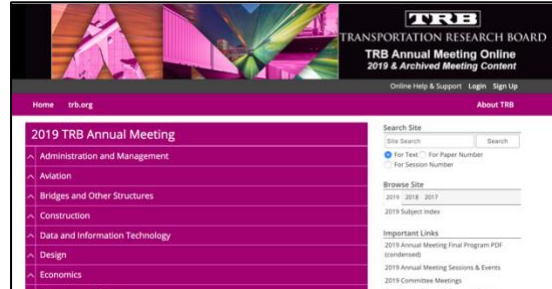




Maintenance at the 2019 TRB Annual Meeting

Resource Spotlight: TRB Annual Meeting Online Portal

If you're searching for the latest research on a transportation topic, don't forget to visit the [TRB Annual Meeting Online](#) portal. The portal includes papers, posters and presentation materials from the 2017-2019 Annual Meetings.



Below we've compiled links to a sampling of the papers related to maintenance that were presented at the 2019 Annual Meeting. Papers are free to download for employees of state DOTs and other TRB Sponsor organizations. If you have trouble accessing the papers, check with your DOT or other transportation library.

Asset Management

This section includes papers on pavement management, bridge management, and managing other assets.

Pavement Management

19-00488 [Condition-Budget Approach for Highway Assets Prediction of Future Asset Condition Ratings](#)

Ali Almalki, William Rasdorf

Jazan University (Saudi Arabia); North Carolina State University

19-03911 [Considering Sustainability Index for Pavement Maintenance Scheduling and Optimization](#)

Stella Obazee-Igbinedion, Manoj K. Jha

Maryland State Highway Administration; MKJha Consulting

19-00644 [Incorporating Livability into Transportation Asset Management Practices Through Bikeway Quality Networks](#)

Marketka Vavrova, Carlos Chang Albitres

University of Texas at El Paso

19-01225 [Life Cycle Environmental Impacts of Asphalt Roadway Maintenance, Repair, and Rehabilitation Alternatives](#)

Song He, Ossama Salem, Baris Salman

Syracuse University; George Mason University (Virginia)

19-01214 [Pavement Management and Maintenance Practices Currently Applied to Low-Volume Roads in Colorado: Best Practices and Potential Improvements](#)

Marwan Hafez, Khaled Ksaibati, Rebecca Atadero
University of Wyoming; Colorado State University

19-00206 [Optimizing Expert-Based Decision Making of Pavement Maintenance Using Artificial Neural Networks with Pattern Recognition Algorithms](#)

Marwan Hafez, Khaled Ksaibati, Rebecca Atadero
University of Wyoming; Colorado State University

19-03705 [Pavement Structural Capacity from Traffic Speed Deflectometer for Network Level Pavement Management System Application](#)

Mahdi Nasimifar, Senthilmurugan Thyagarajan, Sarah Chaudhari, Nadarajah Sivaneswaran
Turner-Fairbank Highway Research Center (FHWA); University of Pittsburgh

Bridge Management

19-01567 [A Comparative Study of Bridge Performance Measures Using a Large Set of Actual Bridge Data](#)

Chi Zhang, Jieun Hur, Abdollah Shafieezadeh
Ohio State University

19-01460 [Bridge Model Validation at Indiana DOT](#)

Gary Ruck, Kathryn Francis
Indiana DOT; Deighton Associates Ltd. (Ontario)

19-01195 [The Application of Machine Learning Techniques for the Analysis of NBI and Bridge Element Data](#)

Graziano Fiorillo, Hani Nassif
Rutgers University

19-05422 [A Comparative Study of Predictive Analysis Methods to Estimate Bridge Response](#)

Fiorella Mete, Ying Chen, Amanda Stathopoulos, David J. Corr
Northwestern University

19-02031 [Reliability Importance as a Measure of Deteriorating Bridge Elements' Condition Index](#)

Sylvester Inkoom, John Sobanjo
Florida State University

Managing Other Assets

19-05307 [Assessing Gaps in High-Quantity Low-Cost Roadway Asset Data Collection: A Survey of the State-of-Art Sensing Technologies](#)

Roya Amouhadi, Majid Khalilikhah, Vahid Balali, David Lee, Arsalan Heydarian
California State University, Long Beach; Tennessee DOT; University of Virginia

19-02641 [Building a Traffic Sign Inventory: Proof of Concept for a Vision-Based Real-Time Detection and Localization Framework](#)

Amir Nohekhan, Kaveh Farokhi Sadabadi
University of Maryland

19-03734 [LiDAR-Based Assessment of Highway Traffic Sign Visibility](#)

Lloyd Karsten, Suliman A. Gargoum, Karim El-Basyouny
University of Alberta (Canada)

19-00754 [Effects of LiDAR Point Density on Extraction of Traffic Signs: A Sensitivity Study](#)

Suliman A. Gargoum, Karim El-Basyouny
University of Alberta (Canada)

19-05114 [Application of Unmanned Aerial Vehicle to Inspect and Inventory Interchange Assets to Mitigate Wrong-Way Entries](#)

Mohammad Jalayer, Michael O'Connell, Huaguo Zhou, Patrick Szary, Subasish Das
Rowan University; Rutgers University; Auburn University; Texas A&M Transportation Institute

19-03779 [Cor-Ten Steel Highway Truss Sign Supports: A Case Study in Charleston Interstate System](#)

Hai Nguyen, Wael Zatar
Marshall University

19-00472 [An Approach to Pavement Marking Prioritization](#)

David Veneziano
Iowa State University

19-01231 [Maintenance Facility Location Optimization Review](#)

William Holik
Texas A&M Transportation Institute

19-02690 [Utilization Measurement of Highway Fleet Equipment: Dump Trucks](#)

Mehrdad Tajalli, Amir Mirheli, Ali Hajbabaie, Leila Hajibabai, Wei Fan
Washington State University; State University of New York; University of North Carolina, Charlotte

19-03271 [Utilization Management of Highway Fleet Equipment: Formulation and Application](#)

Amir Mirheli, Mehrdad Tajalli, Rasool Mohebifard, Leila Hajibabai, Ali Hajbabaie
State University of New York; Washington State University

19-05002 [Cost Effective Fleet Asset Replacement Guidelines: A Case Study](#)

Golam Sarwar, Arif Beg
AgileAssets Inc.

Bridge Repair and Rehabilitation

This section includes papers on repair methods and bridge inspection.

Repair Methods

19-01337 [Thermal Spray Zinc Coatings for Corrosion Protection of Steel Bridges](#)

Martin Gagne, Frank E. Goodwin, Ole Øystein Knudsen, Martin van Leeuwen
International Zinc Association; SINTEF

19-00490 [A New Protocol for Evaluating the Durability of Coatings Used for Reducing Corrosion of Steel Structures](#)

Giri Venkiteela, David P Caronia, Perumalsamy N Balaguru
New Jersey Department of Transportation; COWI North America; Rutgers University

19-05728 [Design of Various Shear Connectors for Repair of Corroded Steel Girders with UHPC](#)

Dominic Kruszewski, Arash Esmaili Zaghi
University of Connecticut

Bridge Inspection

19-01668 [Utilizing UAS and Reality Modeling to Improve Bridge Inspection Results](#)

Barritt Lovelace, Jennifer Wells
Minnesota DOT; Collins Engineers, Inc.

19-04074 [A Streamlined Bridge Inspection System Utilizing Unmanned Aerial Vehicles \(UAVs\)](#)

Brandon Perry, Yanlin Guo, Rebecca Atadero, John W. van de Lindt
Colorado State University

19-01748 [Unmanned Aircraft Systems Policy at State Departments of Transportation](#)

Dennis C. Bausman, Joseph Burgett, Mashrur Chowdhury, Phillip Greider, Katherine Brunk
Clemson University (South Carolina)

19-04718 [Evaluation of the Impact Echo Method for Concrete Bridge Decks with Asphalt Overlays](#)

Shibin Lin, Hoda Azari
FHWA

19-04108 [Automated Detection and Visualization of Defects Using Constant Phase Data from Air-Coupled Impact Echo Testing of Concrete Decks](#)

Najjiya Almallah, Nenad Gucunski
Rutgers University

19-02531 [Comparison of Nondestructive Evaluation of Concrete Overlays Versus Asphalt Overlays on Concrete Bridge Decks](#)

Hoda Azari, Shibin Lin
FHWA

Culvert and Drainage Systems Maintenance

19-03156 [Repair of Metal Culvert Invert with Engineered Cementitious Composite \(Bendable Concrete\)](#)

H. Celik Ozyildirim, Mary Sharifiasl
Virginia Transportation Research Council

19-00251 [Invert Paving of Deteriorated Metal Culverts](#)

Teruhisa Masada, Abdul Fekrat, John Hurd
Ohio University; E.L. Robinson Inc.

19-02053 [Fit-In Glass Fiber Reinforced Polymer \(GFRP\) Profile Liner for Retrofit of Corroded Metal Culverts](#)

Rahulreddy Chennareddy, Amr Riad, Susan Bogus, Mahmoud Reda Taha
University of New Mexico; Al-Azhar University (Egypt)

19-03077 [Carbon Fiber Reinforced Polymer Liners – Introducing a Proven Pipeline Structural Rehabilitation Method to the Culvert World](#)

Brent Bass, Murat Engindeniz
Simpson Gumpertz & Heger, Inc.

19-04998 [Vermont Agency of Transportation's Technical Transfer Adaptation of MnDOT's Hydraulic Inspection Vehicle Explorer \(HIVE\)](#)

Jonathan Griffin
Vermont Agency of Transportation

19-05791 [Rehabilitated Culvert Structural Design and Hydraulic Enhancement Method](#)

Tim Toliver, Donald McGriff, Don LeBlanc
Advanced Pipe Services; ISCO Industries, Inc.; DLVEWS, Inc.

19-00132 [Risk Assessment in Trenchless Technology Box Jacking Technique](#)

Babak Haji, Mohammad Hasan, Mohammad Najafi
PB&A Inc.; University of Texas at Arlington

19-01660 [Effect of Sliplining on Behavior of Corroded Corrugated Steel Pipes Under Loading](#)

Seyed Mustapha Rahmaninezhad, Jie Han, Mahdi Al-Naddaf, Robert Parsons
University of Kansas

19-05685 [Corrosion of Corrugated Metal Pipe in Kansas: A Longitudinal Study](#)

Luke Augustine, Stacey Tucker-Kulesza
Kansas State University

19-05130 [Dynamic, Three Dimensional Response of Corrugated Steel Arch Culvert](#)

Yuchen Liu, Ian Moore, Neil A. Hoult
Queen's University (Ontario, Canada)

19-00552 [Roadway Inundation from Post-Wildfire Flooding](#)

Vanessa Valentin, John Stormont, Deepak Bhatta
University of New Mexico

19-04403 [Review of Literature for Cured-in-Place Pipe \(CIPP\) Chemical Emissions and Worker Exposures](#)

Vinayak Kaushal, Gomathy R. Iyer, Mohammad Najafi, Melanie Sattler, Kevin Schug
University of Texas at Arlington

19-01481 [Laboratory Testing and Analysis of Geopolymer Pipe-Lining Technology for the Rehabilitation of Sewer and Stormwater Conduits](#)

Joseph Royer, John Matthews
Milliken Infrastructure Solutions, LLC; Louisiana Tech University

19-03669 [Optimizing Storm Sewer Cleaning Operations with Alternative Equipment](#)

Tyler Mikita, William Schneider, Teresa Cutright, Mallory Crow
University of Akron (Ohio)

Gravel Road Maintenance

19-00772 [Economics of Upgrading Gravel Road to Otta Seal Surface](#)

Ali Nahvi, Yang Zhang, Ali Arabzadeh, Halil Ceylan, Sunghwan Kim, Charles Jahren, Douglas D. Gransberg, Sharif Y. Gushgari
Iowa State University

19-00373 [Developing an Image Processing Algorithm for Evaluating Gravel Road Dust](#)

Omar Albatayneh, Lars Forslöf, Khaled Ksaibati
University of Wyoming; Roadroid

Maintenance Worker Safety

19-00465 [Simulator and Field Study of Green Lights on Truck Mounted Attenuators in Missouri During Mobile Operations](#)

Siyang Zhang, Zhu Qing, Henry Brown, Carlos Sun, Praveen Edara
University of Missouri

19-05739 [Case Study of Indoor Air Quality for Heavy Duty Diesel Equipment](#)

Phil Lewis, Mohammad Aghaeipoor, Rachel Mosier, Rob Agnew, Yongwei Shan
Texas A&M University; Oklahoma State University

Pavement Monitoring and Evaluation

This section includes papers on pavement condition surveys; detecting, evaluating and monitoring pavement distress; and performance management.

Pavement Condition Surveys

19-01966 [Development of a QC/QA Process for Caltrans Automated Pavement Condition Survey Data](#)

Haiping Zhou, Zhongren Wang, Robert Sherrick, Scott Mathison
Caltrans; Pathway Services Inc.

19-04085 [Analysis of Pavement Condition Survey Data for Effective Implementation of Performance-Based Maintenance Contract](#)

Antonio Pantuso, Giuseppe Loprencipe, Guido Bonin, Bagdat B. Teltayev
University of Rome "La Sapienza"; Kazakhstan Highway Research Institute

19-00081 [Relationship Between the Pavement Condition Index and the Pavement Surface Evaluation and Rating Method](#)

Sharlan Montgomery Dunn, John Haddock
NCE; Purdue University

19-03840 [Relating PCI with PSR for Asphalt Surfaced-Pavements](#)

James Bryce, Richard Boadi, Jonathan Groeger
Wood Environment and Infrastructure Solutions, Inc.

19-01049 [Improving Reliability of Automated Pavement Condition Data for Asphalt Road Surfaces Through Statistics-Based Quality Control](#)

Amir Arshadi, Abbas Kachwalla, Katherine Keegan
AECOM (Chelmsford, Massachusetts; Chicago)

19-05690 [The Relationship Between Surface-Measured Indices and In-Service Pavement Structural Conditions Predicted from Traffic Speed Deflection Devices](#)

Zia Zihan, Mostafa Elseifi, Kevin Gaspard, Zhongjie Zhang
Louisiana State University; Louisiana DOTD

Detecting, Evaluating and Monitoring Pavement Distress

19-03664 [Innovative Monitoring of Pavements on Expansive Soils Using Aerially Collected Data from UAV-CRP Technology](#)

Surya Sarat, Chandra Congress, Anand Puppala
University of Texas at Arlington

19-02870 [Detection of Moisture-Related Damage and Stripping Phenomena in Asphalt Using 3D-Radar GPR System](#)

Kenneth Maser, Aleksey Khamzin, Kyle Hoegh, Shongtao Dai
Minnesota DOT; Infrasense, Inc.

19-02553 [A Tile-Based Image Processing Method Based on Crack Density for Detection and Classification of Pavement Cracks](#)

Nima Safaei, Omar Smadi
Iowa State University

19-02834 [Automatically Detect and Classify Asphalt Pavement Raveling Severity Using 3D Technology and Machine Learning](#)

Yichang Tsai, Yipu Zhao, Anirban Chatterjee
Georgia Institute of Technology

19-05052 [Statistical Analyses of Data Quality of Automated Pavement Cracking Measurements](#)

Jueqiang Tao, Xiaohua Luo, Xin Qiu, Feng Wang
Jackson State University (Mississippi); Zhejiang Normal University (China); Texas State University

19-01177 [Repeatability and Agreement of Various High-Speed Macrotexture Measurement Devices](#)

Vincent Bongioanni, Kyle Maeger, Samer Katicha, Edgar de Leon Izeppi, Gerardo Flintsch
Virginia Tech Transportation Institute

19-01312 [Non-Destructive Evaluation of Crack Initiation and Propagation in Continuously Reinforced Concrete Pavements](#)

Lucio De Salles, Lev Khazanovich, José Tadeu Balbo
University of Pittsburgh; Federal University of São Carlos (Brazil); University of São Paulo (Brazil)

19-01641 [Line-Structured Rut Detection of Asphalt Pavement with Traffic Markings Interference Under Strong Light](#)

Shuo Ding, Yingying Xing, Jian Lu
Tongji University (China)

19-03908 [An Experimental Study of Environmental Effects on Concrete Pavement Surface Cracking Using Infrared Thermography](#)

Aidin J. Golrokh, Yang Lu
Boise State University (Idaho)

19-02262 [Mechanistic Empirical Estimation of Remaining Service Life of Flexible Pavements Based on Simple Deflection Parameters](#)

Karthikeyan Loganathan, Mayzan Isied, Ana Maria Coca, Mena Souliman, Stefan Romanoschi, Samer Dessouky
University of Texas at Tyler; University of Texas at Arlington; University of Texas at San Antonio

19-05884 [State of Practices of Pavement Cracking Definitions](#)

Guangwei Yang, Qiang “Joshua” Li, Kelvin C. P. Wang
Oklahoma State University

19-03211 [Comparison Between Aggregate Base and Full-Depth Asphalt Pavements and Determination of Their Maintenance and Rehabilitation Timing](#)

Yizhuang David Wang, Jaehoon Jeong, Y. Richard Kim
North Carolina State University

19-01406 [Investigating the Influence of Distresses on Long-Term Performance of Pavement Friction of Rural Roads in Ontario Canada](#)

Luciana Omar, Abd El Halim Omar Abd El Halim
Carleton University

Performance Management

19-04193 [Post-Treatment Performance and Treatment Costs Across Pavement Types and Road Functional Classes: Some Empirical Observations](#)

Yu Qiao, Hanna Kemaw, Samuel Labi, Jon Fricker
Purdue University

19-05964 [Proposed Analytical Framework for Next-Generation Pavement Performance Measures](#)

Suri Sadasivam, Leslie Titus-Glover, Jagannath Mallela
WSP USA; consultant

19-01261 [Predicting Asphalt Pavement National Performance Measures Utilizing Tennessee Performance Indices](#)

Xiaoyang Jia, Mark Woods, Hongren Gong, Wei Hu, Baoshan Huang, Bayan Faraj
Tennessee DOT; University of Tennessee

Pavement Repair and Rehabilitation Methods

This section includes papers on pothole patching; crack sealing; and chip seals, slurry seals and surface treatments.

Pothole Patching

19-04080 [Feasibility Study of Asphalt Pavement Pothole Properties Measurement Using 3D Line Laser Technology](#)

Bing Hui, Zhou Wang, Yan Li, Yichang Tsai
Chang'an University (China); Georgia Institute of Technology

19-01830 [Rapid Inductive Heating of Asphalt Concrete to Hot Mix Temperatures for All-Season Pothole Patching: A Feasibility Study](#)

Ben Cox, Webster Floyd, John Rushing, Craig Rutland
U.S. Army Engineer Research and Development Center; U.S. Air Force Civil Engineer Center

19-02525 [Coating Materials for Timely and Durable Maintenance of Asphalt Pavement Potholes in Winter-Rainy Condition](#)

Mengmei Liu, Sen Han, Weigong Shang, Shihao Dong, Zhuang Zhang
Chang'an University (China); Shaanxi Transportation Construction Maintenance Engineering Co., Ltd. (China)

19-02397 [New Polymer Modified Pothole Patching Materials for Timely and Durable Maintenance in Winter-wet Condition](#)

Mengmei Liu, Sen Han, Weigong Shang, Shihao Dong
Chang'an University (China); Shaanxi Transportation Construction Maintenance Engineering Co., Ltd. (China)

19-03440 [Performance of Portland Cement Based Rapid Patching Materials with Different Cement and Accelerators Types, and Cement Contents](#)

Shayan Gholami, Jiong Hu, Yong-Rak Kim
University of Nebraska-Lincoln

19-00082 [Thermal Influence in the Performance of Static and Dynamic Hot Mix Asphalt Pothole Repairs](#)

Juliana Byzyka, Mujib Rahman, Denis Albert Chamberlain
Brunel University (United Kingdom)

19-05618 [Compatibility Evaluation of Asphalt Emulsion and Aggregate Materials](#)

Ala R. Abbas, Munir Nazzal, Bijay Subedi, Tanvir Quasem
University of Akron (Ohio); Ohio University

Crack Sealing

19-02057 [Cost-Effectiveness and Optimal Timing of Crack Sealing in Asphalt Concrete Overlays](#)

Momen Ragab Mousa, Mostafa Elseifi, Mohammad Z. Bashar, Zhongjie Zhang, Kevin Gaspard, Ken Free
Louisiana State University; Louisiana DOTD

19-02052 [Investigation of Crack Sealant Adhesive Properties Considering Complex Service Ambient Conditions Based on Weak Boundary Layer \(WBL\) Theory](#)

Liping Cao, Chen Yang, Jiangcai Chen, Zejiao Dong
Harbin Institute of Technology (China)

19-02355 [Evaluation of Moisture Damage Under Crack-Sealed Asphalt Pavements in Louisiana](#)

Momen Ragab Mousa, Mostafa Elseifi, Zhongjie Zhang, Kevin Gaspard
Louisiana State University

19-00493 [Impact of Crack Sealant on Pavement Skid Resistance](#)

Andrew Fried, Haritha Malladi, Cassie Castorena
North Carolina State University; Lafayette College (Pennsylvania)

Chip Seals, Slurry Seals and Surface Treatments

19-02977 [Design, Construction, and Preliminary Investigation of Otta Seal in Iowa](#)

Sharif Y. Gushgari, Yang Zhang, Ali Nahvi, Halil Ceylan, Sunghwan Kim, Charles Jahren, Ali Arabzadeh
Iowa State University

19-01289 [Development of Quality Assurance Procedures for Chip Seal Construction Using Macrotecture Metrics](#)

Guangyuan Zhao, Shuo Li, Yi Jiang, Jusang Lee
Indiana DOT; University of Waterloo (Ontario); Purdue University

19-01745 [Using 3D Laser Scanners to Automatically Adjust the Chip Seal Binder Application Rate for Varying Surface Texture](#)

Yorguo El Hachem, Sareh Kouchaki, Jorge Prozzi, Sydney B. Abrisz
University of Texas at Austin; Washington and Lee University

19-05067 [Chip Seal Construction Variability and Its Impact on Performance](#)

Jaehoon Jeong, Javon Adams, Y. Richard Kim
North Carolina State University

19-05994 [Performance-Based Percent Embedment Limits for Chip Seals](#)

Ilker Boz, Yogesh Kumbargeri, Muhammed Kutay
Michigan State University

19-06080 [Evaluation of the Effect of Percent Embedment and Aggregate Type on Chip Seal Performance Using Finite Element Analysis](#)

Yogesh Kumbargeri, Anne Blair Heidelberg, Muhammed Kutay, Ilker Boz
Michigan State University; Virginia Transportation Research Council

19-01711 [Using Reclaimed Asphalt Pavement \(RAP\) as Coarse Aggregate in Bituminous Seal Coat](#)

Shervin Jahangirnejad, Dennis A. Morian, Neal Fannin
Pennsylvania DOT; Quality Engineering Solutions, Inc.

19-02062 [Field Measurements of Emulsion Application Rates and Pavement Absorption Rates in Tack Coats and Chip Seals](#)

Haritha Malladi, Cassie Castorena
Lafayette College (Pennsylvania); North Carolina State University

19-02071 [Performance Evaluation of Slurry Seals Containing RAP](#)

Mahdi Saghafi, Nader Tabatabaee, Soheil Nazarian
University of Texas at El Paso; Sharif University of Technology (Iran)

19-04129 [Contribution of Reclaimed Asphalt Pavement Binder to Microsurfacing Slurry](#)

Shih-Hsien Yang, Muhammad Kodri, Hery Susanto
National Cheng Kung University (Taiwan)

19-02054 [Optimizing the Performance of Microsurfacing Treatments in Flexible Pavements and Assessing its Effects on Moisture Damage](#)

Mohammad Z. Bashar, Mostafa Elseifi, Momen Ragab Mousa, Zhongjie Zhang, Kevin Gaspard
Louisiana State University; Louisiana DOTD

19-05031 [Performance Evaluation of an Innovative High Friction Surface Treatment](#)

Xiaoyu Chen, Michele Antonio Lanotte, M. Emin Kutay, Larry Galehouse
Michigan State University

19-03777 [Development of a Portable Pavement Surface Macrotexure Measurement System Applied in China](#)

Hong Lang, Yuexin Lou, Shengdi Chen, Jian Lu
Tongji University (China); Shanghai Maritime University (China)

19-00755 [Experimental Evaluation of Porous Asphalt Ultra-Thin Wearing Course](#)

Mingjun Hu, Lihan Li, Jingrong Feng, Fangxing Peng
Tongji University (China)

19-04609 [Quality Control of Micro-Milling Treatment on Tunnel Concrete Pavement Using 3D Range Data](#)

Bing Hui, Haimei Liang, Mu Guo, Liu Xiaofang
Chang'an University (China)

Roadside Maintenance

19-01028 [Leveraging Telematics and Weather Data to Study the Productivity of Roadside Mowers](#)

Jijo K Mathew, Bill Morgan, Howell Li, William Downing, Matt Kraushar, Timothy Wells, James Krogmeier, Darcy Bullock
Purdue University; Indiana DOT

19-01870 [A Synthesis of Practice on Tree Canopy and its Safety Related Effects on Rural Highways](#)

Bhaven Naik, Andrea Horn, Glenn Matlack, Issam Khoury, Gaurav Sinha, Deborah McAvoy
Ohio University