Research

Overview of Research Experience

I started my research in transportation engineering in the area of asphalt technology while pursuing my *Master of Science in Civil Engineering*. My first project[1] focused on improving the overlay tester (OT) test to assess the cracking properties of asphalt mixtures. My Ph.D. dissertation focuses on the research topics of *implementation of balanced mix design (BMD) concept*, and *development of performance-engineered mix design specifications.*

As a research associate at the CTIS for the last six years, my research direction diversified into several topics related to the design and evaluation of flexible pavements and asphalt mixtures. I have collaborated on research projects sponsored by the TxDOT. The journal article[2] arising from my participation at the Transportation Research Board (TRB) Minority Fellowship program has received more than 20 citations. We were the first researchers to utilize synthetic specimens to calibrate and assess the sensitivity of the OT test to key operational variables. The research findings from that journal article led the research team to develop an alternative analysis methodology to assess the cracking resistance of asphalt mixtures with more reliability in the OT test results[3]. This initial success led to my appointment as a young active member of the TRB *Standing Committee on Structural Requirements for Asphalt Mixtures (AFK50)* in 2018.

In addition to exploring innovative test methods and analysis techniques for cracking test methods, we have extensively investigated the asphalt binder and aggregate interaction for optimizing mix designs to produce BMD mixtures[4]. As a research associate, I led a research group of graduate and undergraduate students to carry out the tasks for two projects: TxDOT 0-6923 "*Develop Guidelines and Design Program for Hot-Mix Asphalts Containing RAP, RAS, and Other Additives through a Balanced Mix-Design Process*[5]" and TxDOT 5-6815-01 "*Implementation of Improved Overlay Tester to Assess Fatigue Cracking Resistance of Asphalt Mixtures*[6]*."* Other research topics we have explored include: (1) *characterization of pavement materials*[7], (2) *investigation of new laboratory testing protocols*[8]*,* and (3) *optimization of coarse aggregate skeleton for asphalt mixtures*[9].

State highway agencies, asphalt contractors and researchers are particularly interested in using asphalt mixes that could reduce the use of virgin natural resources such as mineral aggregates and asphalt binders. Combining with my expertise in pavement materials and mix design, we have established the research theme of *performance-based assessment of asphalt mixtures* to refine specifications for innovative mix designs and newly proposed complementary pavement materials that can be used to

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[1] Garcia, V. M., Miramontes, A., Garibay, J. L., Abdallah, I., and Nazarian, S. (2017). Improved overlay tester for fatigue cracking resistance of asphalt mixtures. No. TxDOT 0-6815-1. UTEP. CTIS.

[2] Garcia, V. M., and Miramontes, A. (2015). Understanding sources of variability of overlay test procedure. Journal of TRR, 2507(1), 10-18.

[3] Garcia, V. M., Miramontes, A., Garibay, J., Abdallah, I., Carrasco, G., Lee, R., and Nazarian, S. (2017). Alternative methodology for assessing cracking resistance of hot mix asphalt mixtures with overlay tester. Road Materials and Pavement Design, 18(sup4), 388-404.

[4] Vieira, D., Garcia, V. M., Abdallah, I., and Nazarian, S. (2020). Role of Aggregate Gradation in Balancing the Performance of Asphalt Concrete Mixtures. Transportation Research Record, 0361198120942515.

[5] Garcia, V. M., Vieira, D., Barros, L., Abdallah, I., and Nazarian, S. (2020). Develop Guidelines and Design Program for Hot-Mix Asphalts Containing RAP, RAS, and Other Additives through a Balanced Mix-Design Process. No. TxDOT 0-6923-01. UTEP. CTIS

[6] Garcia, V. M., Castillo, E., Garibay, J., Rocha, S., Abdallah, I., and Nazarian, S. (2020) Improved overlay tester for fatigue cracking resistance of asphalt mixtures. No. TxDOT 5-6815-01. UTEP. CTIS.

[7] Garcia, V. M., Valenzuela, M., Torres, A., Abdallah, I., and Nazarian, S. (2019). Performance Characterization of Asphalt Concrete Mixtures Modified with a Latex Additive. In Airfield and Highway Pavements 2019: Testing and Characterization of Pavement Materials (pp. 88-99). Reston, VA: American Society of Civil Engineers.

[8] Reyna, M., Garcia, V. M., Garibay, J., Abdallah, I., and Nazarian, S. (2020). Evaluation of Aggregate Crushing Tests and Their Correlation with Superpave Mix Design Properties. *Journal of Materials in Civil Engineering*, *32*(6), 04020141.

[9] Garcia, V. M., Barros, L., Garibay, J., Abdallah, I., & Nazarian, S. (2020). Effect of Aggregate Gradation on Performance of Asphalt Concrete Mixtures. Journal of Materials in Civil Engineering, 32(5), 04020102.

produce durable and stable flexible pavements.

Envisioned Research Program

My ultimate goal of becoming a professor is to leave a piece of my passion for research and education with future, bright engineering professionals. This goal can only be achieved and sustained by developing a nationally and internationally recognized research program. From my advisor's excellent example, I have learned that a successful research program hinges on the collaboration, hard work, and passion from a diverse group of colleagues and students. I firmly believe that I can develop a center for research and education in advanced transportation engineering, with a vision and mission that are student-centered, research-oriented, and culminate with successful professional engineers and scientists.

The main long-term partner for our research program will be the state DOTs, specifically Texas DOT. From my previous research work, TxDOT and FHWA are interested in continuing work on the research topic: *a testing protocol for assessing engineering-related quality of mineral aggregates to produce durable and stable asphalt mixtures.* Other organizations that can also support our research program are: NSF, with their interest on *the application of technological tools to advance the decision-making process for intelligent transportation systems through data-driven Smart Cities concepts*; the national cooperative highway research program (NCHRP), to contribute on *the advancements of engineering characterization of asphalt mixtures, mineral aggregates and asphalt binders*; and local public and private highway agencies to establish *a performance-based database for pavement materials and mix designs in to asses short and long term performance*.

Collaborative Research Opportunities

Diversity in research is a powerful approach to leveraging well-rounded implementable, yet innovative solutions. For example, I collaborated with a professor from the mechanical engineering department at UTEP to conduct research in fracture mechanics concepts for characterization of asphalt mixtures. The research group was able to publish a journal article[10] at the *Journal of Engineering Fracture Mechanics*. Moreover, this initial study resulted in a master thesis[11] for a graduate student whom I had the pleasure to help and guide through his research experiments.

I also had the opportunity to participate in a binational and interdisciplinary research program sponsored by NSF that focused on *developing a flooding alert system for Smart Cities*. Our research group was able to document the research findings in a successful journal publication[12]. The mobile application, technological tools, and techniques learned from this program can be readily implemented to improve the decision-making programs utilized to intelligently manage transportation infrastructure systems such as rehabilitation, maintenance, and planning of roadways and bridges.

In addition, I joined a research group from the College of Education to develop education-related research in the STEMGrow and "Yes She Can" programs funded by the US Department of Education. This partnership has instilled in me a desire to continue performing research in education-related topics to develop advanced education strategies that benefit students that are often underrepresented in STEM. For example, I am currently working with an undergraduate student in assisting in the submittal of a journal article on *engagement models that support Hispanic STEM students facilitate*

[10] Stewart, C. M., Reyes, J. G., and Garcia, V. M. (2017). Comparison of fracture test standards for a super pave dense-graded hot mix asphalt. *Engineering Fracture Mechanics*, *169*, 262-275.
[11] Garcia, E. (2017). Test method for the fracture and fatigue crack growth behavior of hot mix asphalts. Retrieved from UTEP theses and dissertations database.
[12] Garcia, V. M., Granados, P., Medina, M., et al. (2020) Management of Real-Time Data for Smart Flooding Alert System. 2020 IEEE International Conference on Smart Cities (ISC2).

online learning during the COVID-19 pandemic.

I have learned that collaborative research opportunities significantly improve one's research skills and increase your professional network. The proposed research program would also benefit significantly from the collaboration of colleagues from other departments, such as Materials Science to understand the composition of pavement materials, Geology to investigate testing tools for mineral aggregates, Mechanical Engineering to improve cracking tests based on fracture mechanics concepts, Computer Science to implement technological tools for transportation infrastructure management, Chemistry to explore techniques for asphalt binder characterization, and Education to explore alternative learning models and teaching strategies for underrepresented students.

Summary

My role as a researcher is to explore undiscovered fields, create new knowledge, share innovative ideas and apply resources to benefit the quality of life through implementable solutions. I fundamentally consider the following aspects to add more value to my research:

- Do research that is beneficial and of interest to the local community
- Be aware of the new developments, trending topics, societal trends and funding resources
- Explore new research topics from other disciplines through interdisciplinary research groups
- Disseminate my work through publications in reputable journals and international conferences
- Continue learning from the advice, comments and criticism from colleagues and students

As a future tenured assistant professor in Civil Engineering at a university institution with a R2 Doctoral University classification from the Carnegie Foundation, I see myself focusing my academic and research programs in three major areas: asphalt technology, transportation infrastructure, and smart technological applications. My academic and research programs will be enhanced by local, regional, national and global collaborations, and will be complemented by the exposure of real-world applications of engineering research into undergraduate and graduate classrooms.