures in the face of an earthquake. Structural seismic isolation (SSI) systems by means of flexibility or sliding joint in horizontal direction that are placed between the structure and its foundation decouple the structure from the horizontal acceleration of earthquake movements, which prevents the destructive motions to be transferred to the structure (Naeim and Kelly 1999). The idea of SSI systems has become widespread from more than a century to protect buildings and structures with high levels of importance from ground motions. However, the implementation of base isolation in the United States started three decades ago (Warn and Ryan 2012). Recently, utilization of the SSI mechanisms has been increased in developing countries that are located in earthquake-prone regions, however, due to their high cost, their applications are limited to critical structures. One of the goals of the international earthquake engineering community is to introduce low-cost seismic resisting techniques in residential areas to ensure life safety and decrease the victims of this natural disaster (Bozorgnia and Bertero 2004). To this end, many projects have been started in different countries such as Indonesia and Chile ((Taniwangsa and Kelly 1996), (Kelly 1994), and (De la Llera et al. 2004)), one of which was proposed by (Lang and Sargent 2005) to improve the seismic performance of residential buildings by using scrap tires mixed with rock aggregates as a bearing of these buildings. Although some experimental investigations showed that the acceleration response of these structures was reduced by 70%, the main problem with this method is that the building needs to be detached from the ground which is impractical for small buildings and may not be feasible for large structures (Tsang 2008).

One of the recent methods of base isolation systems is applying the flexible or sliding interface in direct contact of soil profile. These base isolation methods include geotechnical techniques, and therefore, it is considered as geotechnical seismic isolation (GSI) systems. In the other word, the GSI technique is a type of soil improvement around the foundation in which a flexible interface such as geosynthetics layer or soil-rubber mixture (SRM) is added under the foundation or between the soil layers (Yegian and Lahlaf 1992).

A preliminary investigation was conducted by the project team at CSU Fresno, in which a shake table study was performed on a scaled 5-story steel frame sitting on pile foundations, embedded in loose sand, using: (1) conventional piles and (2) piles surrounded by TDA (Figure 1a). Each test unit was subjected to seven ground motions with multiple intensities and their seismic responses including absolute acceleration and drift were measured. It was concluded that the proposed GSI system leads to a reduction of the inter-story drift of the superstructure during a design level earthquake motion, as shown on Figure 1b.



(a) (b)

Figure 1. Structure-pile system using TDA: (a) shake table test, (b) preliminary test results.

In order to improve the seismic performance of structures in earthquake prone areas, a novel idea is to combine the two, SSI and GSI, systems. For instance, in cases in which soil layers are weak, collapsible, or liquefiable, using deep foundations with materials that can provide sufficient damping to the system is a proper way to mitigate the earthquake motions. One type of deep foundation that can be utilized as SSI is the sleeved pile isolation system, which is like a caisson

foundation that is not completely filled. The gap between the pile and the sleeve provides the flexibility required for the base isolation and can improve the dynamic response of structure under earthquake movements ((Naeim and Kelly 1999), (Biggs 1982), and (Kelly 1986)). The studies on the sleeved pile systems illustrated that an artificial increase in damping by means of damper devices can protect the system from undesired deflection and resonance due to the energy absorbing property of damping equipment (Kelly 1986). In order to reduce the cost of this isolation system and make it more feasible for residential areas, some geotechnical materials such as the mixture of soil and tire-derived aggregate (TDA) can be substituted for the expensive damper devices in the sleeved pile isolation system (Komak Panah and Khoshay 2015).
On the other hand, to study the seismic response of structures in soft /loose soil deposits, the influence of the underlying soil needs to be considered (Deb Roy et al. 2021). Previous studies on pile supported structures are mainly focused on development of soil structure interaction models, but the influence of seismic soil-pile-structure interaction (SSPSI) on design forces of pile supported structures has not been extensively investigated ((Kaynia and Mahzooni 1996), (Novak 1974), (Nogami and Novak 1976), (Tokimatsu et al. 2005), (Nikolaou et al. 2001), (Meymand n.d. 1998)). Considering the fact that failure of most pile foundation supported structures are due to liquefaction of the ground ((Bhattacharya et al. 2003), (Tokimatsu et al. 1996)), it is important to understand the mechanics of SSPSI in liquefiable soils and its effect on the seismic response of structures to help revamp the existing seismic design guidelines.

The proposed study aims to further explore and evaluate the influence of SSPSI on the seismic response of buildings with sleeved piles filled with TDA in a liquefiable ground. To this end, a superstructure will be built on a sleeved pile foundation system in a liquefiable soil. Three foundation systems will be considered: 1. conventional sleeved piles (the gap between the sleeve and the pile is empty), 2. sleeved piles filled with a mixture of sand and TDA (50-50), 3. sleeved piles filled with 100% TDA. A series of shake table tests will be performed at CSU Fresno, using multiple-level seismic excitations, to study the dynamic characteristics and acceleration response of the scaled soil-pile foundation structural test systems. For verification purposes, numerical simulations will also be performed at CSULA to capture the behavior of the proposed geotechnical seismic isolation system and run extensive parametric studies to investigate the influence of different design variables (e.g., structural systems, number and configuration of piles, sleeves, filling material, soil type, ground slope) as well as ground motions (e.g., multiple-level intensities, near-field vs. far-field, bidirectional shaking) on the response of such systems. For an accurate prediction of the soil response, the results from a series of bi-directional shearing tests on different soil samples, including reconstituted sand (Ottawa sand) specimens will be used in the model simulations.

Background and Literature Review

a. SSI and GSI systems

The SSI systems by virtue of flexible or sliding interface and damping equipment increase the natural period of the structures that results in reducing floor acceleration and inter-story drifts of structures (Warn and Ryan 2012). SSI systems have been developed and a variety of complex systems have been invented based on the combination of primary SSI systems, namely elastomeric, sliding, spring-type, sleeved pile, and rocking systems (Naeim and Kelly 1999). Comprehensive lists and reviews of SSI systems and their mechanism, properties, and applications have been published by multiple researchers. For instance, Kelly (1986) provided a historical list of primary seismic isolation systems or Taylor et al. (1992) summarized the use of elastomers and investigated the long-term behavior of them. Some other reviews of SSI systems can be found in the research of (Buckle and Mayes 1990), (Soong and Costantinou 2014), and (Warn and Ryan 2012).

On the other hand, the GIS system consists of geotechnical materials such as synthetic liners or mixture of soils and scrap tires that are placed beneath or around foundations or between soil layers to lessen the earthquake energy. The idea of applying geosynthetics as the GSI system for isolation of geotechnical structures such as embankment and mat foundations was proposed by (Yegian and Lahlaf 1992). (Yegian and Catan 2004) conducted shake table tests on two geomembrane sheets and observed that the transferred shear forces between two sheets are limited. They also performed shake table tests to evaluate foundation isolation by a smooth synthetic liner. The experimental and analytical research showed that the geotextile materials can be a proper seismic isolation to reduce the ground motion transmitted to the structure.

Another proposed GSI system included the mixture of soil and rubber. (Tsang 2009) performed numerical simulations in order to investigate the effects of using a layer of rubber-soil mixture (RSM) around the foundation. The results showed that the horizontal accelerations at the roof were reduced by 40-60% ((Tsang 2009), and (Tsang et al. 2012)). Some other numerical analysis and analytical approaches investigated the use of GSI systems. For example, (Forcellini 2017) investigated applying the synthetic liner on the bridge configurations and (Karatzia and Mylonakis 2017) studied the EPS geofoams around the bridge peers as a GSI system. These investigations concluded that the GSI system increases the energy absorption under the ground motions due to the damping characteristic of materials.

In some circumstances, such as the existence of weak soil layers beneath the superstructure or the liquefaction potential of soils, the use of pile foundations is necessary. Sleeved pile isolation mechanism is a classic SSI system that uses the flexibility provided by the gap between pile and its caisson to improve the dynamic response of structure under earthquake movements ((Naeim and Kelly 1999),(Biggs 1982),(Kelly 1986)). Sleeved pile isolation system was used in different projects such as in the Union House in Auckland, New Zealand, (1983), Wellington Central Police building (1991) and Randolf Langenbach house in Oakland, California (1998). In all these projects, different types of damping sources such as hydraulic viscous damper, friction damper, and a set of tapered steel plates were utilized in order to prevent unwanted deformation and resonance (Naeim and Kelly 1999).

In 2015, (Komak Panah and Khoshay 2015) introduced a new base isolation system by combining the SSI and GSI systems. In this study, the damping equipment was replaced with the mixture of soil and rubber in order to reduce the cost of this system. They performed a series of field experiments on a model pile to evaluate the seismic response of the proposed system. Using a hydraulic jack to apply a triangular cyclic load to the cap pile, these researchers showed that the proposed method is an inexpensive approach to reduce the acceleration and forces of ground movements. Although this method is a novel idea to reduce the cost of the sleeved pile systems, (Komak Panah and Khoshay 2015) did not consider the seismic soil-pile-structure interaction (SSPIS) nor evaluate the seismic performance of the superstructure. SSPSI is a key subject in earthquake engineering and an essential element in the performance of GSI systems. The SSPSI considers the response of the soil that affects the displacement of the structure and the response of the structure that affects the motions of the soil profile. Consideration of the interaction between structure, pile, and soil provides a more realistic estimate of the stiffness and damping of the system (Wang et al. 2013, Ansari et al. 2020).

On the other hand, seismic designs of structures are influenced by the underlying soil. For stiff grounds, the structure can be analyzed by considering a fixed base. However, if the soil condition changes (i.e., soft/loose soil deposit), the structure behaves differently (Deb Roy et al. 2021). (FEMA 440 2015) highlights the significance of the soil structure interaction on the seismic design of structures built in soft clay and liquefiable loose sandy soil. Therefore, the objective of the proposed study is to investigate (1) the dynamic characteristics and response of the superstructure as well as the sleeved-pile foundation in liquefiable soil, when the system is subjected to multiple-level intensity ground motions and (2) the effect of TDA filling (for sleeved piles) in damping the earthquake oscillations. Both numerical and experimental simulations will be used in this project to study the influence of different design variables (e.g., structural systems, number and configuration of piles, sleeves, filling material, soil type, ground slope) as well as ground motions (e.g., multiple-level intensities, near-field vs. far-field, bidirectional shaking) on the system response.

b. Tire-Derived Aggregates (TDA)

The rise in the number of scrap tires is an environmental challenge associated with concerns for health and safety (EPA 2014). Further, recycling scrap tires has been recognized as an indispensable solution to divert waste from landfills. In the United States, the percentage of scrap tires processed into tire crump has increased from 2% in the 1990s to nearly 12% in 2001 (Sunthonpagasit and Duffey 2004). In recent decades, civil engineering scholars and practitioners have developed different techniques to utilize the recycled used tires, as means of environmental protection and economic enhancement. Processed waste tires, also known as tire-derived aggregates (TDA), alone or mixed with other materials, have variety of applications, such as rubberized asphalt, rubberized concrete, lightweight backfill in embankments, drainage layers, isolation systems and railroad track beds ((Edinçliler et al. 2010), (Miller and Tehrani 2017), (Shireen et al. 2021), (Esmaeili et al. 2016), (Sol-Sánchez et al. 2015), (Martínez Fernández et al. 2018)). Many studies were conducted to determine the mechanical and dynamic behavior of TDA in different applications. The results of these investigations have shown that TDA can be a proper alternative in many projects due to such superior characteristics as durability, strength, resiliency, high frictional resistance, and high damping ratio (Nakhaei et al. 2012).

The research team is familiar with the application of TDA in sustainable and resilient infrastructures. The PI investigated the dynamic parameters of TDA and demonstrated that these materials can improve the seismic response of different structures in the prone earthquake areas ((Sadrinezhad et al. 2019), (Tehrani et al. 2018)). The Co-PI used these sustainable aggregates in the construction of concrete pavement slabs and through a series of impact fatigue tests as well as life-cycle cost analysis indicated the long-term benefits of constructing green and durable infrastructure using TDA on future investments in transportation (Nazari et al. 2022).

Research Program Plan and Expected Outcomes

The proposed project will include five tasks, as summarized in Table 2, and described in the following sections.

Table 2. Project Tasks

Tasks	Sub-tasks
Task 1: Material selection and testing	Bi-directional shear testing of soil using the MRI-funded Confined Variable Direction Dynamic Cyclic Simple Shear (VDDCSS-CON) apparatus at CSULA
Task 2: Numerical Modeling	Finite element simulation of proposed models using Opensees/ PLAXIS, with the recorded soil response from Task 1
Task 3: Shake table testing	Sub-task 1. Design and construction of the superstructure and foundation system Sub-task 2. Design and fabrication of the soil container Sub-task 3. Construction of the test setups and installing the instruments Sub-task 4. Selection and scaling of ground motion excitations and shake table testing Sub-task 5. Data Analysis and Interpretation
Task 4: Parametric Study and Design Guide	Preparing a design guide for the proposed system

Task 1. Material selection and testing:
Soil samples and testing: This task includes obtaining the multiaxial constitutive models of soil, which will be adopted by the numerical model, using the results of a series of bi-directional shearing tests on different soil samples, including reconstituted sand (Ottawa sand). The tests will be conducted utilizing the MRI-funded Confined Variable Direction Dynamic Cyclic Simple Shear (VDDCSS-CON) apparatus at CSULA (Grant Number # 2117908) under the supervision of Dr. Nazari. To this end, two different stress conditions will be considered at the consolidation stage and under the constant-volume setup: (1) without a static shear (at rest, k_o condition) and with a static shear perpendicular to the loading direction (k_α condition), to respectively simulate the level and the sloping grounds. These testing variables will be used when modeling the soil-pile-structure system as part of the parametric studies of Task 4. The soil specimens will be subjected to uni-cyclic harmonic loading and bi-directional transient ground motions, with the excitations to be selected from the Pacific Earthquake Engineering Research (PEER) Center database. The proposed loading paths are shown in Figure 2.

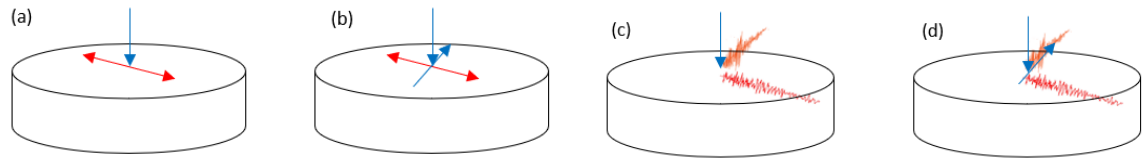


Figure 2. The illustration of various loading paths for soil testing using the VDDCSS apparatus at CSULA: (a) k_o consolidation and uni-cyclic harmonic loading, (b) k_α consolidation and uni-cyclic harmonic loading, (c) k_o consolidation and 2D ground motion, and (d) k_α consolidation and 2D ground motion

The results of the proposed tests will help us generate a variety of soil parameters, including the shear modulus and damping ratio which can be obtained using the hysteretic responses of the soil specimens, and therefore can be extensively applied in robust modeling of geotechnical earthquake engineering problems, including the proposed project.

Task 2. Numerical Modeling:

The seismic response of sleeved piles and their interaction with the superstructure depends on various parameters such as structural system type, number and configuration of piles, sleeves, filling material, soil type, and ground slope as well as intensity, type, and direction of the applied ground motions. This task involves numerical simulations of the interaction models to establish (1) the design details for isolated sleeved piles filled with TDA in order to optimize seismic performance and safety of the superstructure and 2) input for shake table tests in Task 3.

Based on the constitutive models developed in Task 1, finite element (FE) analysis will be used in this task to further explore and refine the proposed pile details. These simulations utilize OpenSees, which is a FE computational analysis framework, along with OpenSees PL, which is a FE graphical interface (pre- and post-processor), to facilitate three-dimensional (3D) studies of lateral pile-ground interaction response. Additionally, PLAXIS with soil-pile-structure interaction capabilities will be used to model the behavior of the system. Dr. Nazari at CSULA will supervise undergraduate and graduate students to perform the numerical simulations. Figure 3 shows the proposed OpenSees model to capture the soil-pile-structure interaction in this project.

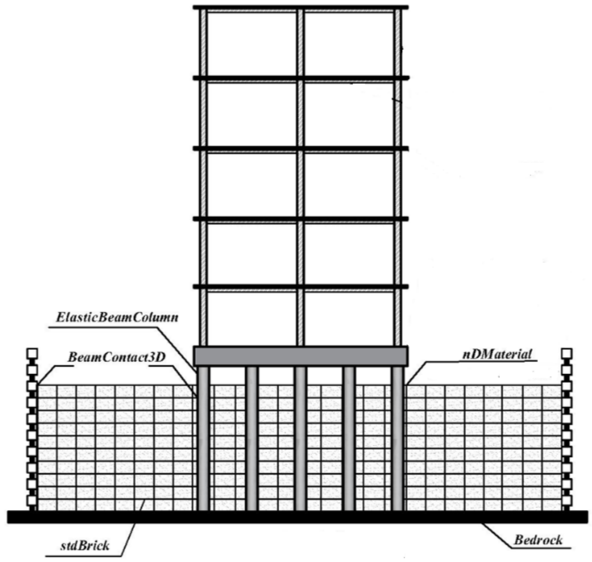


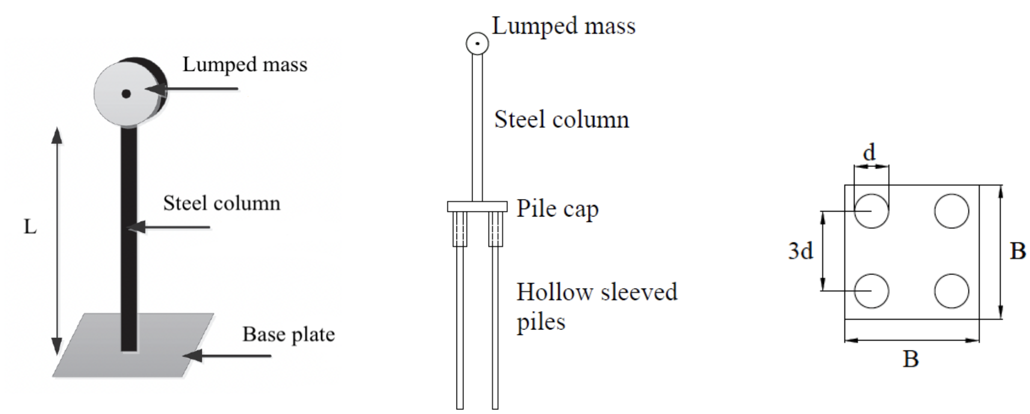
Figure 3. Finite element modeling of the SSPSI setup

“Beam” elements and “Beam-Solid Contact” elements will be respectively utilized to model the piles and pile-soil interface, while the soil response will be captured using “Solid” elements. The existing soil constitutive models in OpenSees for modeling the liquefaction progress for loose sand, including Pressure Dependent Multi Yield 02 (PDMY02) and the Dafalias and Manzari constitutive framework do not cover the spatial and temporal characteristics of earthquake ground motions, as these models are only calibrated against uni-harmonic cyclic simple shear tests. In this project, the generated bi-directional test results of soil samples from Task 1, under the transient ground-motion loadings, will be used to calibrate the OpenSees models.

Task 3. Shake Table Testing:

Sub-task 1: This sub-task includes determining and optimizing the proposed geometries and properties of soil-pile-structure model to be built for experimental studies. This includes choosing the size and materials of the superstructure, size and materials of the piles, and soil type. For the superstructure, similar to the study by (Deb Roy et al. 2021), single degree of freedom (SDOF) structural models in the form of lumped mass supported by a column will be designed (as shown in Figure 4a). Two different fundamental lateral periods (0.3 and 0.7 sec) of vibration resembling building structures with 3 and 7 number of stories, respectively, will be considered. This will simulate short to moderate flexible range periods of superstructures, which comprise the majority of structures in developing countries. The fundamental lateral periods of building structures are calculated as 0.1 times the number of stories as suggested in Indian Standard (IS 1893–1984). The lumped mass attached to the top of the column will be fabricated by using solid cylindrical masses (made of mild steel) of pre-calculated weights to simulate two different periods of the superstructure system. These weights will be screwed at the top of the steel column. The steel column will have a constant lateral stiffness (k) and will be attached to the foundation using a base plate. The cross section of the column will be rectangular with a width of (b) and a thickness of (t). The weight of the lumped masses will be selected based on the desired natural period of model structures using the equation $T = 2\pi\sqrt{\frac{m}{k}}$, where m is the mass of the superstructure and k is the stiffness of the steel column calculated as $k = \frac{3EI}{L^3}$, where E is the young's modulus, I is the moment of inertia ($\frac{1}{12}bt^3$), and L is the length of the steel column. Using the above equations, masses for both natural periods of superstructure systems can be calculated. These periods will be later verified by testing the models to a set of free vibration experiments and white noise excitations. The designed SDOF structure will be rigidly fixed on the model sleeved-pile foundation system (Figure 4b).

For the pile foundations, hollow cylindrical pile groups of 2 by 2 made of light weight alloy of steel will be considered. Piles will have a length of L_P, diameter of d, and thickness of t. The piles will be rigidly connected to a pile cap made of mild steel. The spacing of 3 times diameter (s = 3d) will be used for the group piles (Figure 4c). Piles will be designed based on the maximum load of the heavier superstructure (with 0.7 sec period) plus the weight of the pile cap. A factor of safety of 2 will be considered for this design. It is obvious that the factor of safety for the superstructure with 0.3 sec period will be higher than 2.



(a) (b) (c)

Figure 4. a) Representative lumped mass stick superstructure system, b) Representative model pile supported lumped mass structural system, c) Pile group

Sub-task 2. This sub-task includes designing a soil container in order to model the foundation soil. In order to consider the soil-structure interaction, a laminar soil container will be used to simulate the boundary conditions ((Lu et al. 2002), (Turan et al. 2009), (Hokmabadi et al. 2015), (Kumar and Mishra 2019)). The flexible soil container will consist of steel plates that are stiffened with small braces to avoid over-deformation during lifting. The inner faces of the container will be laminated with a foam layer to minimize the boundary effects. The bottom of the container will be fixed to the shake table using steel fasteners and bolts. A loose saturated sandy soil profile will be used as the foundation soil for this study.

Sub-task 3: This sub-task includes building the test setups and installing the instruments. Three different foundation systems will be considered. The foundation system for the first model will include sleeved-piles with empty gaps. This will be the control model. In the second model, the gap of the sleeved-piles will be filled a mixture of 50% TDA and 50% sand. For the third model, 100% TDA will be used to fill the gap (Figure 5).

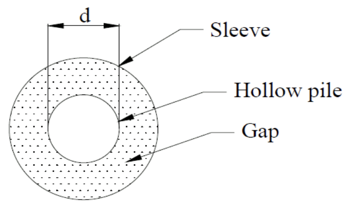


Figure 5. Plan view of the sleeved pile

The designed superstructure will be fabricated and added to the foundation system. Accelerometers will be installed on the superstructure, pile cap, and piles to measure the dynamic response of the superstructure and the piles. Figure 6 illustrates the schematic view of the experimental set up on the shake table. The test matrix is also summarized in Table 3.

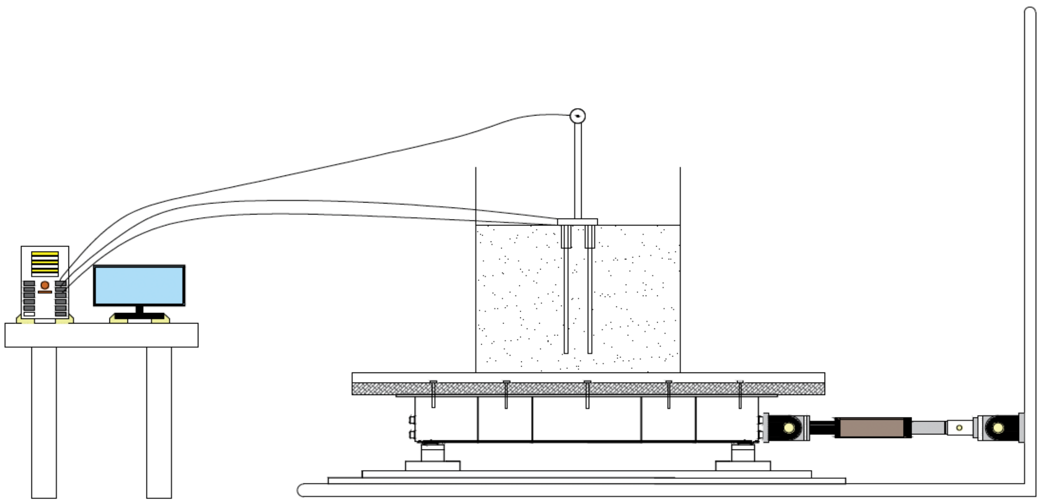


Figure 6. The schematic view of the experimental set up on the shake table

Table 3. Test matrix

Test No	Period of the superstructure (sec)	Pile System
1	0.3	Sleeved piles with empty sleeves
2	0.3	Sleeved-piles filled with 50% TDA + 50% sand
3	0.3	Sleeved-piles filled with 100% TDA
4	0.7	Sleeved piles with empty sleeves
5	0.7	Sleeved-piles filled with 50% TDA + 50% sand
6	0.7	Sleeved-piles filled with 100% TDA

Sub-task 4: This task includes selection and scaling of ground motion excitations and shake table testing. Sinusoidal as well as earthquake motions will be used for shake table testing. The earthquake ground motions will be selected using FEMA P695 (2009). Also, a set of free vibration experiments and white noise excitations will be applied to verify the model periods and energy dissipation of the system.

Experiments will be conducted on the test units using the shake table facility at the Lyles College of Engineering at CSU Fresno (Figure 7). The dimensions of the shake table are 8ft × 7ft, and the load capacity is 20.0 tons. The shake table is driven by a 100 gpm pump and an actuator that provides 55 kip of hydraulic fluid driving force through a 10-in displacement stroke (one-dimensional).

Figure 7. Shake table at CSU Fresno

The test specimens will be assembled and transferred to the top of the shake table by the crane available at the shake table facility. The instrumentations (accelerometers and string potentiometer) will be strategically connected to the National Instrument (NI) data acquisition system that is safely located outside of the shake table. High-definition camcorders will be also used to visually record the seismic behaviors. A series of earthquake simulations will be performed to accomplish this project. Earthquake records will be selected from FEMA P695 (2009) corresponding to the site class. The obtained data will be analyzed to further explore the SSPSI effects and validate the numerical model of Task 3. This task will be done by undergraduate and graduate students at CSU Fresno under supervision of Dr. Sadrinezhad.

Sub-task 5: This task includes data analysis and interpretation of the results. This task will be done as a collaborative work by undergraduate and graduate students at CSU Fresno and CSULA under supervision of Drs. Sadrinezhad and Nazari.

Task 4: Parametric Study and Design Guide: The results obtained from the numerical simulations will be compared with the results obtained from the experimental simulations. The findings will be summarized in the form of a design guide. This task will be done as a collaborative work between undergraduate and graduate students at CSU Fresno and CSULA under the supervision of Drs. Sadrinezhad and Nazari.

Project Schedule:
The PI and co-PI, as listed in Table 1, are responsible for leading research tasks, according to their individual expertise. The total duration of this project is three years. Expected durations of the individual tasks are summarized in Table 4.

Table 4: Project timeline

Activity	Y1			Y2			Y3		
	Fall	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer
Task 1	×	×	×						
Task 2		×	×	×	×				
Task 3		×	×	×	×	×	×		
Task 4							×	×	×

Broader Impacts:
The proposed research advances the seismic design of structures which can reduce the damages caused by earthquakes and increase human safety. Using TDA, which is processed waste tires, instead of expensive dampers, reduces the cost of this seismic isolation method and makes them more accessible for residential areas. Moreover, the recycled nature of TDA contributes to the sustainability of the proposed system by protecting the natural world from pollution.

This project is also a good opportunity for undergraduate and graduate students at CSU Fresno and CSULA to get familiar with advanced experimental and numerical techniques in geotechnical and structural engineering disciplines, which are different from traditional methods covered in various course syllabi. CSU Fresno and CSULA are both Hispanic-Serving Institutions and have a culture that nurtures the diversity and inclusion of various identities. The PI and Co-PI are both female and strongly support the cause of advancement of women in engineering. They are also Co-PIs on the recently funded NSF-ADVANCE grant titled, “Kindling Inter-university Networks for Diverse (KIND) Engineering Faculty Advancement in the California State University System” which aims to strengthen the representation of the female engineering professoriate in the entire CSU system. Therefore, this project will increase participation of women and underrepresented minorities (URM) in engineering. Students' engagement each semester with applied research and design projects will stimulate interest in research among students at CSU Fresno and CSULA, of whom about 56% and 72%, respectively, are from underserved minorities. This will also increase the number of female and underrepresented students pursuing advanced degrees and research careers. Additionally, the participating students will run high school outreach workshops on this topic in order to attract female and underrepresented high school students in the California central valley to the engineering program. If funded, the proposed project has a strong potential to make a long-term impact.

Results from Prior NSF Support

***Drs. Arezoo Sadrinezhad and Maryam Nazari*:**
(1) (Co-PI) NSF ADVANCE Partnership Award No. 2121950. Amount: $1.25M; Period of support: 09/01/2021-08/31/202: Kindling Inter-university Networks for Diverse (KIND) Faculty Advancement in the California State University System.
Intellectual merits: This project aims at addressing gender disparity in the engineering professoriate in the CSU system. It considers intersectionality between gender, race and foreign-born/foreign trained status to investigate retention and advancement of women.
Broader Impact: It will test the impact of data-driven interventions on the largest PUI education system in the USA. The diversification of the professoriate is expected to impact almost 50,000 engineering students enrolled in the CSU system.
Publications: Oka et al. (2022); "Investigating Tenure Experiences of Foreign-Born Women Faculty in Engineering at the California State University System", ASEE Annual Conference, 2022. Two more publications are currently in review.

(2) NSF Subaward No: 28250-04301-S17. Amount: $5,000 Period of Support: 9/7/2017-4/30/2018 PTE: Syracuse University, PI: Shobha Bhatia, PTE Federal Award No: 1536542. Project Title: Long Distance Network Seed Grants. Subrecipient: California State University, Fresno, Sub PI: Lalita Oka. Subaward Project Title: CSU Women Engineering Faculty Support Network (Cal-State WEFSN).
Intellectual merits: The CSU Fresno team investigated networking and collaboration needs of women engineering faculty within the CSU system to establish and expand the support network.
Broader Impacts: The findings led to the current ADVANCE-Partnership grant application, whose proposed activities are based on the findings of this subaward.
Publications: Oka et al. (2019), "Assessing the networking preferences and resource satisfaction among engineering faculty in the California State University system," Conference Proceedings, ASEE Annual Conference and Exposition, 2019 (ASEE Women's division - Best Diversity Paper Award, 2019).

Dr. Arezoo Sadrinezhad:
(3) NSF Subaward No: 28250-04301-S14. Amount: $5,000 Period of Support: 9/7/2017-4/30/2018 PTE: Syracuse University, PI: Shobha Bhatia, PTE Federal Award No: 1536542. Project Title: Long Distance Network Seed Grants. Subrecipient: California State University, Fresno, Sub PI: Arezoo Sadrinezhad. Subaward Project Title: Long Distance Network Seed Grants.
Summary: The goal of the funded proposal was to initiate an undergraduate geotechnical research program at the Department of Civil and Geomatics Engineering at CSU Fresno. The main goals of this research program were: 1) to engage undergraduate students in research activities; 2) to prepare undergraduate students for professional work; and 3) to increase the number of students who attend graduate degree programs. As a result of this grant, a research group was formed consisting three graduate students and six undergraduate students.
Publications: Sadrinezhad et al. (2019) "Shake Table Test of Railway Embankment Consisting of TDA and LECA". Proceedings of the Eighth International Conference on Case Histories in Geotechnical Engineering (Geo-Congress 2019). Tehrani et al. (2018) "Numerical Simulation of the Dynamic Response of Rail Ballast with Tire-Derived Aggregates". Eleventh U.S. National

Conference on Earthquake Engineering (11NCEE). Jeevanlal et al. (2018) "Shake table test of rail embankment consisting of LWA and TDA", CSU Fresno Project Day.

Dr. Maryam Nazari:
(3) (Co-PI) NSF CMMI 2117908, (09/1/21 – 08/31/24) "MRI: Acquisition of a Confined Bi-Directional Cyclic Shear Apparatus for Research and Education on Earthquake-Resilient Infrastructure" ($452,243).
Intellectual Merit: The acquired device will advance knowledge in the areas of geotechnical engineering, earthquake engineering, experimental techniques, and modeling methodologies. Three research projects will be conducted using this device including "partial drainage testing under undrained and boundary-control simple shear settings", "reduction in undrained soil shear strength due to static shear stresses with various magnitudes and directions", and "soil-pile-structure interaction simulations for geotechnical-seismic-isolated buildings".
Broader Impacts: The research projects will improve the fundamental understanding of simple shear testing, which will lead to a more accurate characterization of soil properties. In turn, this will allow more reliable and less costly engineering designs. Within the context of performance-based earthquake engineering, such information will improve public safety and lead to more efficient use of retrofitting resources. The experimental database produced by this research will represent a valuable data set to numerical modelers for calibrating and validating their constitutive models. Publications: None yet.

(4) (Senior Personnel) NSF IUSE 2122941, (10/1/21 – 09/31/24) "Collaborative Research: HSI Implementation and Evaluation Project: Commitment to Learning Instilled by Mastery-Based Undergraduate Program" ($699,999).
Intellectual Merit: This project seeks to redesign key sophomore "gateway" courses using mastery-based grading to improve course completion rates and foster and measure shifts in student attitudes towards learning, confidence as learners, and the development of engineering identity.
Broader Impacts: Through this project a hybrid faculty development course will be developed for using Mastery-Based Grading, which will be made available to faculty in the participating institutions through the Center for Teaching and Learning and will be made useful to other institutions via a public website and other channels. Institutional effective teaching and learning capacity will be enhanced through faculty development activities and faculty learning community; guides for managing the change process will be produced and disseminated to other minority-serving institutions. Publications: None yet.

Proposal 98808 has successfully linked to the following lead proposal:

Temporary ID Number: 97980
Proposal Title: Collaborative Research: RUI: Shake Table Study on Seismic Soil-Pile-Structure Interaction of Buildings with Sleeved Piles Filled with Tire-Derived Aggregates in a Liquefiable Soil
Submission Type: Full Proposal
Principal Investigator: Arezoo Sadrinezhad
Date/Time Proposals Linked: 01/25/2023 6:33 PM EST

Each organization can access its proposal from the listing of in progress proposals within Research.gov.

Sign into Research.gov

Need Help?
You can find helpful Research.gov information by clicking Help in the top right-hand corner of Research.gov.
For additional assistance, please contact the NSF Help Desk at 1-800-381-1532 or Rgov@nsf.gov.
Please DO NOT REPLY TO THIS MESSAGE, as this email was sent from an address that cannot accept incoming messages.

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE **PD 19-073Y**	☐ Special Exception to Deadline Date Policy	FOR NSF USE ONLY NSF PROPOSAL NUMBER **2316739**
FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.) **CMMI - ECI-Engineering for Civil Infr**		

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	UEI (Unique Entity Identifier)	FILE LOCATION
01/25/2023	1	07030000 CMMI	073Y	CJSRSPWTJUH7	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN) **946003272**	SHOW PREVIOUS AWARD NO. IF THIS IS ☐ A RENEWAL ☐ AN ACCOMPLISHMENT-BASED RENEWAL	IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE **CALIFORNIA STATE UNIVERSITY FRESNO FOUNDATION** AWARDEE ORGANIZATION CODE (IF KNOWN) **0011478001**	ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE **4910 N CHESTNUT AVE** **FRESNO,CA 93726-1852 US**
NAME OF PRIMARY PLACE OF PERF **California State University-Fresno Foundation**	ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE **4910 N CHESTNUT AVE** **FRESNO,CA 93726-1852 US**

IS AWARDEE ORGANIZATION (Check All That Apply) ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS | ☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT
Collaborative Research: RUI: Shake Table Study on Seismic Soil-Pile-Structure Interaction of Buildings with Sleeved Piles Filled with Tire-Derived Aggregates in a Liquefiable Soil

SHOW LETTER OF INTENT ID IF APPLICABLE

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 165,513	36 months	08/01/2023	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW
- ☐ BEGINNING INVESTIGATOR
- ☐ DISCLOSURE OF LOBBYING ACTIVITIES
- ☐ PROPRIETARY & PRIVILEGED INFORMATION
- ☐ HISTORIC PLACES
- ☐ VERTEBRATE ANIMALS IACUC App. Date ______
- PHS Animal Welfare Assurance Number ______
- ☒ TYPE OF PROPOSAL **Research**
- ☐ HUMAN SUBJECTS Human Subjects Assurance Number ______
- Exemption Subsection ______ or IRB App. Date ______
- ☐ FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE
- ☐ FUNDING OF FOREIGN ORGANIZATION OR FOREIGN INDIVIDUAL
- ☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED
- ☒ COLLABORATIVE STATUS
  A collaborative proposal from multiple organizations (PAPPG II.D.3.b)

PI/PD DEPARTMENT **Civil and Geomatics Engineering**	PI/PD POSTAL ADDRESS **4910 N. Chestnut Ave** **Fresno,CA 937261852** **US**
PI/PD FAX NUMBER	

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address
PI/PD NAME **Arezoo Sadrinezhad**	PhD	2014	559-278-1657	asadrinezhad@csufresno.edu
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

Attachments: Task 2 – Developing a New Graduate Level Course

Syllabus:

CE291T Geotechnical Earthquake Engineering
Spring 2023

Course Modality: Digital Campus Synchronous (100% virtual)	
Course ID: CE 291T	**Instructor Name:** Dr. Arezoo Sadrinezhad
Units: 3	**Department:** Civil and Geomatics Engineering
Class Meeting Location & Time: Tue 5-7:50 pm Zoom info: Meeting ID: 838 5818 3330 Passcode: Earthquake	**Email / Telephone:** asadrinezhad@csufresno.edu
Canvas: *fresnostate.instructure.com*	**Office:** EE194
Prerequisites: The knowledge of soil engineering and geotechnical engineering design is required for this class.	**Student Support Hours (by appointment):** Mon: 12:00 – 2:00 pm (In-person) Thu: 12:00 – 3:00 pm (Virtual) Zoom link: https://fresnostate.zoom.us/j/5250745609

Course Description: This is a 3-unit course. Course lecture occurs once a week. This course is concerned with the study of aspects of geotechnical engineering related to earthquakes and other dynamic effects. In this course, we will study how soil responds to dynamic loading and how the soil modifies the transmission of the traveling ground motion. It is usually expected that students will spend approximately 2 hours of study time outside of class for every one hour in class. Since this is a 3-unit class, you should expect to study an average of 5 hours outside of class each week.

Required Course Materials:
Textbook: Geotechnical Earthquake Engineering, Steven L. Kramer, Prentice-Hall, 1996.
Software: GeoStudio QUAKE/W

Course Learning Objectives: In this course, students will learn about:
1. Earthquake motion sources, ground motion, time history, and response spectra.
2. Analysis of wave propagation through soil.
3. Analysis of soil liquefaction.
4. Simplified analysis of underground structures.

Attendance/Classroom Participation: Classroom participation represents 20% of the final grade for the course and includes:

1. Factors such as attendance, punctuality, attentiveness, respectfulness, preparedness, and engagement. Arriving more than 10 minutes late is considered an absence. Missing class more than 3 times will result in negative points. If you are absent from the class, it is your responsibility to inquire about announcements during your absence. For unplanned, authorized absences, student is responsible for notifying and providing documentation to Instructor within 24 hours following the absence. Make-up or excusing of assignments, quizzes, and exams will only be provided for authorized student absences per APM 232 (http://www.fresnostate.edu/academics/facultyaffairs/documents/apm/232.pdf). (5%)

2. Student presentation: At the start of every lecture, a designated student will present a summary of the previous lecture to the class. The summary should be presented using a PowerPoint presentation in a bullet form (5-8 minutes). (5%)

3. Case study: At the end of every lecture, a designated student will present an earthquake case history summarizing the geotechnical aspects of the earthquake and how they relate to material presented in class. The summary should be presented using a PowerPoint presentation (10-12 minutes). (10%)

Assessment: Assessment will be by marks awarded for the following:
Homework Assignments: 20%
Midterm Exam: 30%
Final Exam/Project: 30%
Class Participation (attendance/presentations/case studies): 20%

Letter grades will be used at the following scale to measure student's performance
A = 90 - 100%
B = 80 – 89.9%
C = 70 – 79.9%
D = 60 – 69.9%
F = 0 – 59.9%
Please be warned that students earn less than 59.9% will fail this course
Homework Policy: Homework assignments should be submitted on Canvas. You can discuss homework problems with classmates, however, the work submitted (i.e., discussion, spreadsheet, graphs, calculations, etc.) must be your own.
Late Submissions: All assignments must be submitted before the due date or will be considered late. You will be penalized 10% for every day an assignment is late. Assignments submitted over one week after the deadline will not be graded. Please contact the instructor immediately if you cannot submit the homework on time.
Exam Policy: There will be one midterm exam and a final group project. Format of the exam will be announced on Canvas. Exam scores will not be adjusted (i.e., curved).
Group Project: Groups will be formed to conduct a term project. Instructions and specifications are given in a separate handout.

Statement Regarding Academic Honesty: ***Cheating*** is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that it includes any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. ***Plagiarism*** is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work. Penalties for cheating and plagiarism range from zero (0) on a particular assignment, through an F for the course, to expulsion from the university. The University's policy regarding cheating and plagiarism can be found at: Cheating and Plagiarism.

Plagiarism Detection: The campus subscribes to Turnitin, a plagiarism prevention service, through Canvas. You will need to submit written assignments to Turnitin. Student work will be used for plagiarism detection and for no other purpose. The student may indicate in writing to the instructor that he/she refuses to participate in the plagiarism detection process, in which case the instructor can use other electronic means to verify the originality of their work. Turnitin Originality Reports will be available for your viewing.

Disruptive Classroom Behavior: "The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop an understanding of the community in which they live. Student conduct which disrupts the learning process shall not be tolerated and may lead to disciplinary action and/or removal from class." Cell phones should be turned off while you are attending the class.

Dispute Resolution: If there are questions or concerns that you have about this course that you and I are not able to resolve, please feel free to contact the Chair of the department to discuss the matter.
Chair's name: Dr. Fayzul Pasha
Department name: Civil and Geomatices Engineering
Chair's email: mpasha@mail.fresnostate.edu
Department phone number: 559-278-2464

Intellectual Property: All course materials, including but not limited to the syllabus, readings, quiz questions, exam questions, and assignments prepared by the instructor are property of the instructor and University. Students are prohibited from posting course materials online (e.g., Course Hero) and from selling course materials to or being paid for providing materials to any person or commercial firm without the express written permission of the professor teaching this course. Doing so will constitute both an academic integrity violation and a copyright violation. Audio and video recordings of class lectures as well as images of chat or messages shared during course sessions are prohibited unless I give you explicit permission in advance. Students with an official letter from the Services for Students with Disabilities office may record the class if SSD has approved that service. Otherwise, recordings of lectures are included in the intellectual property notice described above. These provisions exist regardless of the modality of the course. That is they apply to in-person, hybrid and online courses.

Student Ratings of Instruction: In the final weeks of the semester, you will be asked to complete a short survey to provide feedback about this class. The primary goal of student ratings is to help your instructor improve the class. Feedback will also be reviewed by the department chair and the college dean. You will be given 15 minutes of class time to complete student ratings. Please offer feedback honestly and thoughtfully. Your participation is appreciated. You can access your student rating surveys and get more information at: https://sites.google.com/mail.fresnostate.edu/fresno-state-sri/fssri-for-students.

University Policies:
Students with Disabilities: Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the University Library, Room 1202 (278-2811).

The following University policies can be found on the web at:

- Adding and Dropping Classes
- Cheating and Plagiarism
- Computers
- Copyright Policy
- Disruptive Classroom Behavior
- Honor Code
- Title IX

University Services

The following University services can be found on the web at:

- Associated Students, Inc.
- Students with Disabilities
- Dream Success Center
- Library
- Learning Center Information
- Student Health and Counseling Center
- SupportNet
- Survivor Advocacy
- Writing Center

The following sections regarding COVID are subject to change given changing circumstances on-campus and in the community. Please check the COVID website for the most up-to-date information at: ***www.fresnostate.edu/coronavirus***

Vaccination:

The California State University system's COVID-19 vaccination requirement remains unchanged and is in effect for spring 2023. All students, faculty and staff are required to have a COVID-19 vaccination and booster when eligible on file in order to access campus facilities and programs, and participate in any campus-sponsored in-person activities on or off-campus. As previously announced, the CSU's COVID-19 vaccination policy allows students and employees to seek exemptions on medical and religious grounds. As a reminder, you are eligible for a booster five (5) months after receiving a final dose of the Pfizer or Moderna vaccine; or two (2) months after receiving a Johnson & Johnson vaccine.

Face Coverings:

Based on updated guidance from public health experts, Fresno State highly recommends that all students, faculty and staff, regardless of vaccination status, wear a surgical grade or KN95 mask indoors. Free surgical grade masks are available at the Student Health and Counseling Center, Atrium, University Warehouse, Student Recreation Center, Library and the University Student Union (USU). ***Faculty will continue to have the discretion to require face coverings for their in-person classes as they evaluate the health and safety needs of their individual classroom environments***.

Testing:

Our COVID-19 Testing Center will continue to be open and available this Spring at no cost for our entire campus community. The Testing Center will be located on the main level of the USU and will have saliva PCR tests available to retrieve from a vending machine Monday - Friday. Testing is available for all students and employees.

Please remember that the same student conduct rules that are used for in-person classroom instruction also apply for virtual/online classrooms. Students are prohibited from any unauthorized recording, dissemination, or publication of any academic presentation, including any online classroom instruction, for any commercial purpose. In addition, students may not record or use virtual/online instruction in any manner that would violate copyright law. Students are to use all online/virtual instruction exclusively for the educational purpose of the online class in which the instruction is being provided. Students may not re-record any online recordings or post any online recordings in any other format (e.g., electronic, video, social media, audio recording, web page, internet, hard paper copy, etc.) for any purpose without the explicit written permission of the faculty member providing the instruction. Exceptions for disability-related accommodations will be addressed by Student Disability Services working in conjunction with the student and faculty member.

Tentative Syllabus and Calendar: This syllabus and schedule are subject to change in the event of extenuating circumstances.

	Date	**Topic**	**Reading Assignment**	**Assignment Due**
1	Tue., Jan 24	Syllabus, Text book, Introduction	- Chapter 1	
2	Tue., Jan 31	Seismology and Earthquakes	- Chapter 2	HW1
3	Tue., Feb 7	Seismology and Earthquakes	- Chapter 2	HW2
4	Tue., Feb 14	- Vibratory Motion - Strong Ground Motion	- Appendix A & Chapter 3	HW3

	Date	Topic	Reading Assignment	Assignment Due
5	Tue., Feb 21	- Dynamics of Discrete Systems - Strong Ground Motion	- Appendix B & Chapter 3	HW4
6	Tue., Feb 28	Seismic Hazard Analysis	Chapter 4	HW5
7	Tue., Mar 7	Seismic Hazard Analysis Midterm Exam Review	Chapter 4	
8	Tue., Mar 14	Midterm Exam		HW6
9	Tue., Mar 21	Dynamic Soil Properties	Chapter 6	
10	Tue., Mar 28	Soil Liquefaction	Chapter 9	HW7
	Tue., April 4	Spring Break		
11	Tue., April 11	Soil Liquefaction	Chapter 9	HW8
12	Tue., April 18	Seismic Slope Stability Project Description	Chapter 10	HW9
13	Tue., April 25	Goestudio software – QUAKE/W		
14	Tue., May 2	Seismic Slope Stability	Chapter 10	
15	Tue., May 9	Project Presentations		HW10
Finals week			**Days**	**Dates**
Final Exam Preparation & Faculty Consultation Days:			Thursday and Friday	May 11 – 12
Final Semester Examinations			Monday – Thursday	May 15 – 18
Final Exam in this course			Project reports should be submitted on Thursday by midnight.	May 18

California State University Fresno

TOPICS COURSE (T-COURSE) PROPOSAL

Semester: Spring **Year:** 2023 **Department:** Civil and Geomatics Engineering

GENERIC (Parent Course) TOPIC TITLE (Same as in Catalog, Example: CHEM 140T "Topics in Chemistry"

CE291T: Geotechnical Earthquake Engineering

FULL SPECIFIC TOPIC TITLE (Child Course)

Geotechnical Earthquake Engineering

Subject	Catalog No	Short Title (16 Characters, Including Spaces)	CS# Link Lect	CS# Link Lab	Units Lect	Units Lab	Grading Basis	Course ID *(if known)*
CE	291T	Geotech EQ Eng	C2		3		Letter Grad	

Will this course be combined with another course? No ☑ Yes ☐ **If yes, indicate which course below.**

Subject	Catalog No	Course Title	Course ID

COURSE DESCRIPTION: (600 Characters or less, including spaces)

This course is concerned with the study of aspects of geotechnical engineering related to earthquakes and other dynamic effects. In this course, students will learn about: 1. earthquake motion sources, ground motion, time history, and response spectra, 2. Analysis of wave propagation through soil, 3. Analysis of soil liquefaction, and 4. Simplified analysis of underground structures.

JUSTIFICATION FOR COURSE:

In this course students will learn about geotechnical aspects of Earthquake Engineering, which deals with the design of geo-structures in order to resist the effects of earthquakes.

APPROVAL SIGNATURES:

DEPARTMENT CHAIR

COLLEGE/SCHOOL DEAN

NOTE: If a Topics Course has been offered 6 semesters or more it must be converted to a new course before it can be offered again. This rule applies even when the title has been slightly modified.

1. Number of times this Topics Course subject has been offered (use "1" to indicate it's a new T-course):

2. List all previous offerings of this Topics Course by semester and year (waived if new T-course):

Offering #	Semester	Year
1		
2		
3		
4		
5		
6		

3. If this Topics Course has been offered six times, and this current submission will be the 7th time, what are plans to convert this Topics Course to a regular course or cancel it?
   a. ☐ Will cancel after current proposal to offer it.
   b. ☐ Will convert it to a regular course. The catalog title and number will be:
   Subject/Catalog #: ______ Course Title: ______
   (ex: **SOC 125** - *Statistics for the Social Sciences*)

Arezoo Sadrinezhad

Faculty Center | Advisor Center | Search

Class Roster

Spring 2023 | Regular Academic Session | California State Univ Fresno | Postbaccalaureate

Change Class

CE 291T - 02 (37752)

Geotechnical Earthquake Engineering (Lecture)

Days and Times	Room	Instructor	Dates
Tu 5:00PM-7:50PM	Digital Campus Synchronous	Arezoo Sadrinezhad (She/Her/Hers)	01/19/2023 - 05/18/2023

Room Capacity 500

***Enrollment Status** Enrolled

Enrollment Capacity 20 **Enrolled** 6

Select display option

◉ **Link to Photos** ○ **Include photos in list**

Permission Numbers

Students who do not attend class or do not satisfy course requisites may be administratively dropped by the primary instructor no later than the 10th day of instruction. To drop students from this class, check the box next to all the students to be dropped, and click on the "Drop Selected Students" button. This will drop the student(s) from the class and display a confirmation page.

Enrolled Students Find | View All | First 1-6 of 6 Last

	Notify	Photo	ID	Name	Pronouns	Units	Program and Plan	Academic Level	Add Dt	Grade Dt
1	☐		105995116	Alameda,Enrique		3.00	Graduate - Civ Engr-Wtr Rs & Env Engr Opt	Graduate	11/03/2022	
2	☐		301382329	Amareh,Mohammadkazem		3.00	Graduate - Civ Engr-Wtr Rs & Env Engr Opt	Graduate	01/27/2023	
3	☐		109166648	Guthrie,Andrew		3.00	Graduate - Civ Engr-Wtr Rs & Env Engr Opt	Graduate	10/31/2022	
4	☐		105511529	Poythress,Richard Lawrence		3.00	Graduate - Civil Engineering	Graduate	11/26/2022	
5	☐		301426581	Sattu,Radhika		3.00	Graduate - Civil Engineering	Graduate	01/05/2023	
6	☐		301085110	Vampu,Tanishq Rao		3.00	Graduate - Civil Engineering	Graduate	01/27/2023	

Find | View All | First 1 of 6 Last

Attachments: Task 3 – Redesigning CE134 course

Syllabus:

Fall 2023, CE134, L Foundation Design
Mon-Wed 9:00 – 9:50 am, 10:00 am – 10:50 am, EE 180

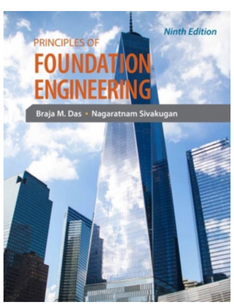
Instructor:
Dr. Arezoo Sadrinezhad
Office: EE 194
Phone: 559-278-6603
Email: asadrinezhad@csufresno.edu

Office Hours:
Tue: 9:00 am – 12:00 pm
Virtual Office Hours (via email or zoom): Thu: 8:30 am – 10:30 pm
Meeting ID for Virtual Office Hours: 525 074 5609 by appointment.

Course Description: This is a 3-unit course. Course lectures occur twice a week. Prerequisite courses are CE 123 Soil Engineering and CE 123L Soil Engineering Lab. This is a design course in geotechnical engineering area, offered to senior undergraduate students in civil engineering. This course covers the design and analysis of shallow foundation, deep foundations, and earth retaining structures. This course also has a Course-Based Undergraduate Research Experience (CURE) module (4 sessions).

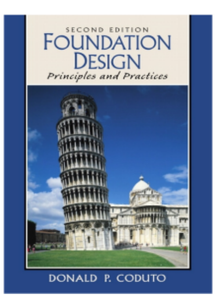
Required Textbook:

Principles of Foundation Engineering
by Braja M. Das, Nagaratnam Sivakugan
9th Edition | Copyright 2019
ISBN-10: 0357703863 | ISBN-13: 9780357703861
Note: Old editions are allowed. Class lectures are based on the 8th edition.



Suggested reference book:

Foundation Design: Principles and Practice (2nd edition)
Author: Donald P Coduto
Publication Date: Sep, 2009
Publisher: Pearson
ISBN-10: 0135897068 • ISBN-13: 9780135897065



Course Learning Objectives:

The purpose of this course is to introduce senior undergraduate students in civil engineering the concepts and designs of shallow and deep foundation. At the conclusion of this course, the student should be able to:
1. Understand the typical field drilling, sampling, and testing methods and equipment.
2. Estimate bearing capacity and design a simple shallow foundation.
3. Estimate elastic and consolidation settlement of shallow foundation.
4. Determine the required thickness of shallow foundations and the size, number, and spacing of the reinforcing bars (structural design of shallow foundations)
5. Estimate load carrying capacity and design a deep (pile and drilled shafts) foundation.
6. Compute lateral earth pressure and check safety of earth retaining walls.
7. Learn about basic research methods
8. Develop inter-personal skills by working together in a group.

Relationship of Course to ABET Criteria for Student Outcomes (SOs)
This course satisfies partly or in whole the following ABET Student Outcomes

Student Outcome	Description	Correlation with the curriculum
(a)	Apply knowledge of math, science, and engineering	High
(c)	Design system, component, or proceed to meet needs	High
(e)	Identify, formulate, and solve problems	High
(g)	Communicate effectively (oral or in writing)	medium
(i)	Need for life-long learning	Low
(j)	Knowledge of contemporary issues	Low

Assessment:
Assessment will be by marks awarded for the following:

Homework Assignments	15 %
Quizzes & In-class Group/Individual Assignments	10 %
Midterm Examination	30 %
Final Examination	30 %
Research Project	15 %

Letter grades will be used at the following scale to measure student's performance
A = 90 - 100%
B = 80 – 89.9%
C = 70 – 79.9%
D = 60 – 69.9%
F = 0 – 59.9%
Please be warned that students earn less than 59.9% will fail this course
Homework Policy: Homework assignments should be submitted on Canvas. You can discuss homework problems with classmates, however, the work submitted (i.e., discussion, spreadsheet, graphs, calculations, etc.) must be your own.
Late Submissions: All assignments must be submitted before the due date or will be considered late. You will be penalized 10% for every day an assignment is late. I will not accept assignments submitted over one week after the deadline. Please contact me immediately if you cannot submit the homework on time.

Please follow the following "Rules for homework assignments" to get full credit:

Rules for Homework/Assignments: The following rules should be followed when you complete homework. These items constitute a professional approach toward working on any engineering problems. Following this procedure will help you better understand your solution when you refer to the problems at a later time. It is the instructor's prerogative to deduct points from your homework/exam if these rules are not followed.

- Rule 1. **Write legibly.**
- Rule 2. To get partial credit, you must show all your work. Please annotate, comment, or explain calculations. It is a good practice to add brief comments every a few steps about what you are doing.
- Rule 3. Where appropriate, draw a schematic and label all the important components.
- Rule 4. **Carry units** throughout the problem. You will lose points in homework and exams if you miss the units.
- Rule 5. **State all the assumptions clearly**. Making reasonable assumptions is the essence of good engineering practice but you must mention them clearly.
- Rule 6. Where appropriate, plot your results. You may use computer programs such as EXCEL, MATLAB to generate high quality graphs. Make sure the axes and data series are labeled correctly and in a legible font. All plotted data points should be clearly visible.
- Rule 7. **Box or Frame the final answers.**

Homework Format:

CE 134	**HW #**	**NAME**	**Page xx/yy**
Given:	List initially defined variables, give definitions, values, and units. (If needed, draw a picture or schematic and label all the important components)		
Determine:	Write what you want to find in your own words		
Solution:			

Classroom Participation: Classroom participation includes factors such as attendance, punctuality, attentiveness, respectfulness, preparedness, and engagement. Quizzes and in-class individual/group assignments will be assigned during lectures and will account for 10 % of your overall grade. Late submissions are not accepted for these activities.

Exam Policy: There will be one midterm exam and a final exam. Midterm exam is during the time of the class. For final exam's date/time, please refer to the course calendar.

Please note that while homework and class participation grades are used to compute the final grade for the course, the exam grades will be used as a basis for a pass/fail determination. A student must have a passing exam average (i.e., 60 % or greater) to pass the course. Exam scores will not be adjusted (i.e., curved).

Research Project (CURE): The last two weeks of this class is dedicated to a research project. This is a group project and the deliverables are a project report (in a format of a conference paper) and an in-class oral presentation. There will also be a peer evaluation to evaluate the contribution of each member of the group into the project. The rubric for the research paper and the oral presentation can be found at the end of the syllabus. The learning outcomes of this research project are as follows:

a) Apply knowledge of math, science, and engineering

b) Identify, formulate, and solve problems
c) Work collaboratively with peers to develop content knowledge and communication skills
d) Communicate effectively (oral or in writing)

Due dates:
Oral presentations: Last day of class (Dec 9th)
Project report: On the final exam's day (Dec 14th) by midnight

Policy on Absences: Absence from quizzes and exams could result in zero on the exam and will be at the discretion of the instructor. For excused absences, students may be given the opportunity to make up missed quizzes and exams. It is the student's responsibility to inform the instructor of the absence no later than one week after the period of absence or, if feasible, in advance.

Statement Regarding Academic Honesty: ***Cheating*** is the actual or attempted practice of fraudulent or deceptive acts for the purpose of improving one's grade or obtaining course credit; such acts also include assisting another student to do so. Typically, such acts occur in relation to examinations. However, it is the intent of this definition that the term 'cheating' not be limited to examination situations only, but that includes any and all actions by a student that are intended to gain an unearned academic advantage by fraudulent or deceptive means. ***Plagiarism*** is a specific form of cheating which consists of the misuse of the published and/or unpublished works of others by misrepresenting the material (i.e., their intellectual property) so used as one's own work. Penalties for cheating and plagiarism range from zero (0) on a particular assignment, through an F for the course, to expulsion from the university. For more information on the University's policy regarding cheating and plagiarism, refer to Cheating and Plagiarism

Students with Disabilities: Upon identifying themselves to the instructor and the university, students with disabilities will receive reasonable accommodation for learning and evaluation. For more information, contact Services to Students with Disabilities in the Henry Madden Library, Room 1202 (278-2811).

Computers: "At California State University, Fresno, computers and communications links to remote resources are recognized as being integral to the education and research experience. Every student is required to have his/her own computer or have other personal access to a workstation (including a modem and a printer) with all the recommended software. In the curriculum and class assignments, students are presumed to have 24-hour access to a computer workstation and the necessary communication links to the University's information resources." Computers

Disruptive Classroom Behavior: The classroom is a special environment in which students and faculty come together to promote learning and growth. It is essential to this learning environment that respect for the rights of others seeking to learn, respect for the professionalism of the instructor, and the general goals of academic freedom are maintained. Differences of viewpoint or concerns should be expressed in terms which are supportive of the learning process, creating an environment in which students and faculty may learn to reason with clarity and compassion, to share of themselves without losing their identities, and to develop an understanding of the community in which they live.

Copyright policy: Copyright laws and fair use policies protect the rights of those who have produced the material. The copy in this course has been provided for private study, scholarship, or research. Other uses may require permission from the copyright holder. The user of this work is responsible for adhering to copyright law of the U.S. (Title 17, U.S. Code). To help you familiarize yourself with copyright and fair use policies, the University encourages you to visit its Copyright Web Page Copyright Policy.

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Privacy Statement: Course materials (videos, assignments, problem sets, etc) are for use in this course only. You may not upload them to external sites, share with any person outside of this course, or post them for public commentary without my written permission.
We are recording class meetings to provide everyone in the class with useful study aids. These recordings will be available for review through Canvas. The University strictly prohibits anyone from duplicating, downloading, or sharing live class recordings with anyone outside of this course, for any reason.

Tentative Syllabus and Calendar:

- This syllabus and schedule are subject to change.
- Students are expected to study the chapter(s) before the lecture.

	Date	Topic	Reading Assignment
1	Mon., Aug 23	Introduction, Syllabus, Text book (synch)	Chapter 1
2	Wed., Aug 25	Geotechnical Properties of Soil (asynch)	Chapter 2
3	Mon., Aug 30	Geotechnical Properties of Soil (synch)	Chapter 2
4	Wed., Sept 1	Natural soil deposits and subsoil exploration (asynch)	Chapter 3
	Mon., Sept 6	HOLIDAY – Labor Day	
5	Wed., Sept 8	Natural soil deposits and subsoil exploration (asynch)	Chapter 3
6	Mon., Sept 13	Shallow foundations: Ultimate bearing capacity (synch)	Chapter 4

	Date	Topic	Reading Assignment
7	Wed., Sept 15	Shallow foundations: Ultimate bearing capacity (asynch)	Chapter 4
8	Mon., Sept 20	Shallow foundations: Ultimate bearing capacity (synch)	Chapter 4
9	Wed., Sept 22	Settlement of Shallow foundations (asynch)	Chapter 7
10	Mon., Sept 27	Settlement of Shallow foundations (synch)	Chapter 7
11	Wed., Sept 29	Settlement of Shallow foundations (asynch)	Chapter 7
12	Mon., Oct 4	Midterm Exam	
13	Wed., Oct 6	Mat foundations (synch)	Chapter 8
14	Mon., Oct 11	Mat foundations (asynch)	Chapter 8
15	Wed., Oct 13	Pile foundations (synch)	Chapter 9
16	Mon., Oct 18	Pile foundations (synch)	Chapter 9
17	Wed., Oct 20	Pile foundations (asynch)	Chapter 9
18	Mon., Oct 25	Pile foundations (synch)	Chapter 9
19	Wed., Oct 27	Lateral Earth Pressure	Chapter 12
20	Mon., Nov 1	Lateral Earth Pressure	Chapter 12
21	Wed., Nov 3	Lateral Earth Pressure	Chapter 12
22	Mon., Nov 8	Retaining Walls	Chapter 13
23	Wed., Nov 10	Retaining Walls	Chapter 13
24	Mon., Nov 15	Retaining Walls	Chapter 13
25	Wed., Nov 17	Retaining Walls	Chapter 13
26	Mon., Nov 22	Research Project (CURE) – Introduction	
	Wed., Nov 24	Thanksgiving Break	
27	Mon., Nov 29	Research Project (CURE) - Methodology	
28	Wed., Dec 1	Research Project (CURE) - Analysis	

	Date	Topic	Reading Assignment	
29	Mon., Dec 6	Research Project (CURE) - Oral Presentations		
30	Wed., Dec 8	Final Exam Review		
Finals week			**Days**	**Dates**
Final Exam Preparation & Faculty Consultation Days:			Thursday and Friday	Dec 9 – 10
Final Semester Examinations			Monday – Thursday	Dec 13 – 16
Final Exam in this course			Monday	Dec (8:45-10:45am)

CE 134 Research Project

Simple Project to Introduce Geotechnical Engineering Research Methods

Learning Outcomes:

1. Apply knowledge of math, science, and engineering
2. Identify, formulate, and solve problems
3. Work collaboratively with peers to develop content knowledge and communication skills
4. Communicate effectively (oral or in writing)

Assessment:

1. Students will submit a group report, in a format of a conference paper, describing the findings
2. Students will present their work in classroom

Problem Statement

Rotational stability of a cantilever Retaining walls with different backfill materials (soil (sand) vs soil-rummer mixture (SRM = Sand + TDA) using GeoStudio – SLOPE/W software.

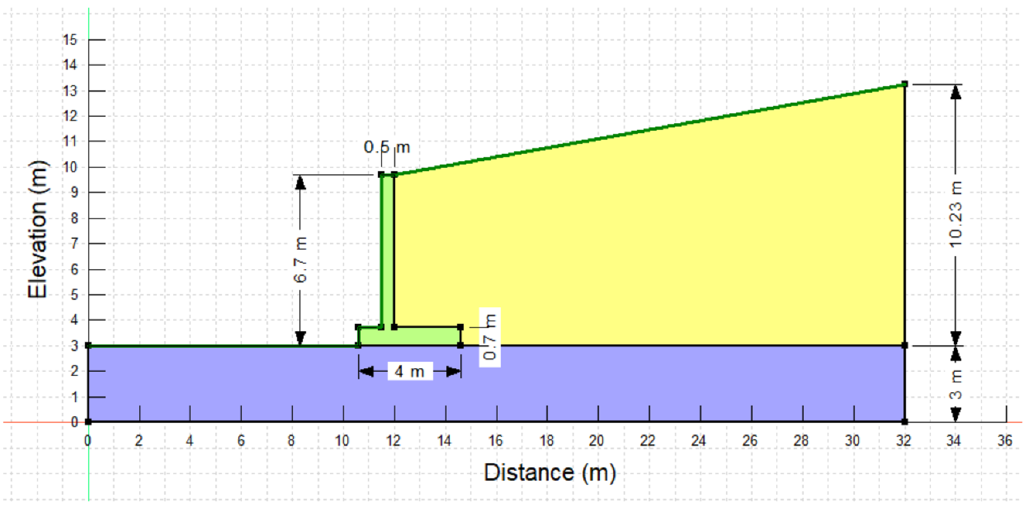
Keywords: Retaining wall, stability, sand, shredded tire, GeoStudio SLOPE/W

Material Properties:

- Foundation soil: c =0.01 kN/m^2, phi=42 deg, unit weight=19.5 kN/m^3
- Backfill: c =0.01 kN/m^2, phi=42 deg, unit weight =18.5 kN/m^3
- Concrete: c =15000 kN/m^2, phi=89 deg, unit weight =27 kN/m^3 or high strength material
- Soil+TDA: c = 37 kN/m^2, phi=25.6 deg, unit weight =15.5 kN/m^3
- Note: Student version only allows 3 materials.

Foundation soil dimension: Length = 32 m (10.6 m, B= 4 m, 17.4 m), y = 3 m (no passive soil)

Retaining wall dimensions: H= 6.7 m, B = 4 m, t_f = 0.7 m, t_w= 0.5 m, backfill slope = 10 deg,



Research Methods:

- Literature review
- Methodology
- Analysis
- Results

CE134 Research Project – Presentation Rubric

(Curtsey Dr. Tehrani)

Grading: 20% of the grade for the project

3.5 or more	2.5 to less than 3.5	1.5 to less than 2.5	1.0 to less than 1.5	Less than 1.0
A	B	C	D	F

Project presentations are graded based on the clarity, delivery, organization, technical content, and addressing questions. <u>Students are responsible to overcome potential conflicts and challenges.</u>

Criteria	Excellent (4)	Very Good (3)	Satisfactory (2)	Unsatisfactory (1)
Overview (Title, introduction, outline)	Title is concise and informative, all members are introduced in a consistent manner, and the outline is complete.	Title needs refinement, introduction is complete but not consistent, and/or outline is not complete.	Title needs correction or length adjustment, Incomplete introduction, improper outline.	Title is misleading, there are errors in introduction, and/or outline confuses audience.
Voice (Volume, clarity, and rate of speech)	Presenter is easy to hear. Rates of speech are appropriate.	Audience is able to hear as a whole, but there are times when volume is not quite adequate. Speaker may at times seem like s/he is rushing or exaggerating pauses.	Presenter is often difficult to hear. The rates of speaking are often inappropriate.	Presenter is difficult to hear. The rates of speaking are too slow or too fast.
Delivery (Engagement, enthusiasm, and mannerisms)	Presentation Involves audience, allowing time for audience to think and respond. Speaker makes eye contact with everyone and has no nervous habits. Speaker has excellent posture.	Audience is involved but inadequate processing or response time is provided. Eye contact may focus on only select few members. Mildly Distracting nervous habits are present in the beginning only and do not override the content.	Audience is rarely involved. Inadequate processing or response time is provided. Very little eye contact is made, may be with only one member of the audience. Mildly distracting nervous habits are present throughout the presentation.	Speaker does not involve audience. No little eye contact is made with the audience. It may sound like the speaker is reading the presentation. Nervous habits that distract the audience are present.

Audiovisual Materials (Quantity and quality)	Visual aids are well done and are used to make Presentation more interesting and meaningful.	Visuals aids are adequate but do not inspire engagement with the material.	Very little or poor use of visual materials.	Visual aids are adversely impacting the quality of presentation.
Organization (Logical progression and team coordination)	Presentation is well organized with a beginning, middle, and end. There is a strong Organizing theme, with clear main ideas and transitions.	Presentation is well organized with few interruptions in the flow of information.	Speakers lose train of thought, do not stay with the proposed outline, or connections are attempted but not made clear for the audience.	Presentation shows little organization, unclear purpose, and/or unclear relationships or transitions.
Technical Content (Correct and complete) (x3)	Information is complete and accurate. Clear evidence of in depth analysis and research.	Research and analysis component is less evident. Resources are present but less than adequate for assignment.	Details and examples are lacking or not well-chosen for the topic or audience. Lacks evidence of research or analysis.	Content is not clear. Audience is confused or misinformed.
Time Management (Length and Completeness)	Appropriate length. Clear summary is provided. Audience is involved in synthesizing the information.	Time is appropriately used, but may run slightly over or under allotted time.	The length is substantially over or under allotted time and/or information is not tied together or conclusion is inadequate.	Presentation lacks conclusion and/or time is not appropriately used.
Addressing Questions	Speaker is relaxed, self-confident, and respectful, self-reliant on information, describes the project at a proper level to audience, helps other members to response	Answers are smooth and respectful, somehow self-reliant on information, describing project in somehow understandable level, does not contribute to group response	Mildly nervous habits exist, not confident about information, and level of description is not appropriate, relies on other members of the group for response.	Nervous habits distract the audience, lack of respect, incorrect information about the project, inappropriate level of description, liability to the group.

CE134 Research Project: Report Writing Rubric
(Curtsey Dr. Tehrani)
Grading: 75% of the grade for the project.

3.5 or more	2.5 to less than 3.5	1.5 to less than 2.5	1.0 to less than 1.5	Less than 1.0
A	B	C	D	F

Project reports are graded based on the clarity, legibility, presentation, and technical content.

Criteria	Excellent (4)	Very Good (3)	Satisfactory (2)	Unsatisfactory (1)
Content (x4)	Balanced presentation of relevant information that shows a thoughtful, in-depth analysis of the main topic	Information provides support for a central argument and displays evidence of a basic analysis of main topic	Information supports a central purpose at times. Analysis is basic. Reader gains few insights.	Central argument is not clear. Analysis is vague. Reader is confused or misinformed.
Organization	Ideas arranged logically to support main argument. Ideas flow from one to another and are clearly linked together.	Ideas arranged logically to support main argument. Ideas usually but not always, linked together.	In general, writing is arranged logically, although occasionally ideas fail to make sense together. Some clarity of writers' intend	Writing is not Logically organized. Frequently ideas fail to make sense together. Hard to identify a line of reasoning.
Sentence Structure	Sentences are well structured and varied in length. Sentences flow smoothly from one to another.	Sentences are well-structured as there is some variety in length. Sentence flow is generally, but not always present.	Some sentences are awkwardly constructed so that reader is occasionally distracted.	Mistakes in sentence structure and major distraction to the reader.
Grammar	Writing is free or almost free of errors.	Occasional errors.	Writing has many errors, and reader is distracted by them.	So many errors that meaning is obscured. Reader is confused and stops reading.

References	Primarily professional books, journals, and standards (Excluding textbooks).	Although most of the references are professional and peer-reviewed, a few are questionable (e.g., general books and magazines, etc.)	Most of the references are from sources that are not peer reviewed (e.g., general sources on internet, etc.)	There are no professionally reliable sources. Reader seriously doubts the value of the material
Presentation	High quality of format and presentation is demonstrated. Texts, drawings, and equations are prepared by appropriate software.	Good quality of format and presentation is demonstrated. However, some materials are not camera-ready per publication standards	Format and presentation is fair, but, includes many draft quality text, drawings, equations, etc.	The materials are hand-written and hand-sketched, representing the very first draft of the work.
Style	The proper style is followed for citation, pagination, cross-references, front matters, etc. (e.g., Chicago Manual of Style, ASCE guidelines, etc).	The proper style is followed with few errors (e.g., few incorrect citations, few missing cross-references within the text, etc.).	The style is not completely and consistently followed (e.g., numerous incorrect citations and cross-references, incomplete tables of contents/figures/ tables, etc.)	The style is not followed. Citations and cross-references are incorrect; tables of contents / figures / tables are missing; pagination and margins are inconsistent; headings and subheadings are missing.

Attachments: Task 4 - KIND program

Faculty Success Seminar

Thursday, Sep 15, 2022 | 3:00 pm – 5:00 pm PT

Goal: The KIND Faculty Success Seminar is a 2-hour workshop that occurs once a year in summer and it aims to equip all CSU engineering academic leaders, faculty, and lecturers to address biases and other systemic sources of career obstacles that impact women and faculty from racially and ethnically minoritized identities.

Title: Identifying and Disrupting Systemic Exclusion and Inequities in Higher Education

Description: Why does my college or university struggle to attract and retain faculty from diverse backgrounds? How can I thrive in an institution as “the only”? What can I do to contribute to and foster an inclusive workplace and/or academic climate for everyone? If you have ever asked these questions, this training will provide you with a starting point for answering them. This session includes thought-provoking activities designed to: raise awareness of biases and stereotypes, provide strategies for overcoming systemic inequities, and share practical steps toward inclusive leadership and engagement. It uses examples that cover multiple and intersectional identities (e.g., race, ethnicity, disability, gender, socioeconomic status, age, and sexual orientation) and draws from principles of justice, equity, diversity, and inclusion in engineering societies’ codes of ethics.

Learning Objectives: After completing this training, participants will be able to:

- recognize biases and stereotypes – explicit and implicit, positive and negative – and their impacts on engineering education and practice;
- act as change agents to challenge and overcome systemic inequities;
- identify and overcome organizational barriers to systemic change; and
- employ strategies - as targets, allies, or offenders - to manage behaviors that are counter to JEDI.

Who should attend? This event is open to all full-time CSU engineering faculty and lecturers (especially academic leaders). We encourage individuals who identify as underrepresented in engineering to attend this event.

Meeting Format: Virtual (zoom link will be provided to the participants)

Registration: Required
Use this link to register by September 12, 2022. Registration is limited to the first 40 individuals.

Contact Information:
If you have any questions, please click a name to email any of the following contributors:
- Arezoo Sadrinezhad, Fresno State
- Maryam Nazari, Cal State LA
- Feruza Amirkulova, San Jose State University
- Liz Thompson, Cal Poly SLO

Speaker: Yvette E. Pearson, Ph.D., P.E., F.ASCE

A Fellow of the American Society of Civil Engineers (ASCE), Dr. Yvette E. Pearson is recognized globally for over 25 years of contributions to engineering education, particularly for her work along the intersections of sustainability and justice, equity, diversity, and inclusion (JEDI). As past vice chair of the Committee on Diversity and Inclusion she was part of the team that first introduced DEI into ASCE's Code of Ethics in 2017, providing leadership for the principle that requires engineers to consider the diversity of the communities they serve and to include diverse perspectives in planning and design. In 2019, she was appointed inaugural chair of ASCE's board-level committee, MOSAIC (Members of Society Advancing an Inclusive Culture), which is charged with leading the Society in all matters of DEI for the profession. During her tenure as chair, MOSAIC revised an ASCE policy, which is now titled "Justice, Equity, Diversity, and Inclusion" and created a Best Practices Resource Guide for Diversity, Equity, and Inclusion. Dr. Pearson is founder and principal consultant of The PEER Group, a company that specializes in training, evaluation, organizational leadership, program development and facilitation with a focus on JEDI. Among her numerous awards and honors are ABET's Claire L. Felbinger Award for Diversity and Inclusion, ASCE's Professional Practice Ethics and Leadership Award, University of Texas Regents Outstanding Teaching Award, the Society of Women Engineers' Distinguished Engineering Educator Award, and the President's Medal, one of the highest honors awarded by ASCE. Pearson is a registered Professional Engineer, a Commissioner on ABET's Engineering Accreditation Commission, and host of Engineering Change Podcast, which has listeners in over 70 countries on six continents.

Participants_KIND Faculty Success Seminar Participant Report 9.15.22

Meeting ID	Topic	Start Time	End Time	User
83450992197	KIND Faculty Success Seminar: Id	09/15/2022 04:47:50 PM	09/15/2022 07:23:34 PM	info@
Name (Original Name)	User Email	Total Duration (Minutes)	Guest	
Yvette E. Pearson (she/her) (The PEER Group)	info@peergroupconsulting.com	156	No	
Julie Fogarty - Sacramento State (Julie Fogarty)		130	Yes	
Michael D. Smith# D.Eng. (he/him)		156	Yes	
Arezoo Sadri (Fresno State) (Arezoo Sadrinezhad)		137	Yes	
Reza Raeisi		130	Yes	
Brad Hyatt - Fresno State (Brad Hyatt)		29	Yes	
Jun Ou (Cal Poly Humbodlt) (Jun Ou)		112	Yes	
Ozgul Yasar (Ozgul Yasar)		129	Yes	
17146868668		3	Yes	
Ram Nunna - Fresno State		129	Yes	
Susan Nachawati		120	Yes	
Jaya Dofe CSUF (She/her) (Jaya Dofe (She/her))		127	Yes	
Homeyra Sadaghiani/ CPP (she/ hers)		127	Yes	
shokoufeh Mirzaei-Cal Poly Pomona (shokoufeh Mirzaei)		126	Yes	
Hui Yang (San Francisco State) (Hui Yang)		125	Yes	
Ankita Mohapatra - CSUF (Ankita Mohapatra)		23	Yes	
Elahe Enssani (She/Her) - SFSU (Elahe Enssani)		125	Yes	
Maryam Nazari (CE# Cal State LA)		62	Yes	
The Nguyen (Fresno State - Mech. Eng.) (The Nguyen)		78	Yes	
Natalie Schaal (she/her (Natalie Schaal (she/her))		107	Yes	
Winncy Du		26	Yes	
Kimberly Stillmaker (Fresno State) her/she (Kimberly Stillmaker)		24	Yes	
Bori Mazzag (Humboldt# she/her/hers)		62	Yes	
Beth Eschenbach (CalPolyHumboldt)She/They (Elizabeth Eschenbach)		117	Yes	
Lalita Oka (Fresno# California)		100	Yes	
Lisa Gong		101	Yes	
Margherita Capriotti (SDSU) (Margherita Capriotti)		63	Yes	
Negin Forouzesh (Cal State LA) (Negin Forouzesh)		34	Yes	
Wiincy Du		89	Yes	
Ankita Mohapatra# CSUF		94	Yes	
Rakesh Mahto (CSUF) (Rakesh Mahto)		64	Yes	
Liz Thompson (Cal Poly SLO) (Liz Thompson (she/hers))		59	Yes	
Homeyra Sadaghiani		61	Yes	
Margherita's iPhone		42	Yes	

KIND*- Speed Mentoring Event

Friday, Nov 18, 2022, 3:00 pm – 5:00 pm PST

Goal: The KIND Speed Mentoring program is an inter-institution networking-based mentoring program that occurs three times a year (Fall, Spring, and Summer) and it aims to provide mentoring and networking opportunities for all CSU engineering faculty.

Who can attend? This event is open to all CSU engineering (tenured, tenure-track) faculty. We especially encourage individuals who identify as underrepresented in engineering to attend this event.

Meeting Format: Virtual
https://fresnostate.zoom.us/j/83011347248?pwd=Uzl4ajNIbWJrOVZvb2lmY0RKcnpqUT09
Pass code: KIND)

Registration Deadline: Nov, 15 2022
Please fill out the Google form. (Google Form Link: https://forms.gle/LnfgYbNzrDdXy9s88)

List of mentors and topics:

Name	**Rank**	**Institution**	**Topic**
Dr. Susamma Barua	Full Professor /Dean	CSU Fullerton	Leadership in Academia
Dr. Deborah Won	Full Professor	CSU LA	Navigating tenure/early career advice
Dr. Winncy Du	Full Professor	SJSU	Work life balance
Dr. Vivien Luo	Full Professor	CSU Fresno	Proposal Writing
Dr. Mónica Palomo	Full Professor	Cal Poly Pomona	Building a research network
Dr. Liz Thompson	Full Professor	Cal Poly SLO	Developing Engineering Education Research

Schedule:
There are two 45-min mentoring sessions during the event. Every mentee can choose two different topics.

3:00 – 3:15 pm: Introduction
3:15 – 4:00 pm: Mentoring session 1
4:10 – 4:55 pm: Mentoring session 2
4:55 – 5:00 pm: Concluding remarks

If you have any questions, please contact any of the following contributors:
Arezoo Sadrinezhad, Fresno State, asadrinezhad@csufresno.edu
Maryam Nazari, Cal State LA, mnazar12@calstatela.edu
Feruza Amirkulova, San Jose State University, feruza.amirkulova@sjsu.edu
Liz Thompson, Cal Poly SLO, lschleme@calpoly.edu

***The KIND Program is a new CSU system-wide initiative funded by the NSF-ADVANCE Partnership grant #2121950**
https://www.nsf.gov/awardsearch/showAward?AWD_ID=2121950

"Kindling Inter-university Networks for Diverse (KIND) Engineering Faculty Advancement in the California State University System." The goal of this project is to bring about systemic changes to increase the representation of women, particularly URM women, and to support equity for diverse groups, in the CSU engineering professoriate throughout 19 campuses.

Participants

Mentors

1. Leadership in Academia
2. Navigating tenure/early career advice
3. Work life balance
4. Proposal writing
5. Building a research network
6. Developing engineering education research

Participants

gloria faraone
Perla Ayala
Margherita Capriotti
Atousa
Natalie Mladenov
Yilin Feng
Negin Forouzesh
Wen Chin(Amy) hsu
Laila Jallo
Shokoufeh Mirzaei
Julie Fogarty
Hadil Mustafa
Aubrey Kemp
Kanika Sood
Natalie Schaal
Winncy Du
Rakesh Mahto
Maysam Mousaviraad
Feruza Amirkulova
Liza Boyle
Hyoungsoo Kim
Zahra Sotoudeh
Jeyoung Woo
Arezoo Sadrinezhad
Marta Miletic
Javier Gonzalez-Sanchez
Lalita Oka
Kimberly Stillmaker
Maryam Nazari

Abstract 1:

The Power of Cross-Institutional "Speed" Mentoring and Networking Program in Advancement of Women, URM, and Foreign Born/Trained Engineering Faculty (Work-in-Progress)

Mentoring interventions, particularly mentoring that incorporates networking, have been effective at meeting the professional needs of women and under-represented minority (URM) faculty (Austin and Laursen, 2014; Mendez et al., 2020). Women in STEM careers are reported to feel left out of networks and thus face decreased social and administrative support (Xu et al., 2011). The isolation of URM women in engineering in the xxx system is apparent in the fact that many xxx engineering departments have no more than a single URM woman faculty. Thus, despite current mentoring programs at each xxx campus, there is not a single other woman within their engineering department with whom they may discuss shared experiences of their intersectional identity. As part of the NSF funded ADVANCE grant (XXXX), in order to address this isolation and to provide mentoring and networking opportunities for women engineering faculty in the xxx system, particularly woman who identify as URM, a series of virtual (to enable cross-campus mentoring), small group setting (to incorporate networking) mentoring events were organized. These are three "speed" mentoring events each year with a short two-hour commitment for mentors. Mentees rotate to breakout rooms on topics of their choice, such as navigating tenure, proposal writing, building a research network, academic leadership, dealing with biases, and engineering education. There are usually 3 to 8 people in each session which provides an opportunity to make meaningful connections and broaden faculty networks. Note that there was no such cross-institutional program available in the xxx system before this initiative. Another aspect of this initiative that is unique is the emphasis on foreign born or trained women. Past studies have found that women born or trained outside the US face unique challenges in academia (Oka et al. 2022). Although the speed mentoring events are open to all, there is specific emphasis on those who are normally excluded from formal mentoring. Although we are only in the second year of this effort, we will report the post-event survey results which includes the demographics of the participants and will discuss the importance and impact of these events.

ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION Conferences & Notification Arezoo Sadrinezhad

2023 ASEE Annual Conference & Exposition > Paper Management > Paper

Read Chair And Reviewer Comments | Checklist | Deadlines | Instructions | Change History

Draft Version 4 Paper ID 38055

The Power of Cross-Institutional "Speed" Mentoring and Networking Program in Advancement of Women, URM, and Foreign Born/Trained Engineering Faculty (Work-in-Progress)

Your abstract has been accepted

Please upload the draft paper by Tuesday - February 14, 2023. Don't forget to read the chair and reviewer comments

Upload Draft

Authors

+ Add A Co-Author

In the event your paper is accepted, these authors will appear in the proceedings in the order below. Also, please select the presenting author.

Dr. Arezoo Sadrinezhad	It's me		Presenting?
Dr. Lalita G Oka	Accepted	Completed Info	Presenting?
Dr. Lizabeth L Thompson P.E.	Accepted	Completed Info	Presenting?
Dr. Maryam Nazari	Accepted		Presenting?
Dr. Kimberly Stillmaker P.E.			Resend invite
feruza.amirkulova@sjsu.edu			Resend invite
cata_cardenas@mail.fresnostate.edu			Resend invite

Reviews

A reviewer commented on the abstract

SO, where can I sign up? Seriously, though. This is a phenomenal idea. It is a part of an NSF funded grant, so obviously, it is a phenomenal idea. I see that there was some lit review done for the abstract. I anticipate that you will have more lit support for the final paper. It would have been nice to see a preview of your results, if even a hypothesis of what your survey results would be so that we can get a glimpse of what you expect. In your final paper, you will likely need to more clearly state your research question and what your anticipated results would be. I am very excited to see the finished product. Well done!

A reviewer commented on the abstract

It is my opinion that this abstract is a good fit for the WIED call for papers. I think that conference attendees would be interested in the subject, particularly in the details of the mentoring activity and the level of organic participation of mentors.

A reviewer commented on the abstract

I look forward to reading the full paper with your results to date. I'm not sure if it will be included, but your abstract piques my interest in if the participants continued to interact with each other after each event -- in other words, did participants create longer-lasting mentoring relationships after these brief encounters. I believe that your work will be broadly applicable because many of us share the same challenges regarding a dearth of women of color engineering faculty and the fact that they are unlikely to have a critical mass of colleagues in any one department or college.

Abstract 2:

Using CIP codes to improve multi-institutional analysis of applicant demographics for equity in engineering faculty hiring (Work In Progress)

Women, particularly women of Black/African American, Hispanic, and Native American backgrounds (referred to collectively as URM women in this paper), are significantly under-represented in the US engineering professoriate. Administrators often point to the lack of diverse representation in the hiring pool as an impediment to improving the representation of under-represented groups. Beyond this anecdotal evidence, there is often no mechanism for tracking pools, interviewees, or selected candidates by gender or ethnicity accessible to administrators and faculty. Without such a system, these stakeholders are limited in their ability to make informed changes to hiring practices in a way that will improve equity. While lack of representation of URM women in applicant pools certainly limits the potential that they will be selected to fill open engineering faculty positions, it is only one component of a larger problem. If administrators focus only on the applicant pool, the role faculty search practices can play to impede diversification of the professoriate is trivialized. Analysis of faculty applicant demographics throughout all stages of a search, e.g. initial pool, phone interviews, on-campus interviews, and final selection, is essential to identifying potentially biased practices and opportunities for improving the search process. Unfortunately, in the analysis of faculty hiring pool and interviewee demographics, several issues arise such as analysis of small sample sizes and difficulties comparing data across campuses or across time frames in the midst of departmental restructuring. Through the support of an NSF ADVANCE PARTNERSHIP award, the xx University System is working towards developing a unified dashboard to analyze engineering faculty hiring pools and interviewee demographics. The xx system has recently transitioned to use of a single unified software, PageUP, for handling faculty searches. Through this program, applicant demographics data will be obtained for engineering searches at all campuses, allowing for an aggregated approach to demographic data analysis. One key element of creating this unified approach was the integration of a standard code for Classification of Instructional Programs (CIP code) pertaining to each search into PageUP. Because campuses group disciplines into departments differently, the standard method of categorizing searches by departments prevented accurate multi-campus aggregations. By aggregating the data between campuses using discipline specific CIP codes, the xx system will be able to better understand the effect of their hiring processes on diversity as well as be able to compare with the national pool of candidates and be better positioned to develop strategies to improve diversity.

Additional Curriculum Activities During Sabbatical:

1. Conference presentation

From: **Felipe Perez** fperez@cpp.edu
Subject: [cpp-cec01] Paper ID: 23 - Editorial Decision on Abstract
Date: February 28, 2022 at 10:11 AM
To: Arezoo Sadrinezhad asadrinezhad@csufresno.edu
Cc: Merced Martinez-Guerra notifications@instructure.com

Dear Arezoo Sadrinezhad:

Congratulations, your abstract 23: Application of TDA in Seismic Response of Railway Embankments has been accepted for presentation at 1st Cal Poly Pomona Civil Engineering Conference which is being held 2022-09-12 at Pomona. You may now submit your paper for further review.

Thank you and looking forward to your participation in this event.
Felipe Perez
Editors
fperez@cpp.edu

Conference Secretariat
CPP CEC-01

From: **Cal Poly Pomona** gifts@cpp.edu
Subject: CEC Conference Registration Acknowledgement
Date: July 25, 2022 at 11:06 AM
To: Arezoo Sadrinezhad asadrinezhad@csufresno.edu

CP

Dear Arezoo,

Thank you for registering your sponsorship for the Civil Engineering Conference!

Please print and keep this email as a confirmation of your registration.

The following information was recorded for your conference registration:

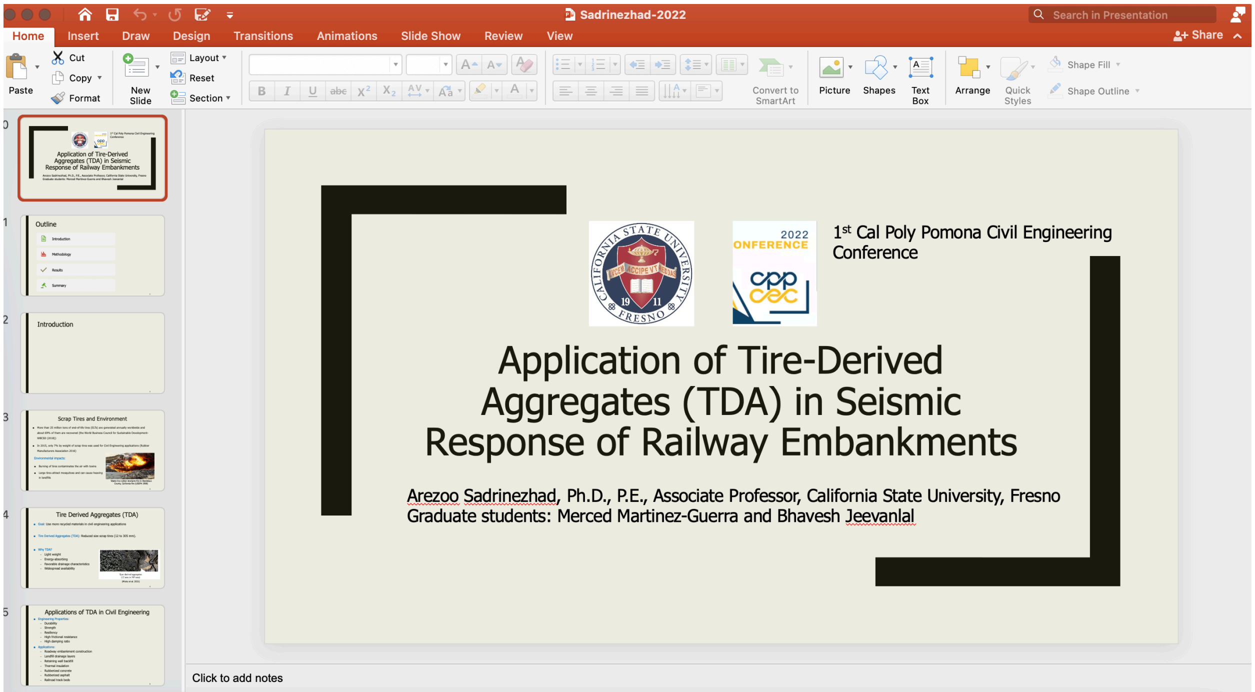
1st Cal Poly Pomona Civil Engineering Conference
Individual Registration
Arezoo Sadrinezhad

Total Amount: $645.00
Payment Method: Visa Credit Card (8872)

Date: 7/25/2022

On behalf of our entire organization, thank you again for registering, and we look forward to seeing you at the conference!

Information regarding the conference is available at the following website: https://cppceconf.wixsite.com/cpp-cec-01. If you need any additional information, please feel free to contact us via email at info-ce-conf@cpp.edu.


Sadrinezhad-2022
1st Cal Poly Pomona Civil Engineering Conference
Application of Tire-Derived Aggregates (TDA) in Seismic Response of Railway Embankments
Arezoo Sadrinezhad, Ph.D., P.E., Associate Professor, California State University, Fresno
Graduate students: Merced Martinez-Guerra and Bhavesh Jeevanlal
Click to add notes

Accepted paper:

FRESNO STATE

Arezoo Sadrinezhad <asadrinezhad@mail.fresnostate.edu>

2023 Geo-Congress – Final Phase: NOTICE of Acceptance for Proceedings

1 message

noreply@omnipress.com <noreply@omnipress.com> Fri, Oct 28, 2022 at 11:00 AM
Reply-To: bkeelor@asce.org
To: asadrinezhad@csufresno.edu

This email is being sent to you via the 2023 Geo-Congress CATALYST online paper submission site.

Dear Arezoo Sadrinezhad,

We are pleased to inform you that your final paper:
ID: 0621_0877_000090
TITLE: APPLICATION OF TDA IN SEISMIC RESPONSE OF RAILWAY EMBANKMENTS

… has received final approval for presentation at the 2023 Geo-Congress, and inclusion in the conference proceedings.

If you need to communicate with conference organizers about your submission, be sure to include the ID number of your paper. Please share this message with your co-authors as needed.

WHAT HAPPENS NEXT?

First, Register for the Conference

Navigate to https://www.geocongress.org/registration to register for the conference as soon as possible. Registration will open in early November, and Early Bird rates will be available until January 13. Presenting authors will receive a discount- please keep an eye out for this code.

The program committee will in November to determine podium and poster presentations, and we will notify all authors in December of their decisions. Following this, the final conference program will be developed, including dates and times of all presentations.

Thank you again for participating in the 2023 Geo-Congress submission process. We look forward to seeing you in Los Angeles.

Sincerely,

Program Committee
Geo-Congress 2023
March 26-29, 2023
Los Angeles, California

Application of Tire Derived Aggregates in Seismic Response of Railway Embankments

Arezoo Sadrinezhad, Ph.D, P.E.,[1] and Merced Martinez[2]

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ABSTRACT

Railways are an important part of infrastructure that work to deliver materials and people quickly across far distances with fewer emissions than transportation through vehicles in traffic. Damage to railways from seismic events can lead to train derailments due to deformation of the railway embankment. Previous experimental studies have shown that addition of Tire Derived Aggregates (TDA) in the sub-ballast layer of railway embankments decreases the displacement of the embankment due to seismic loading. In this study, a finite element model is created to determine the optimum amount of TDA that can be added to the sub-ballast layer in order to improve the seismic behavior of railway embankments. Four models, conventional (100% sand), sand with 15% TDA, sand with 20% TDA, and sand with 25% TDA are considered. The models are subjected to an earthquake loading and the displacement and acceleration results of three points on the embankments are recorded. The obtained results indicated that addition of TDA in the sub-ballast layer reduces the maximum acceleration and maximum displacement of the railway embankment under seismic loading. As the optimum percentage of TDA, values around 20% to 25% can be proposed for practical uses.

INTRODUCTION

The increase in the number of vehicles worldwide has resulted in increased amount of scrap tires. Approximately 1000 million tires reach the end of their service life per year with an estimated increase of 1200 million and 5000 million in future years (Yadav and Tiwari 2019). In the United States, the percentage of scrap tires processed into tire crump has increased from 2% in the 1990s to nearly 12% in 2001(Sunthonpagasit and Duffey 2004). Developed countries report reusing over 90% of tire scraps, however, a large percentage is burned for energy, which pollutes the air and harms the environment (Shireen et al. 2021). Therefore, recycling scrap tires has been recognized as an indispensable solution to divert waste from landfills.

In recent decades, civil engineering scholars and practitioners have developed different techniques to utilize the recycled used tires as means of environmental protection and economic enhancement. Processed waste tires, also known as tire derived aggregates (TDA), alone or mixed with other materials, have variety of applications, such as rubberized asphalt, rubberized concrete, lightweight backfill in embankments, drainage layers, isolation systems and railroad track beds ((Edinçliler et al. 2010), (Miller and Tehrani 2017), (Shireen et al. 2021)). Many studies were conducted to determine the mechanical and dynamic behavior of TDA in different applications ((Noorzad and Raveshi 2017), (Nakhaei et al. 2012), (Rao and Dutta 2006), (Anastasiadis et al. 2012)). The results of these investigations have shown that TDA can be a proper alternative in many projects due to such superior characteristics as durability, strength, resiliency, high frictional resistance, and high damping ratio. Moreover, dynamic parameters of TDA demonstrated that these materials can improve the seismic response of different structures in the prone earthquake areas ((Sadrinezhad et al. 2019), (Tehrani et al. 2018), (Ahn and Cheng 2014), (Dram et al. 2022), (Tsang 2008)).

Ballasted rail track is one of the most widely used railway structures and it is commonly composed of the steel rail, sleeper, ballast layer, and sub-ballast layer built on the subgrade. Recently, there have been many studies in using scrap tires in the railway embankment. For example, (Sol-Sánchez et al. 2015) used crumb rubber as elastic aggregates mixed with ballast particles in order to reduce the ballast degradation. (Esmaeili and Rezaei 2016) used a TDA layer under the ballast layer in order to reduce the train induced vibrations. (Martínez Fernández et al. 2018) placed rubber aggregate mixtures in a full-scale railway track under real traffic conditions and analyzed the vibration alleviation performance of the railway track. The results indicated that the use of rubber-aggregate mixtures fulfil all the requirements set for sub-ballast layers and provide vibration attenuation while helping to reuse waste material.

In 2019, (Sadrinezhad et al. 2019) performed a series of shake table experiments on ballasted railway embankments supported on different sub-ballast layers of dense soil (as the witness prototype) and dense soil with 20% TDA. The results indicated that replacing 20% of the dense sand by TDA in the sub-ballast layer improves the seismic behavior of railway embankments by reducing the acceleration and displacement of the embankment. Note that (Sadrinezhad et al. 2019) did not consider the effect of the various amount of TDA to be added to the sub-ballast layer. Therefore, the aim of this paper is to investigate how different amount of TDA in the sub-ballast layer affects the seismic response of railway embankments.

METHODOLOGY

In this study, the finite element analysis software, GeoStudio QUAKE/W was used for the numerical analysis. Four models with different amounts of TDA in the sub-ballast layer were considered. The first model was a conventional railway embankment model consisting of crushed granite gravel in the ballast layer and 100% sand (no TDA) in the sub-ballast layer. In the other three models, a mixture of sand and varying amounts of TDA (15%, 20%, and 25%) was used as the sub-ballast layer.

Geometry of the models. The ballast layer was 0.45 m in height and the sub-ballast layer was 0.15 m for a total embankment depth of 0.6 m. The sleeper’s dimensions were 2.5 m by 0.23 m by 0.23 m and it was embedded 0.15 m in the ballast layer (Li et al. 2018) (see Figure 1). A pressure of 4.8 kPa was used to model the sleeper weight. The embankment crest width was designed to allow for a walkway along each side of the single railway track (BNSF 2018). The slopes of the ballast and sub-ballast layers were 2H:1V (AREMA 2014).

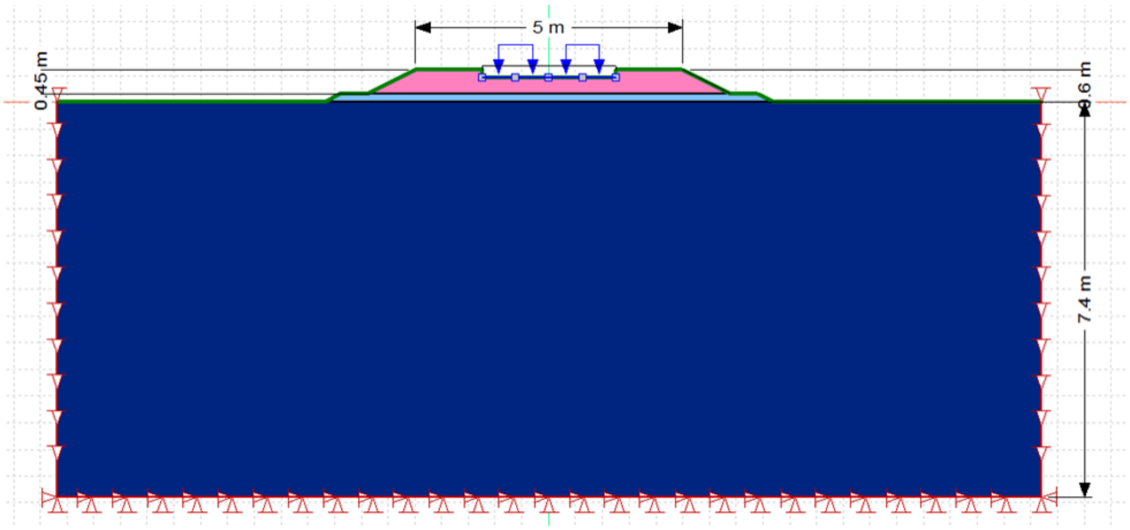

Figure 1. Model dimensions and layers

Material properties. The material properties of sand and mixtures of sand and TDA that were used in the analyses are shown in Table 1. The values for the Poisson ratio and shear modulus were estimated using the data from previous studies ((Moormann et al. 2016), (Tehrani et al. 2018)). Note that the addition of TDA decreases the unit weight of the mixture and the decreasing trend was used to estimate the unit weight of the mixtures of sand and TDA (Esmaeili et al. 2016).

Table 1. Material properties

Parameter	Ballast	Sub-ballast				Subgrade (dense)
		Sand	Sand with 15% TDA	Sand with 20% TDA	Sand with 25% TDA	
γ_d(kN/m^3)	18	20	18.15	17.5	16.8	19
φ (°)	35	40	34	32	30	28
ν	0.3	0.48	0.45	0.44	0.43	0.35
G_{max} (kPa)	79,097	64,072	54,071	37,542	33,397	56,063

Numerical analysis. A nonlinear dynamic analysis with an initial static parent analysis was used for analyzing the models. For both analyses, a fixed boundary condition in both directions (x and y) was considered at the bottom of the subgrade layer. For the initial static analysis, a fixed boundary condition in the x direction was used for both left and right vertical boundaries (the soil was free to settle in the y direction). For the dynamic analysis, the vertical movements along both sides were restricted, but the horizontal movements were allowed.

The 1994 Northridge earthquake (M_w = 6.4) was used for the seismic analysis. Earthquake data was collected from a station near Los Angeles with data for every 0.01 second and has a peak acceleration of 0.38952 g, as can be seen in the earthquake's acceleration graph in Figure 2. The acceleration data was used for the horizontal earthquake loading in GeoStudio with an applied baseline correction.

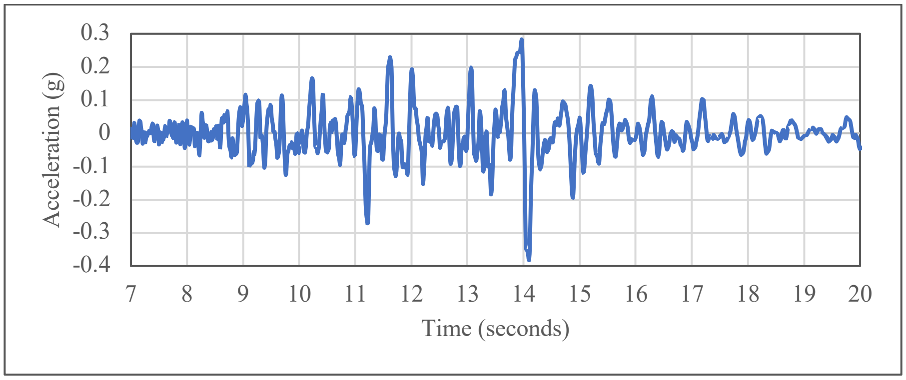

Figure 2. Northridge 1994 Earthquake

Figure 3 shows the location of history points, which are the points within the domain where results are saved for each and every time step while integrating through the earthquake record (GEO-SLOPE 2014). The first history point is at the bottom of the sub-ballast layer, the second is at the top of the sub-ballast, and the last is at the bottom of the sleeper. The mesh was created using 1187 elements and 1244 nodes. An approximate global element size of 0.1 m was used for the embankment.

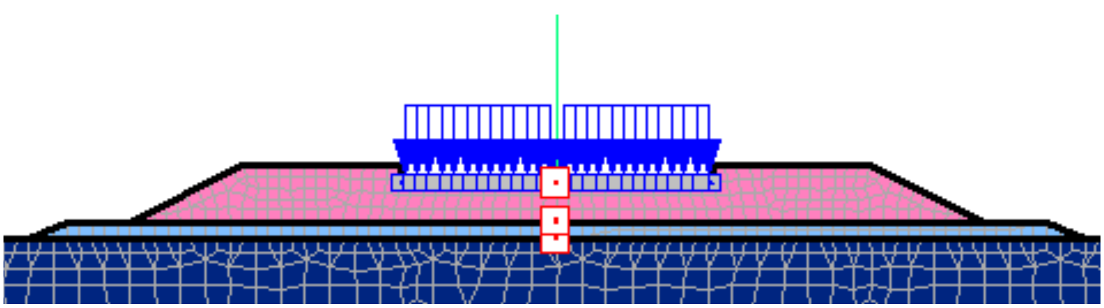

Figure 3. History points for earthquake analysis

RESULTS

The numerical analysis was performed for all four models. Figure 4 illustrates the deformed shape of the railway embankment under the seismic loading for the first model (conventional railway embankment).

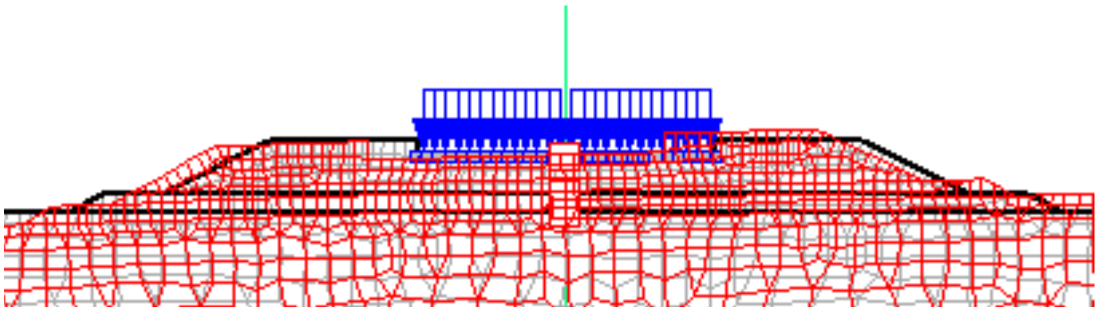

Figure 4. Deformed shape of the conventional railway embankment

The acceleration and displacement at the history points were recorded. The highest absolute value of the accelerations and displacements for all four models were obtained and compared. The summary of the comparisons is presented in the following sub sections.

Acceleration Results. The maximum acceleration at the history points for all four embankments are shown in Table 2. As can be seen, the acceleration of embankments decreases by adding the TDA to the sub-ballast layer, however, there is not a significant difference between the acceleration of the model with 15% TDA and the models with 20% and 25% TDA and the accelerations of the models with 20% and 25% TDA are the same.

Table 2. Acceleration results (g)

History Point	1	2	3
100% Sand	0.663	0.663	0.663
85% Sand + 15% TDA	0.631	0.6315	0.632
80% Sand + 20% TDA	0.630	0.631	0.631
75% Sand + 25% TDA	0.630	0.631	0.631

In order to visualize the results better, the acceleration results for the conventional model and the model with 25% TDA are displayed in the figure below.

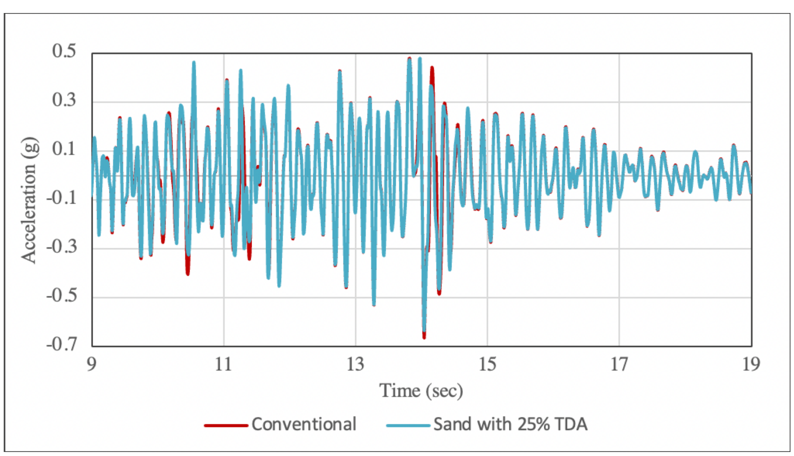

Figure 5. Acceleration results of the conventional model and the model with 25% TDA

Displacement Results. Table 3 shows the displacement values at the history points for all the four models. As can be seen from this table, the conventional embankment has the biggest displacement and the displacement decreases as the amount of TDA increases. However, the displacement values only slightly decreased by increasing the amount of TDA from 20% to 25%.

Table 3. Displacement results (cm)

History Point	1	2	3
Sand	4.43	4.43	4.43
Sand + 15% TDA	4.22	4.22	4.22
Sand + 20% TDA	3.821	3.822	3.823
Sand + 25% TDA	3.817	3.819	3.819

In order to visualize the results better, the displacement results for all four models are displayed in the figure below.

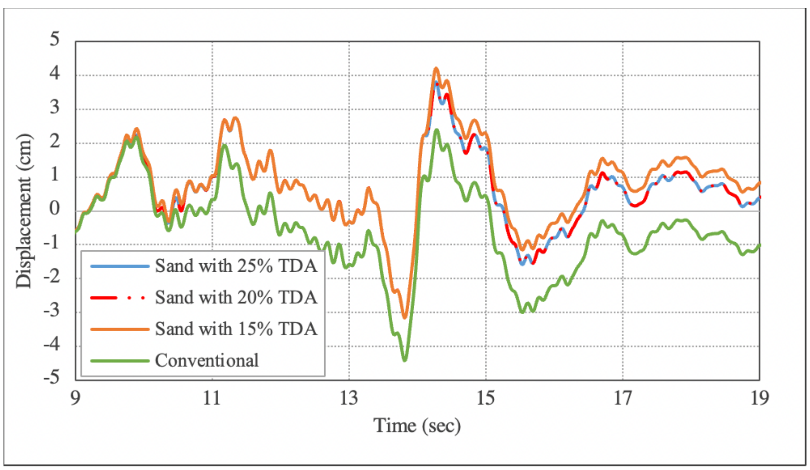

Figure 6. Displacement results for all four models

Note that since the maximum acceleration did not change by increasing the amount of TDA from 20% to 25% and the maximum displacement only slightly decreased, the amount of TDA was not increased any further in this study.

CONCLUSION

Numerical analyses were performed for four railway embankments under dynamic motion of the Northridge earthquake. The sub-ballast layer for the first model contained 100% sand similar to the conventional railway embankments. In the other three models, the sub-ballast layers were replaced by different mixtures of sand and TDA (85% sand + 15% TDA, 80% sand + 20% TDA, and 75% sand + 25% TDA). The accelerations and displacements at three history points of the embankments were recorded. The following results were obtained from the numerical analyses:

- Addition of TDA in the sub-ballast layer reduced the maximum acceleration and maximum displacement of the railway embankment under seismic loading.
- The maximum acceleration did not change by increasing the amount of TDA from 20% to 25% and the maxim um displacement only slightly decreased.
- Since the changes between the models with 20% and 25% TDA were not significant, values around 20% to 25% can be proposed as the optimum percentage of TDA for practical uses.

In conclusion, using TDA in the sub-ballast layer of railway embankments is an effective way to use waste tires in order to improve the seismic behavior of these infrastructure and also preserve the natural world by reducing the environmental footprint.

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One submitted abstract to EURODYN 2023:

Shake Table Study on Influence of Surrounding Pile Foundations by TDA on Seismic Performance of Structures

A mixture of sand and Tire-Derived-Aggregates (TDA) can be used around the pile foundations to reduce seismic demand of piled structures during earthquakes. This mixture provides the flexibility required for the base isolation and improves the dynamic response of the structure under earthquake movements. Previous Investigations on the sleeved-pile systems have illustrated that an artificial increase in damping by means of damper devices protects the system from undesired deflection and resonance due to the energy absorbing property of damping equipment. To reduce the cost of the isolation system, this study proposes to substitute the expensive damper devices in the sleeved-pile isolation system with alternative geotechnical materials such as tire-derived aggregate (TDA). The viscous damping and the low rigidity of TDA contribute to isolation and energy absorption mechanisms of the pile system. In this study, the seismic performance of structures sitting on pile foundations surrounded by the mixture of sand and TDA were assessed. To this end, a 15-storey RC building and a pile foundation with end-bearing piles were designed and they were scaled down using the appropriate scaling factor and relations. Having the properties of scaled model, all of its components were designed and fabricated in the lab. Furthermore, the laminar soil box was used to simulate the free-field boundary conditions. Finally, a set of shake table tests was conducted on two test units using the shake table facility of California State University, Fresno; (1) a structure sitting on a pile foundation with classic piles (2) a structure sitting on a pile foundation surrounded by the mixture of sand and TDA. Each model was subjected to seven multiple in-tensity ground motions to measure the seismic demand of superstructures using the instrumentation installed on them. The results showed that using the TDA leads to a reduction in the seismic demand of superstructure. In addition, the forces created in the pile heads were reduced comparing to the forces in the classic pile foundation. Therefore, using the mixture of sand and TDA can be considered as an economy efficient method to protect the structure against earthquake.

EURODYN2023

Dear Arezoo Sadrinezhad

We are happy to inform you that your abstract {abstract_title} has been accepted for presentation at EURODYN2023!

Please read the following carefully, as there are some important deadlines for you as an author coming up:

- **If you wish to write a full paper for the proceedings of JPCS (Journal of Physics Conference Series), the final deadline for submission is set to the 15th of March 2023. The review will take place using the platform of JPCS. More explanation on the submission and guidelines for the paper can be found here.**