Understanding of Seismic Design of Building Structures From Structural Dynamic Experiments to Real-World Applications

Instructor：Chia-Ming Chang
Schedule ：Thursday 789(2:20pm~5:20pm)

The objective of this "Civil Engineering Capstone Challenge" class is to demonstrate the importance of seismic design to students and to train students about the fundamentals of structural dynamics from experimental approaches. This class will begin with the experimental testing for a SDOF structure. Then, students should apply knowledge learnt from SDOF structures to the experimental testing of MDOF structures. After understanding of MDOF structures, students will perform modeling and dynamics analysis of real-world structures as well as carry out seismic design of these structures.

Course Description:
This class will have students to learn and practice several experimenting methods in the beginning. These methods will allow students understanding the importance of dynamic characteristics of structures, e.g., natural frequencies, damping ratios, and mode shapes. After these dynamic characteristics have been experimentally obtained, students will learn how to derive structural properties such as stiffness and damping matrices and to establish a numerical model. These derived structural properties will be also compared with experimental results to affirm the correctness of numerical models. Then, students will understand the relationship between time- and frequency-domain responses from structures subjected to harmonic excitation. By observing harmonic responses, students will map the steady-state amplitudes to the transfer function magnitudes. Finally, earthquake records will be input to structures by shake table testing. From this test, students will learn the critical issues in seismic design. After this final test, students will numerically simulate the same structure via commercial software and experience the importance of seismic design.

1. Analyzing experimental data from shake table testing and acquiring modal properties of structures
2. Deriving structural parameters (e.g., stiffness and damping), performing modal analysis, and comparing numerical results with experimental outcomes
3. Designing and fabricating a small-scale MDOF building structure and comparing the dynamic characteristics of this small-scale building with experimental results
4. Conducting dynamic experiments of structures under harmonic and seismic excitations and comparing of dynamic behavior between numerical and experimental approaches
5. Designing a simple structure against earthquakes through structural analysis software

In this semester, the testing capability owned by NTU-CE and NCREE will allow students testing small-scale structures by shake table testing as well as understanding the fundamentals of structural dynamics and earthquake engineering. The integration of experimental findings, numerical modeling and simulation, and structural dynamic analysis will direct students to learn the basic ideas of earthquake engineering. The tasks that students should conduct include:

The Sustainable She-Zi Island

The Development Blueprint of She-Zi Island Considering the Ecosystem the Flood Control, and the Transportation Infrastructure Plans

Instructors：Jiing-Yun You、Yu-Ting Hsu
Schedule ：Tuesday 789(2:00pm~5:00pm)

She-Zi Island (actually a peninsula) is located at Shi-Lin District of Taipei City and is also the place where the Keelung River joins the Tamsui River. Due to its relatively low altitude, She-Zi Island has suffered from serious floods. Hence, She-Zi Island was designated as "Floodplain" in *Taipei Flood Prevention Project* in 1970, and the limit on building permission was further imposed throughout the area. Since then, She-Zi Island has become one of the few low-developed areas in Taipei City. Not until 2018 did the Ministry of Interior deliberated the development plan of She-Zi Island (conditionally) by which the half-century-long limit on building permission was finally relieved. However, before 2018, two mayors of Taipei, including the mayor Wen-Je Ko and the ex-mayor Lung-Pin Hau, have proposed different ideas regarding the development of the area during their campaigns, respectively. For example, "Taipei Manhattan" and "Taipei Venice" plans. What's more, an online voting by the citizens chose "Sustainable She-Zi Island" as the development goal…

However, the plan has not yet reached its final version. The development plan also involves several controversial issues, such as, the enlargement of the river's active channel, the uplifting of the ground of She-Zi Island, and the re-zoning of the flood control facilities in San-Chong, Lu-Zhou, and Guan-Du. Besides, there are also issues within transportation systems, such as, the ramps of Zhou-Mei Expressway (under construction), and the new metro station of the Circular Line at She-Zi Island. Lastly, the government still have to deal with the removal and resettling of the demolished homes.

Starting from the perspectives of flood control and prevention, "Capstone 2021: The Sustainable She-Zi Island" will first investigate the current Taipei flood prevention project in the development plan of She-Zi Island and study its feasibility. Upon the investigation and study, we will further incorporate the consideration of the natural environment and the human ecology to implement full evaluation of the transportation systems of the development plan and propose our own development blueprints of She-Zi Island. This course contains not only field surveys but also practical applications of Hydrology, Hydraulic Engineering, Transportation Planning, and Urban Planning. We welcome all students who are interested in understanding the evolution and challenge of urban developments from different aspects to join us!

Students in this course are required to team up to fulfill the following tasks:

1. Simulate the flood potential of She-Zi Island based on the historic hydrological data.
2. Propose the flood prevention scheme and its feasibility study
3. Investigate and analyze the ecological environment and community on the peninsula by field surveys
4. Conceive different scenarios of developments and propose the corresponding transportation planning
5. Simulate and test transportation contingency plans under different flood scenarios

Civil Engineering Capstone Challenge Spring 2021

- To sign up for either course, please fill and submit the form.
- If they wish to work as teammates, students are encouraged to sign up together(by submitting a joint form).
- If the maximum enrollment is exceeded, participants will be selected at random.
  Please select at least 2 courses among the 5 sections.
  MSc students or students wanting to take the course a second time can obtain credits via optional course Civil Engineering Consulting Practice.
- If any questions,
  please contact TA Oscar, Yu-Jun, Huang
  Email address: yjh1234@ntu.edu.tw

Sign up link:
https://docs.google.com/forms/d/e/1FAIpQLScq4rzDzpYgDSR1O1ssEp0JmPZBHsJrEfyW3fiOUZpDe126CQ/viewform