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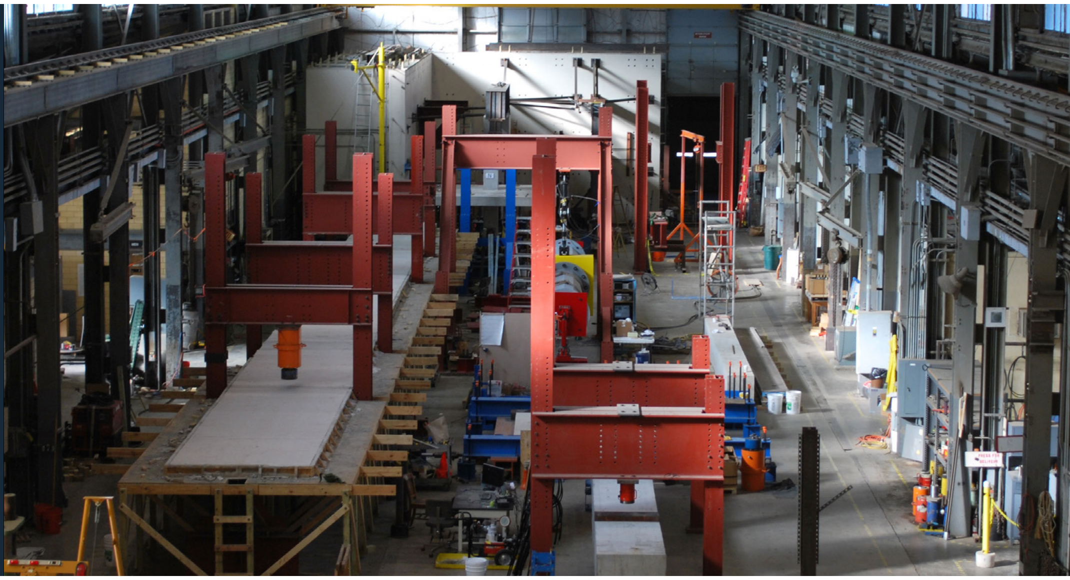


FSEL NEWSLETTER

Volume 11, Issue 1, February 2020

FSEL

The Ferguson Structural Engineering Laboratory (FSEL) located on the Pickle Research Campus of The University of Texas at Austin is named after Professor Phil M. Ferguson, who was an inspirational teacher and a meticulous researcher.

We hope that you enjoy learning about our laboratory and ongoing research.

NEWS FROM BUILDING 24

WELCOME TO NEW STAFF MEMBERS!

We have had four new staff members join us at FSEL over the last year: Abdullah Hamid, Dustin Miller, Angela Scheer, and Zach Webb. We hope you've had a chance to meet them already, but if not here is a little more about each of them.

ABDULLAH HAMID joins FSEL from Southern California where he was a Research & Development Engineer at the Powell Structural Engineering Labs at the University of California, San Diego (UCSD). He also earned his BS (with a focus in Civil Structures) as well as his MS (with a focus on Structural Behavior and Computational Solid Mechanics) from UCSD. His Masters project involved the use of non-linear acoustic scattering techniques to determine strain and temperature characteristics in long-span pipelines.

At Powell Labs, he developed MTS procedures that became the cornerstone of much of the quasi-static testing. Additionally, he has experience running Shaker Tables, configuring data acquisition systems, and developing Python apps.

DUSTIN MILLER (not pictured) was born and raised in Austin, and he currently lives here with his wife and two sons. He started at UT in 2018 as a facilities services HVAC technician. Dustin joined the FSEL team in 2019 as a technical staff member to assist with the the launch of the Concrete Bridge Engineering Institute and other concrete research projects.

ANGELA SCHEER joins FSEL after working with the Office of Sponsored Projects for almost 2 years where she learned the ins and outs of sponsored projects for the University. Before OSP, she worked in Human Resources for almost 3 years with UT and an additional 5 years in the private sector. After working in the central offices for 5 years, she finds it nice to see what happens at the department level. It's constantly a learning process with all of the different tasks she handles on a daily basis. She's excited to grow with Ferguson!

Technically not a new face at the lab, **ZACH WEBB** is an FSEL alumnus and holds BS and MS degrees in Civil Engineering from UT Austin. He is a licensed Professional Engineer with industry experience in a variety of engineering disciplines and practice areas, including research, precast/prestressed concrete design and construction, structural evaluation, repair and rehabilitation design, structural monitoring, and project management. Zach joined us in July to help launch the Concrete Bridge Engineering Institute and to assist with ongoing research projects.

ABDULLAH HAMID, Structural Engineering Research Coordinator

ANGELA SCHEER, Senior Administrative Associate

ZACH WEBB, PE, Research Engineer

REBUILDING THE BUILDING 24 COMMITTEE

This semester sees the formal "rebuilding" of the Building 24 Committee. Esteban Zecchin is leading this effort, with assistance from Dr. Todd Helwig, Abdullah Hamid, Dr. Jongkwon Choi, Zach Webb, and Jarrod Zaborac. The vision of the committee is to "increase **productivity** at Ferguson Laboratory through improved **communication** and **collaboration** of students, staff, and faculty." The first meeting takes place after the bimonthly lab safety meeting on Friday, February 14th. In addition to the coordination meetings, the Building 24 Committee will also be scheduling periodic social events, so keep a look out in your emails!

ONGOING RESEARCH AT FSEL

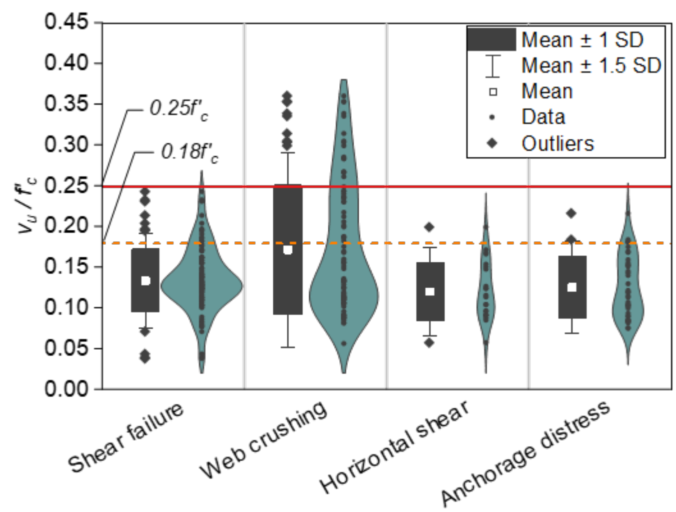
There are 45 student researchers working at FSEL, and this newsletter summarizes 17 of our ongoing projects. We hope you enjoy learning more about the exciting projects we have going on at FSEL.

ANALYZE SHEAR CAPACITY OF TEXAS STANDARD PRESTRESSED BEAMS FROM STRUT-AND-TIE MODELS OF BEAM ENDS

PROJECT TEAM: JONGKWON CHOI, HANSOL JANG, & SANGYOUNG (THOMAS) HAN

SUPERVISOR: OGUZHAN BAYRAK

From the AASHTO LRFD provisions, the shear stress in the end region of the support portion of the beam should be designed not to exceed $0.18f_c'$ to prevent diagonal compression or horizontal shear failure. However, the $0.18f_c'$ shear stress limit can be exceeded if load transfer into the supports can be justified by an appropriate strut-and-tie model (STM). The first purpose of this project is to create STM for the end regions of Tx-Girders, U-beams, box beams, X-beams, slab beams, and decked slab beams. The ultimate goal of this project is relaxing the $0.18f_c'$ shear stress limit. There are some difficulties when constructing STM for pretensioned girders such as harped strand, debonded strand, bearing conditions and end blocks. The STM suitable for TxDOT's girders will be proposed considering these variables. In an effort to investigate the possibility of relaxing the shear stress limit ($0.18f_c'$ as per AASHTO LRFD) at the end region of TxDOT's standard prestressed concrete girders, an expanded-version of the anchorage evaluation database (AEDB), based on the UT's prestressed concrete shear database (UTPCSD), was created and initial evaluation was performed.



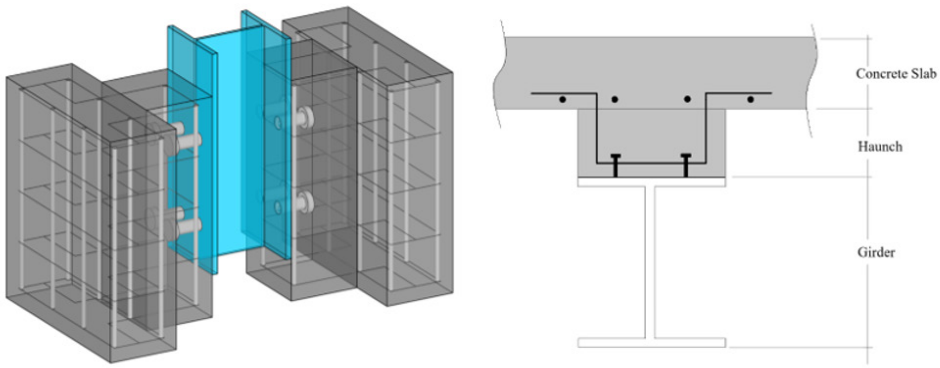
Database initial evaluation results

DEVELOP GUIDANCE FOR STRUCTURAL BEHAVIOR OF TALL HAUNCHES IN TXDOT BEAM AND GIRDER BRIDGES

PROJECT TEAM: NIDHI KHARE, ZHENGHAO ZHANG, SHAY RUTENBERG, & ANGIE TSAI

SUPERVISOR: ERIC WILLIAMSON, TODD HELWIG, & OGUZHAN BAYRAK

The haunch is the area between the top of a bridge girder and the bottom of the concrete deck as shown in the accompanying figure. Haunches are often needed to maintain a uniform deck thickness or account for camber and cross-slope. Due to unusual geometric situations or design errors, beam and girder bridges sometimes require tall haunches, which calls into question the overall constructability and horizontal shear transfer between the girders and the deck. Current TxDOT detailing practices for reinforcing tall haunches have not been thoroughly tested. Therefore, the goal of the research is to develop guidelines for the analysis and design of haunches with variable heights and reinforcement detailing. The research will include an international literature review, full-scale laboratory testing, analysis of data and modeling to create guidelines for a range of applicable haunch designs. A parametric study will represent the range of dimensions encountered for the vast majority of Texas bridges. The experimental program includes push-out tests for both steel and prestressed concrete girder bridges. The push-out tests will help determine the ultimate strength and load-slip behavior of different haunch configurations.



Push-out test specimen with the haunch

DEVELOPMENT OF NON-FRACTURE CRITICAL STEEL BOX STRADDLE CAPS

PROJECT TEAM: ESTEBAN ZECCHIN & CHEN LIANG

SUPERVISOR: TODD HELWIG & MICHAEL ENGELHARDT

Steel box straddle cap over north I-35 frontage road (Google Maps)

Straddle caps are commonly utilized in congested urban environments when the use of conventional piers is not possible, due to sources of interference such as intersecting roads, right of way limitations or location of utilities and underground infrastructure. Although straddle caps can be either prestressed concrete girders or steel box beams, the high strength-to-weight ratio of steel makes the steel straddle caps efficient from a construction and performance perspective.

However, steel straddle caps are categorized as fracture critical (AASHTO LRFD Bridge Design Specifications, 8th Edition), which necessitates more stringent design requirements and biennial hands-on inspections. As a result, the long-term costs of the caps are substantial.

The goal of this project is to develop details to provide internal redundancy to the steel box straddle caps and, therefore, reclassify these members as non-fracture critical. This study will provide solutions for newly constructed straddle caps and also produce retrofitting methodologies for the existing ones.

Having conducted the literature and background review and preliminary analyses of design concepts during the Fall of 2019, the Research Team is now focused on the design and fabrication of the test specimens and the test setup. The experimental testing will likely be carried out in the Fall of 2020.

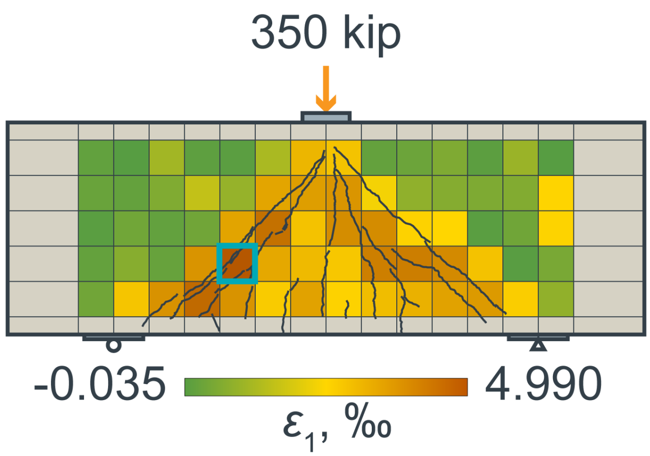
IN THIS ISSUE

EVALUATION OF DEEP BEAMS WITH INSUFFICIENT WEB REINFORCEMENT

PROJECT TEAM: JONGKWON CHOI & JARROD ZABORAC

SUPERVISOR: OGUZHAN BAYRAK

One of the most common benchmarks for the assessment of in-service reinforced concrete structures is measured cracking information, such as crack width or spacing. These measurements are typically compared to preestablished limits, and structural elements are then sorted into qualitative condition states (e.g., "good" or "severe"). While these methods are useful for tracking damage progression, they neglect important influential factors that affect cracking behavior. Reinforcement detailing is one such factor. For the fact that many aged structures requiring assessment are not compliant with modern detailing standards, it is important to understand the influence that out-of-date reinforcement detailing may have on the structural assessment of existing structures. An experimental program of deep beams with varying levels of crack control reinforcement is underway. Currently, five have been tested, and five to seven additional specimens will be tested this spring. Key components of the investigation are extensive documentation of the cracking behavior and motion capture data of the beam side faces. Preliminary results comparing these data have been promising, and it is envisioned that the insights obtained from this test program can be used to make recommendations for the assessment of visually observed cracking in reinforced concrete members.



Observed crack pattern and estimated tensile strains from motion capture data

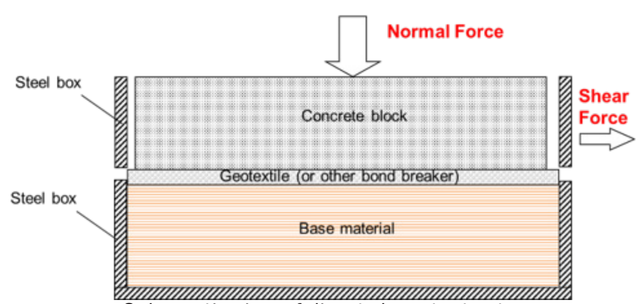
EVALUATION OF SEAMLESS BRIDGES

STUDENT: XIAOYI CHEN

SUPERVISORS: JUAN MURCIA-DELSO, TODD HELWIG, & JORGE ZORNBERG

Conventional continuously reinforced concrete pavement (CRCP)-bridge connections use expansion joints to accommodate deck expansion and contraction. However, joints require periodic inspections and maintenance actions, which entail significant costs. The seamless bridge concept was first proposed in Australia, which completely eliminated the need for expansion joints between the bridge deck and CRCP. The primary goal of TxDOT Project 0-7011 Evaluation of Seamless Bridge is to develop design guidelines for implementing seamless connections between bridges and CRCP in Texas based on the findings of experimental and analytical research.

A literature review on slab-base interaction, Australian and other seamless bridge concepts and technologies was conducted. The slab-base interaction is significant for the performance of seamless bridges. Currently, we are working on experimental characterization of interface shear strength between concrete and different base materials with and without bond breakers by doing direct shear tests, as shown in the figure below. Granular base, cement-stabilized base and hot-mixed asphalt base will be used as bases. Bond breakers, such as a thin layer of hot-mix asphalt, woven geotextile, non-woven geotextile, one or two layers of polyethylene sheet, will be tested. The interface force-displacement response and the coefficient of friction will be determined.



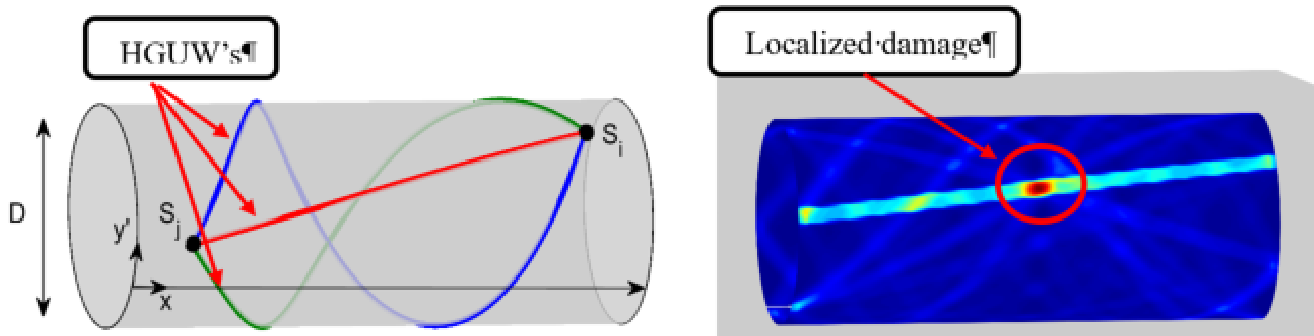
Schematic view of direct shear test setup

INTERNAL CORROSION MONITORING IN PIPELINES BY USING HELICAL ULTRASONIC WAVES

PROJECT TEAM: STYLIANOS LIVADIOTIS & ARVIN EBRAHIMKHANLOU

SUPERVISOR: SALVATORE SALAMONE

The main objective of this project is to design, implement and validate a nondestructive evaluation (NDE) technology for detecting, evaluating and monitoring the progression of internal corrosion in pipelines. This new approach is based on utilizing a novel class of waves called helical guided ultrasonic waves (HGUW) that offer several advantages over traditional guided waves, such as the small number of sensors required. This new approach uses a permanently attached network of piezoelectric sensors that is capable of exciting and sensing the HGUW. The corrosion process in pipes can be monitored through specific characteristics of the propagation of the HGUW including the wave's phase and group velocity. These features can provide both the location of potential damage in pipes as well as an estimate on the remaining wall thickness of the pipe. Experiments are being conducted on pipes subjected to accelerated corrosion, to validate the proposed methodology. Also, numerical models are being correlated with the experiments to further improve the effectiveness of the suggested approach.



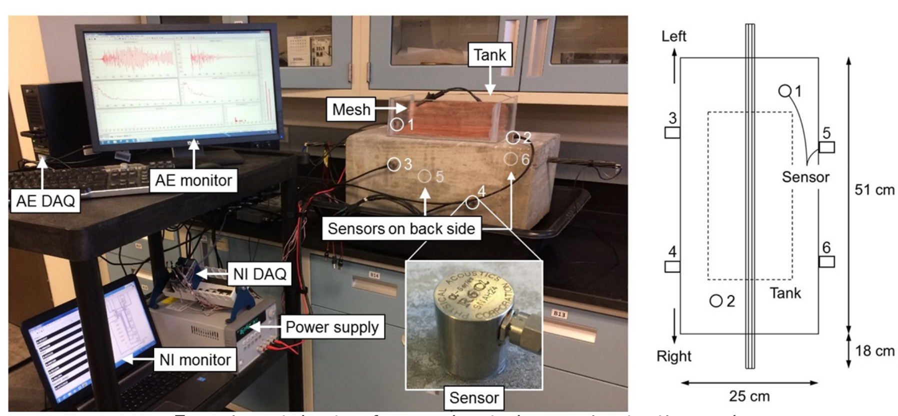
Helical guided ultrasonic waves and localized damage

MONITORING CORROSION IN PRESTRESSING STRANDS

PROJECT TEAM: BRENNAN DUBUC, ARVIN EBRAHIMKHANLOU, & KONSTANTINOS SITAROPOULOS

SUPERVISOR: SALVATORE SALAMONE

This project examines the suitability of a monitoring system based on ultrasonic waves for detecting the initiation and growth of corrosion damage in prestressed concrete girders. The proposed monitoring system is based on piezoelectric sensor networks, which have the capability of sensing acoustic energy emitted from corrosion evolution. The potential of topological data analysis (TDA) to aid acoustic emission in revealing early signs of corrosion in prestressed concrete was recently demonstrated through the project. The current work serves to extend the experimental investigation of this corrosion monitoring potential. The topological method was evaluated in accelerated corrosion testing of control and weathered prestressed concrete specimens. The results highlight the potential of TDA to aid in extracting corrosion information from acoustic data. In particular, diagnosing corrosion onset and corrosion-induced crack initiation prior to the appearance of external visual indicators. In addition, the results demonstrate the potential generalizability of the method toward existing in-service prestressed concrete girders.



Experimental setup for accelerated corrosion testing and acoustic monitoring of prestressed concrete specimen

PROPOSED MODIFICATION TO AASHTO CROSS-FRAME ANALYSIS AND DESIGN

PROJECT TEAM: SUNGHYUN PARK, MATT REICHENBACH, & JOSH WHITE

SUPERVISORS: TODD HELWIG & MICHAEL ENGELHARDT

Research team instrumenting a horizontally-curved bridge with strain gages and wireless monitoring equipment

NCHRP Project 12-113 aims to improve the design and analysis of cross-frame systems in steel I-girder bridges. Cross-frames have traditionally been detailed and fabricated based on general rules-of-thumb. In recent years, however, developments in highway bridge design and analysis have necessitated the modernization of cross-frame design and analysis practices. More specifically, the appropriate design criteria for fatigue and stability bracing are investigated. Through a series of field experiments and finite element parametric studies, quantitively-based modifications are proposed for implementation into AASHTO LRFD Bridge Design Specifications.

The research team performed its field experiments on three active bridges in the greater Houston area throughout 2018. During the fall 2019 semester, the team continued to conduct extensive parametric studies to understand the load-induced response of cross-frames for a variety of bridge geometries (i.e. straight and horizontally-curved bridges with normal or skewed supports). The project is scheduled to conclude in September 2020, where the team will prepare a final report and ballot items for the AASHTO Highway Subcommittee on Bridges and Structures.

RAIL DEFECT DETECTION BY NONCONTACT VIBRATION MEASUREMENTS

PROJECT TEAM: KORKUT KAYNARDAG & CHI YANG

SUPERVISOR: SALVATORE SALAMONE

The goal of this research is to develop a novel, non-contact system to detect internal defects in rails before they reach critical states and result in the breakage of the rail. The detection is performed by applying damage detection techniques to the vibration and wave propagation signals of rails. These signals are obtained from laser Doppler vibrometers (LDVs) placed on rail cars. Consequently, non-contact sensing at operating speeds can be achieved to avoid disturbance of the traffic. The system uses the vibrations and waves induced by the rail car wheels, and, consequently, it does not involve excitation mechanism (i.e. passive excitation).

The damage detection techniques under development are based on two approaches. The first approach exploits the changes in the frequencies of the dynamic vibrations due to internal defects while the second approach aims to use the reflection of propagating waves from the internal defects. Advanced noise reduction techniques are also applied at the LDV signals to enhance the signal quality for data processing.

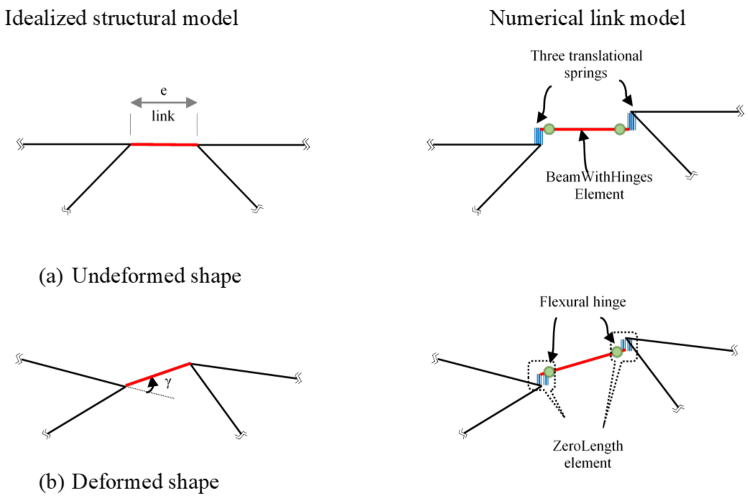
As Rail damages caused 1232 derailments between 1998 and 2008 in the USA, resulting in 294 million dollar loss in the economy, developing a rail defect detection system is crucial to prevent railway accidents.

Laboratory tests

RESIDUAL DRIFTS OF ECCENTRICALLY BRACED FRAMES

MEHMET BAKIR BOZKURT & MICHAEL ENGELHARDT

The aim of this study is to investigate the residual drift of eccentrically braced frames (EBFs) subjected to several ground motions by including structural components which are not considered in the design of lateral load resisting system. For each archetype having different number of stories, numerical models of bare EBF and EBF with gravity frames (GFs), will be developed to explore the effect of lateral stiffness of gravity frames (GFs) and out-of-plane rigidity of composite slab on seismic response of EBFs. Nonlinear time history analyses will be performed by using Opensees software. Inter-story drift ratio, residual drift ratio, and link rotation angle are considered as the response indicators. The effects of the type of ground motion, ground motion scaling, presence of composite slabs and GFs on the self-centering capacity of EBFs will be determined. In addition, removal process of damaged links will be simulated to calculate the amount of remaining drifts after this process.



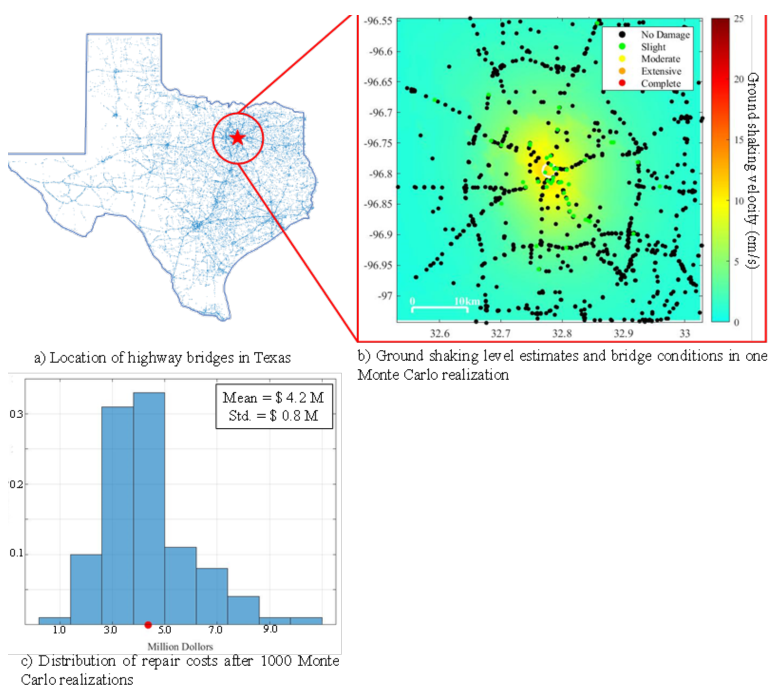
Undeformed and deformed shapes of idealized structural model and numerical link model

SCENARIO-BASED RISK ASSESSMENT OF TEXAS AND OKLAHOMA EARTHQUAKES

STUDENT: FARID KHOSRAVIKIA

SUPERVISOR: PATRICIA CLAYTON

This research aims to investigate potential losses to the built environment from the recent Texas and Oklahoma earthquakes triggered by more intense oil and gas activities. The loss, in this context, is characterized by the repair cost due to the structural damage. A probabilistic framework was developed to estimate losses using region-specific ground-motion models that estimate ground shaking levels around the location of the earthquake, as well as region-specific structural fragility models to estimate the probability of damage and its severity (e.g., slight, moderate, extensive, and complete) given the shaking level at the structure. The framework includes Monte Carlo simulation and repair cost analysis to generate a probabilistic estimate of the extent of damage across the region and the ensuing loss. The framework is applied to predict losses to the highway bridges and residential buildings following specific earthquake scenarios. The figure shows the results for a hypothetical earthquake with magnitude (M) 5 in Dallas, Texas. In one realization of the Monte Carlo simulation, shown in the right side of the figure, 47 bridges experienced slight level of damage, resulting in approximately 3.5 million dollars of repair cost. The variation of repair costs estimates from 1000 Monte Carlo simulations is shown in the bottom plot.



Investigation of potential loss for a hypothetical earthquake with magnitude (M) of 5 in Dallas, Texas

SEISMIC RESPONSE OF RC COLUMNS WITH MODIFIED BOND PROPERTIES

STUDENT: GHASSAN FAWAZ

SUPERVISOR: JUAN MURCIA-DELSO

Specimen 1 steel cage

Partial debonding of the longitudinal reinforcement may alleviate strain concentrations in the bars and enhance the seismic performance of hinging components. However, previous experimental studies on the effects of partial debonding have shown varying degrees of success in improving the ductility capacity of RC members. An experimental study will be conducted to investigate the cyclic response of RC columns with conventional and modified bond properties. The experimental program will comprise one conventional (control) column specimen and two column specimens in which the longitudinal reinforcement will be partially debonded to alleviate strain concentrations and improve column response. The column specimens will be tested under quasi-static lateral cyclic loading up to failure. The response of the columns and effectiveness of debonding strategies will be assessed in terms of the lateral strength, ductility and energy dissipation capacities, and level of damage. Test results will also be used to further verify the FE models proposed in a previous study that we did last year. Based on the experimental and numerical results, recommendations for reinforcement debonding strategies will be provided. The first specimen preparation is almost done, and the plan is to finish the study by the end of summer 2020.

SHEAR BEHAVIOR OF SPLICED POST-TENSIONED GIRDERS WITH UNGROUTED TENDONS

PROJECT TEAM: JONGKWON CHOI, SANGYOUNG (THOMAS) HAN, & HANSOL JANG

SUPERVISOR: OGUZHAN BAYRAK

The objective of this project is to test the implementation of the previously developed research products for cases in which ducts are not grouted or are filled with flexible fillers such as wax. The previous research project was limited to post-tensioned girders with a grouted duct (TxDOT Project 0-6652-1). Thus, this led to expand the scope to the use of ungrouted tendons (i.e., the same effect of flexible fillers) in spliced girders and to investigate the effect of the ungrouted tendon on the shear capacity. In an effort to investigate the shear behavior of post-tensioned concrete members with ungrouted ducts, grouting ducts and duct layouts were selected as test variables that could exacerbate the sectional behavior. By conducting targeted tests on spliced girders with grouted and ungrouted tendons, the implementation of the previously developed design expressions to such cases shall be accomplished. The calibration of shear capacity reduction factors that consider the influence of ungrouted tendons shall be necessary in addition to the factors of size and duct material. The case of ungrouted tendons is pertinent to intermediate construction stages before bridges are completed or in cases where TxDOT may consider using fillers that have not been tested or used previously.

Post-tensioned concrete girder at FSEL

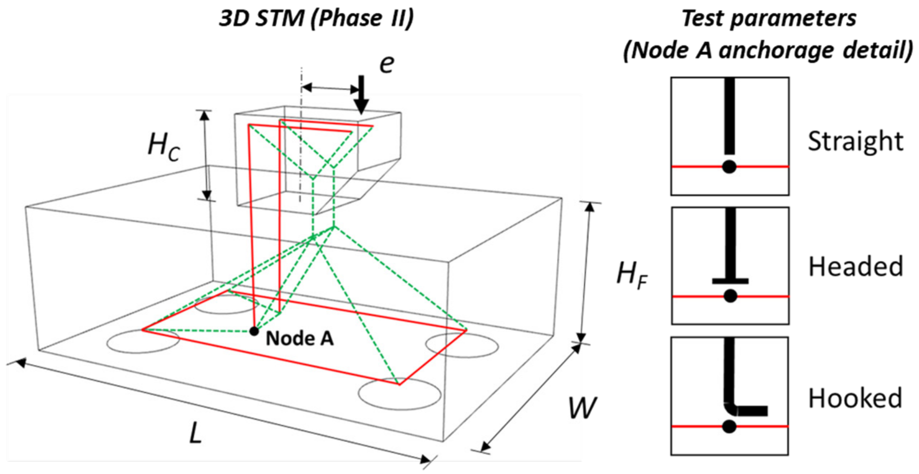
STRUT-AND-TIE MODELING AND DESIGN OF DRILLED SHAFT FOOTINGS

PROJECT TEAM: YOUSUN YI, DENNIS KIM, & RYAN BOEHM

SUPERVISORS: OGUZHAN BAYRAK, JUAN MURCIA-DELSO, & TREVOR HRYNYK

The design and detailing of reinforced concrete footings varies greatly on a state, district, and municipality basis due to the continued use of legacy (sectional) design methods. Therefore, a full transition to strut-and-tie modeling is required for uniform design and detailing of shaft-supported footings. This project aims to refine the STM guidelines for 2D structures to those for 3D structures through experimental and analytical approaches. A total of 13 footing specimens under concentrically applied loading have been tested so far, and the test results will be analyzed to propose the 3D STM guidelines.

During the Spring 2020 semester, a series of footings with column corbels will be tested to investigate behavior under eccentric loading. The corresponding 3D strut-and-tie model has vertical ties at the column reinforcement locations. For strut-and-tie design, full yield strength is assumed to be developed in the entire length of the tie elements. Therefore, a proper anchorage detail of the bottom end node (Node A in the figure) should be provided to develop the full yield strength at the bottom end. To suggest the proper detail, the research team is going to test a total of three specimens having different anchorage details; straight, hooked, and headed bars.



3D strut-and-tie model for the footings under eccentric loading

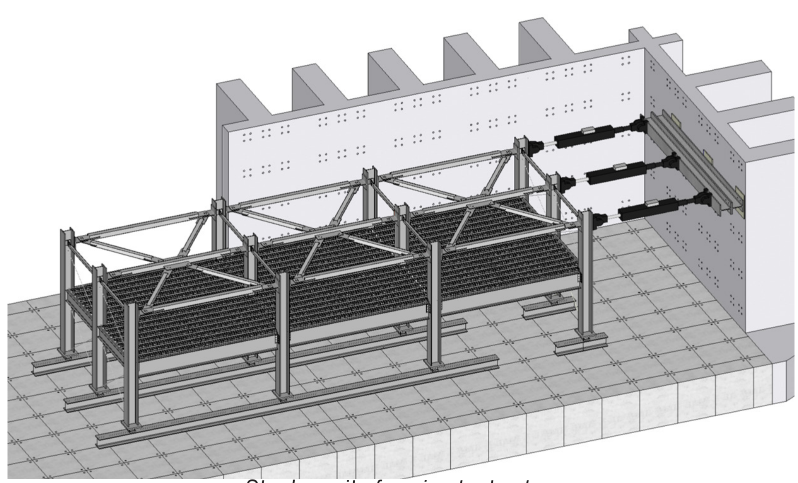
SYSTEM LEVEL SEISMIC PERFORMANCE OF STEEL GRAVITY FRAMING

PROJECT TEAM: SANGWOOK PARK, JORGE HERNANDEZ, CÉSAR SAAVEDRA, & ADAM SCHULZ

SUPERVISORS: PATRICIA CLAYTON, MICHAEL ENGELHARDT, TODD HELWIG, & ERIC WILLIAMSON

The overall goal of this project is to investigate the role of gravity framing systems on the seismic performance and collapse resistance of steel buildings. Previous tests have confirmed that the presence of the composite floor slab can significantly increase the flexural capacity of simple shear connections compared to those without a slab; however, recent testing by the investigators has shown that the tensile capacity of the metal decking profoundly affects connection strength and behavior, a finding not recognized in previous work. These tests also suggest that the restraint provided by surrounding framing bays may have a significant beneficial influence on connection behavior at large inter-story drifts, an important effect that is not captured by the boundary conditions provided in past subassembly test programs.

The test program includes two composite steel gravity framing system specimens with multiple bays to simulate realistic boundary conditions and restraint to frame expansion provided by neighboring bays. It is expected that the gravity framing connections in the multi-bay test set up will exhibit larger flexural capacity than would be predicted by previous subassembly tests. These tests will lead to improved understanding and modeling of lateral force-resisting mechanisms in steel gravity framing systems including contributions from connection components, metal decking, and slab.


Steel gravity framing test setup

USE OF LARGER DIAMETER SHEAR STUDS FOR COMPOSITE STEEL BRIDGES

PROJECT TEAM: LU WAN, YUCEL ALP, & JEONG-HWA LEE

SUPERVISORS: MICHAEL ENGELHARDT, TODD HELWIG, & ERIC WILLIAMSON

The use of larger diameter shear studs can significantly reduce the required number of shear studs, and thus increase the safety during construction and reduce the possibility of deck damage during deck replacement. This research project is focused on the feasibility of using shear stud diameters greater than 7/8 inch for composite steel bridge construction, and the development of design guidelines for evaluating the static and fatigue strength of larger diameter shear studs. Shear stud diameters ranging from 1 inch to 1-1/4 inch will be considered in this study. The research includes tests to evaluate issues with welding procedures and quality control for larger diameter shear studs. In addition, extensive laboratory testing will be conducted consisting of push-out or similar type specimens to obtain data to evaluate both the static strength and fatigue strength of larger diameter shear studs. This will be followed by large-scale composite beam tests and associated computational studies to provide a thorough evaluation of the performance of composite steel bridge girders with larger diameter shear studs. Deliverables for the project include comprehensive design recommendations for the use of larger diameter shear studs.

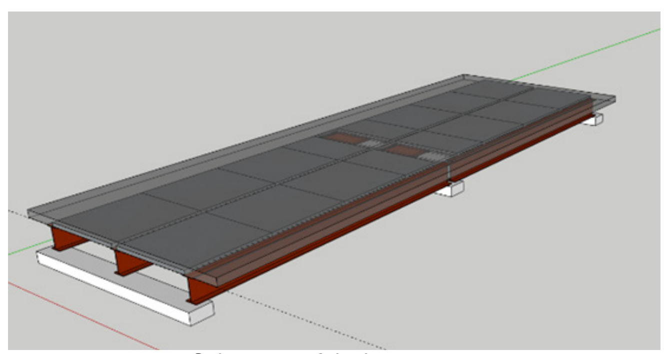
Shear studs on tub girder flange

UTILIZING STEEL FIBERS AS CONCRETE REINFORCEMENT IN BRIDGE DECKS

PROJECT TEAM: JONGKWON CHOI, THANOS DRIMALAS, ZACH WEBB, SOON KWANG JEONG, MIKE KIRKLAND, & JARROD ZABORAC

SUPERVISORS: OGUZHAN BAYRAK, JUAN MURCIA-DELSO, & KEVIN FOLLIARD

Precast, prestressed concrete panels (PCPs) are widely used in Texas as a stay-in-place formwork for bridge decks. PCPs support the cast-in-place (CIP) portion of the deck and associated traffic loads. Bridge decks often experience cracking during the service, and they are the most repaired type of bridge element, due to their susceptibility to crack-related deterioration. Steel fiber reinforced concrete (SFRC) can improve concrete cracking behavior. This project aims to develop improved SFRC mix designs and optimized reinforcement details. Deck strip tests will be completed to evaluate the crack control and load-resisting performance under idealized flexural loading conditions. Nonlinear finite element analysis in conjunction with the tests will be used to develop recommendations for full-scale testing. Full-scale tests with four different optimized reinforcements will be completed to examine the system level performance of SFRC bridge decks. The test will evaluate the capacity of the bridge in AASHTO LRFD design truck loading conditions. In addition, cracking of the decks will be investigated through high-precision non-contact optical measurement systems. The literature review was completed in Fall 2019; mix design, analysis, and experimental design are ongoing tasks for the research team.



Schematic of deck test setup

NEW FACES AT FSEL

My name is **ANAS DAOU**, from Dalhoun, a small town in Chouf, Mount Lebanon. I was born in United Kingdom and lived in Beirut. After completing my bachelor's degree in civil engineering at Beirut Arab University, I was involved in the master's program in civil Engineering at the American university of Beirut, as a graduate research assistant.

Joining the Ph.D. program FSEL at University of Texas at Austin will offer me broad research opportunities in the field of Structural Engineering. My passion towards the field of Structural Mechanics, shall be always guiding me to impact the lives of people locally and internationally. In short, joining University of Texas at Austin would allow me to convert my potential into useful work that is able to contribute to science and the welfare of mankind.

While I do enjoy research, my skills are not limited to that. I enjoy swimming and playing football in my free time.

CHEN LIANG. I am a fourth-year PhD student at Tongji University, China, and I am a visiting student here. My research topic in China is on composite joints and composite cable-stayed bridges. Now I am working with Dr. Helwig on steel bridges and will stay here for two years. In my spare time, I enjoy hiking and swimming. I am really glad to be a part of FSEL family and I am looking forward to meeting everyone!

My name is **HANSOL JANG** and I am a first year Ph.D. student at UT. I am from South Korea and I received BS and MS in Civil and Environmental Engineering from Hanyang University. My research interest is performance of reinforced and prestressed concrete. I recently joined the projects "Analyze Shear Capacity of Texas Standard Prestressed Beams from Strut-and-Tie Models of Beam Ends" and "Shear Behavior of Spliced Post-Tensioned Girders with Ungrouted Tendons."

JEONGHWA LEE. I am a visiting researcher at UT, and I am from South Korea. I received my BS degree in civil engineering from Seoul National University of Science and Technology and my MS and Ph.D degrees in structural engineering from Korea University. My research is focusing on horizontally curved bridges, applications of high strength materials, instability, earthquake engineering on seismic composite columns. Currently, I am working on a research project "Use of Larger diameter shear studs in composite bridges" under the supervision of Prof. Engelhardt, Prof. Helwig, and Prof. Williamson. I am glad to be working with FSEL team.

My name is **LU WAN**. I am from Chengdu, China. I graduated from Southwest Jiaotong University in China and got my master's degree at Columbia University. I am now working with Dr. Engelhardt to do research in composite structures. It's a great experience to do my PhD at UT. In my free time I enjoy watching movie and running. I also like making new friends with you.

MEHMET BAKIR BOZKURT. I come from Manisa Celal Bayar University, Turkey. I received my MS and PhD from Istanbul Technical University and Middle East Technical University respectively. I am interesting in earthquake resistant design of steel structures. Currently, I am studying with Dr. Engelhardt on the seismic response of eccentrically braced frames under strong ground motions. I enjoy hiking in my spare time.

NIDHI KHARE. I am from Indore, India and I did my undergraduate studies in civil engineering at Sardar Vallabhbhai National Institute of Technology, India. Before coming to UT for my masters and doctorate, I worked for two years as an assistant structural engineer at Arup India Pvt. Ltd. At UT, my research is about design and detailing of tall haunches. It involves both experimental and computational work. I am very glad to be a part of UT and FSEL. In my free time, I enjoy dancing and watching movies.

SANGYOUNG (THOMAS) HAN. I am a first-year PhD student at UT. I was born and raised in South Korea. I received my Bachelor's degree in architectural engineering from Chungnam National University. Right after graduation, I worked for six years as a civil engineer in Samsung. I started the MS program at the University of Florida focusing on topics related to mass concrete and concrete design. Currently, I am working on two projects: Spliced Post-Tensioned Girders with Ungrouted Tendon and Analyze Shear Capacity of Texas Standard Prestressed Beams from STM of Beam Ends. I'm really happy at UT as a member of FSEL.

YUCEL ALP. I received my bachelor's degree from Akdeniz University, Turkey. I worked for two years in a structural engineering firm after graduation. During this period, I realized the importance of pursuing a master's degree. I came to the UT to complete my MS degree under the supervision of Dr. Engelhardt, and I focused on finite element analysis of eccentrically braced frame shear links. After completing my MS degree in 2019, I stayed at UT to pursue my Ph.D. Currently, I am involved with composite bridge research.

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