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Sam Houston State University

Bridging Public Infrastructure with State Security

How proactive infrastructure maintenance enables more effective commerce, emergency management, and security mitigation

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Abstract
The resilience of transportation infrastructure is critical to public safety, economic stability, and societal well-being. When well maintained, infrastructure is often overlooked and underappreciated—yet underfunded, neglected roadway infrastructure, particularly bridges, can lead to cascading effects that cost lives and billions in economic harm.

This paper examines the state of bridge infrastructure in Texas, focusing on structural integrity and its implications for transportation security. While bridge age and maintenance status are a primary focus, the report also evaluates vulnerabilities such as the scale of economic disruption, based on average daily drivers reliant on a bridge, if disrupted by a bad actor. This paper recommends policymakers evaluate specific threats, remedies, and priority regions and corridors to safeguard.

Texas has one of the largest bridge networks in the United States, reflecting its size and economic significance. Using public data from state and federal sources, cross-referenced with the American Society of Civil Engineers (ASCE), the American Road & Transportation Builders Association (ARTBA), and others, the report highlights the most traveled bridges in Texas and surveys maintenance status, economic value of daily traffic, and other key indicators. A comparative analysis measures Texas's performance against national averages, emphasizing the state's unique proficiency in bridge maintenance. Additional analyses examine the impact of both maintenance-related collapse and disruption from cyber or terrorist attack, providing a dynamic evaluation of infrastructure resilience across multiple dimensions.

Beyond raw statistics, the paper explores broader implications. Structurally deficient bridges pose public safety risks, including accidents and emergency response delays. Economically, they affect supply chains, raise transportation costs, and impair regional competitiveness. Cascading effects—such as economic fallout from bridge closures—can ripple through local and national economies, undermining resilience and security.

Finally, the paper shows how well-maintained infrastructure enhances safety, economic security, and public trust. Recommendations prioritize maintenance investments, real-time monitoring technologies, and cross-sector collaboration to ensure that Texas's transportation infrastructure meets the demands of a growing population and economy. This report underscores the role of robust infrastructure in supporting the security and resilience of transportation systems in Texas and beyond.

Key Words: Transportation, Infrastructure, Bridges, Roadways, Commerce, Security, Cascading Effects

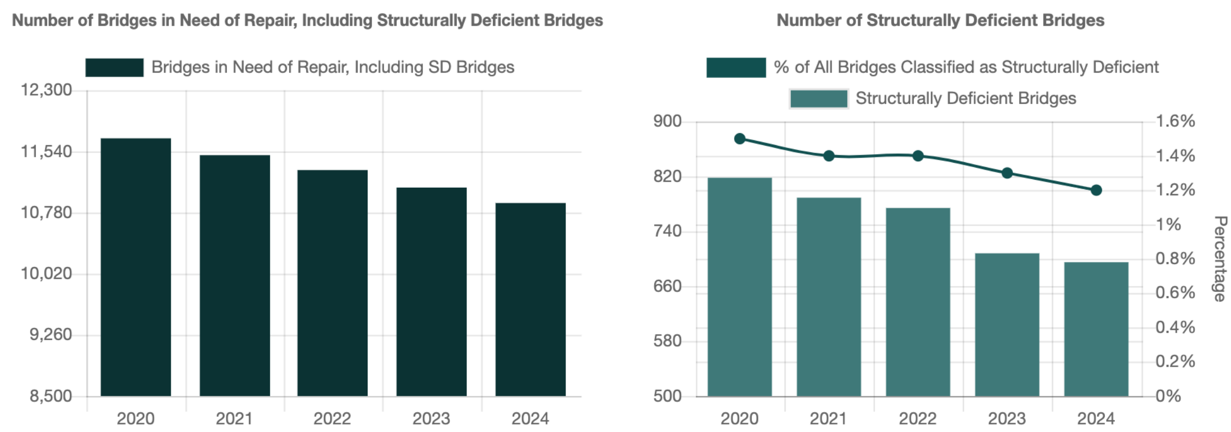
Introduction

Among the most iconic and recognizable features of the United States is its vast and connected Interstate system. Over 40,000 miles of public highways connect cities, communities, and enable the American economic engine to prosper. Along this network and throughout communities nationwide are critical infrastructure components that serve to facilitate movement and also pose the risk of being choke points if not functioning. These are the nation's 617,000 bridges.

Connecting road users over expanses of water, wetlands, intersecting road and rail infrastructure, and rising above cityscapes, bridges are unsung heroes of the economy. Little or no attention is paid to them when they function well, perhaps outside of bottle necks and standard congestion, while a laser focus turns to them when the worst occurs: a collapse. Because bridges are an infrastructure solution, ensuring they remain problem solvers and not liabilities of their own requires strategic maintenance and upkeep, innovative technology for inspections, and economic and security evaluation to mitigate and prevent risks that can threaten public safety, commerce, and even national security.

As a national leader in many categories, it is no surprise that Texas boasts the leading number of bridges within its borders. At approximately 57,000, the Lone Star State is home to nearly 10 percent of all bridges in the United States. These facilitate the second largest state economy in the country and help connect over 30 million Texans to their work, schools, hospitals, groceries, friends, family, and communities.

While the state identified repair needs on over 10,000 of the state's bridges as recently as 2024, just under 700 of those are considered structurally deficient and in dire need of repair.[1] Texas policymakers and communities can have confidence that the state ranks 50th out of 51 in the percentage of its bridges being considered structurally deficient – second only to Arizona with a lower share of its bridges in this state of needed repair.[2, 3] Not only this, but the trend is downward indicating forward progress in repairing those bridges most in need of repair both in total number and proportion of total bridges.



Texas Bridges by Repair Status[4]

While the good news is worth recognizing, two things remain clear: (1) there can be no break in the continued pursuit of repair and maintenance to eliminate any backlogs and restore 100 percent of bridges to high standards and (2) risks remain for bridges in need of repair and all bridges, given high dependence upon them.

To the first point, we can estimate that if the current repair rate continues, the backlog would extend past 2045 until Texas eliminates all structurally deficient bridges in the state.[5] This estimate assumes the repair rate from the past five years continues while accounting for additional bridges becoming deficient over time due to aging or wear. The rapid economic and population growth expected over that time period will also put additional strain on the state's roadways and bridges.

A higher population will also necessitate increased freight transport, putting more heavy vehicles on the roads that can accelerate deterioration.[6] Trucking is the nation's most popular way to move freight across the nation, making the bridges crucial to domestic trade and manufacturing. This makes bridges essential infrastructure that must remain well-maintained, efficient, safe, and secure to ensure continuous operation and prevent costly disruptions.

To the second point, the use and nature of these bridges calls economic activity, public safety, and security to mind. Of the top 25 most traveled structurally deficient bridges in Texas, the average age is 57 years old, while the average daily crossings exceed 80,000.[7] Over two million crossings take place on these 25 bridges every day. In total, around 3.5 million crossings take place daily on all structurally deficient bridges across the state.[8] Aging bridges reaching the end of their designed lifespan must also be considered, even if they remain in good condition. More than half of the bridges in Texas were built prior to 1980.[9]

While a collapse with drivers on the road would be the most direct public safety threat, any kind of collapse or even closure of the bridge for prolonged repairs would mean as many as 200,000

Texans must find another route to work, school, hospitals, and more. The added pressure on traffic and congestion resulting from this rerouting would then affect tens of thousands of additional residents and businesses. Congestion already costs users $10 billion annually in Texas.[10] All told, millions of Texans are directly dependent on bridges currently considered structurally deficient. Moreover, all Texans are indirectly dependent on bridges across the state for commerce—regardless of condition—which can pose risks if closures occur.

States of Repair and Policy Needs

Bridges in Texas are in generally good status compared to other states, but there remains room for improvement. Not only do some bridges need immediate attention, but as others age and experience wear and tear, the state must ensure a backlog is not created. Similarly, policymakers must look for new and innovative ways to inspect and collect data on bridges to gain early detection of defects and engage in proactive maintenance.

The 2025 ASCE Infrastructure Report Card rated Texas with a B- for its bridge infrastructure, above average but still beaten out by several states.[11] No state received the “Exceptional, fit for future” rating, with the highest score being a B+ for Alaska, Arizona, and Utah.[12] Despite these relatively strong ratings, significant challenges remain. Around 3.5 million daily crossings still take place on structurally deficient bridges in Texas. TxDOT has a bridge division dedicated specifically to this issue, which regularly makes plans for upgrades, repairs, and inspections of Texas bridges. However, ASCE estimates that Texas is short 3,000 full-time equivalent (FTE) employees to meet demand, and the number of TxDOT bridge employees has decreased since the year 2000.[13] Since the year 2000, more than 16,000 bridges have been built, and another 3,600 have been reconstructed. The average age of Texas bridges will only increase with time, as fewer new bridges are constructed despite the population boom.

Over 88 percent of TxDOT’s budget goes towards highway improvement and project development, which includes bridge development.[14] According to ASCE, Texas currently spends $1.1 billion on bridge capacity and $736.4 million on maintenance annually.[15] Texas also benefits from the Bridge Formula Program created by the 2021 Infrastructure Investment and Jobs Act (IIJA). Between Fiscal years 2022 and 2026, Texas is slated to receive a total of $576 million in federal funding through this program for bridge projects.[16] This program, along with the total $35 billion received from the IIJA for transportation infrastructure, is set to end in 2026, which may require Texas to secure additional funds.[17]

While funding and personnel are key aspects of maintaining resilient infrastructure, so too is innovation. With new technologies, like distributed fiber optic sensing, transportation officials can gain real-time access to traffic data, disruptions, and threats to roadways. Likewise, prudent use of drones, high-quality photography, and artificial intelligence to analyze structural conditions represent opportunities for the state to utilize its financial resources more efficiently and identify needs and conduct maintenance on public infrastructure without hiring thousands of new employees. With population growth, economic activity, and bridge age all trending upward, integrating proactive technological solutions will be vital.

Bridges are critical to transportation infrastructure because they serve as choke points—unlike flat roadways, which pose fewer risks and allow for more rerouting, a bridge failure can severely restrain movement. When a bridge is highly trafficked but is no longer available, either due to significant maintenance activity, a collapse, or a pending threat, it causes all daily drivers to find alternative routes. At a minimum, this creates economic consequences from traffic delays, lost productivity, and fuel loss. At worst, it creates further congestion across all other local roadways and bridges, impedes emergency vehicle movement, and forces commercial vehicles onto less efficient roadways – both delaying movement of goods and increasing their costs to consumers – while creating new wear and tear in unanticipated locations.

Importantly, these factors hold true regardless of which bridge is inoperable or the reason. That means a structurally deficient bridge collapse due to overdue maintenance has the same impact as a bad actor planting an explosive device and collapsing a bridge in good condition. This leads to the critical need for state officials to carefully evaluate each transportation corridor for a number of factors using advanced data analysis. The state must have a plan in place should each and every critical bridge experience a problem, whether or not they are in a poor structural condition.

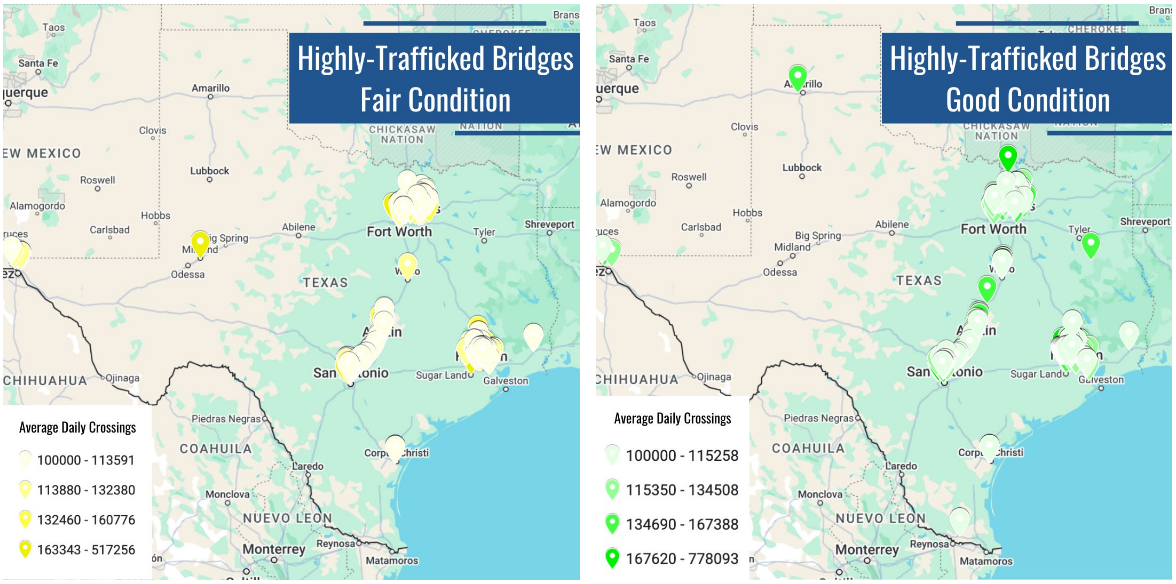
Heavy commercial vehicles are essential to the modern Texas economy, and have a much greater impact on road and bridge wear than traditional cars or trucks, necessitating more vigilant maintenance and monitoring, and increased spending on infrastructure.[18] Highways are the infrastructure that facilitates freight movement, with trucks transporting more than 60 percent of the Nation's freight.[19] While dated, a notable Government Accountability Office report detailed that an 18,000-pound truck was found to exert over 5,000 times more wear on roadways than a standard automobile, underscoring the exponential impact of heavy freight.[20] Today, trucks can legally weigh 80,000 pounds without a special permit, but there have been talks of increasing this weight limit to 91,000 pounds or higher.[21] The advocacy group Coalition Against Bigger Trucks published a research paper estimating that proposed 91,000 pound trucks would put 2,184 Texas bridges at risk and necessitate over $1 billion in direct bridge upgrades, not including increased maintenance.[22] Countervailing arguments include that weight distribution has improved over time and special permitting for heavier trucks can be an added source of revenue.

Because of their vulnerability as chokepoints, bridges require proactive planning to ensure safety and economic continuity. This preparation is especially vital amid projected population growth, freight increases, and infrastructure aging. Important to this preparation is the analysis of what is at stake and the regional infrastructure at the most risk.

Strategic Corridors and Economic Value
Bridges and highways are the foundation of the economy of Texas. As noted by the Texas Comptroller's Office, "Texas' highway network, the nation's largest, is the backbone of its economy. Economic growth depends in large part on the efficiency, reliability and safety of our highways and transportation systems, which support individual mobility needs as well as commerce and industry."[23] It is estimated that three trillion dollars in freight value was transported within Texas in 2018, and that freight directly employed one million Texans.[24] The projected growth of the state will increase the demand on the freight network further, necessitating renewed investments in bridge and highway infrastructure in order to sustain progress and maintain safety.

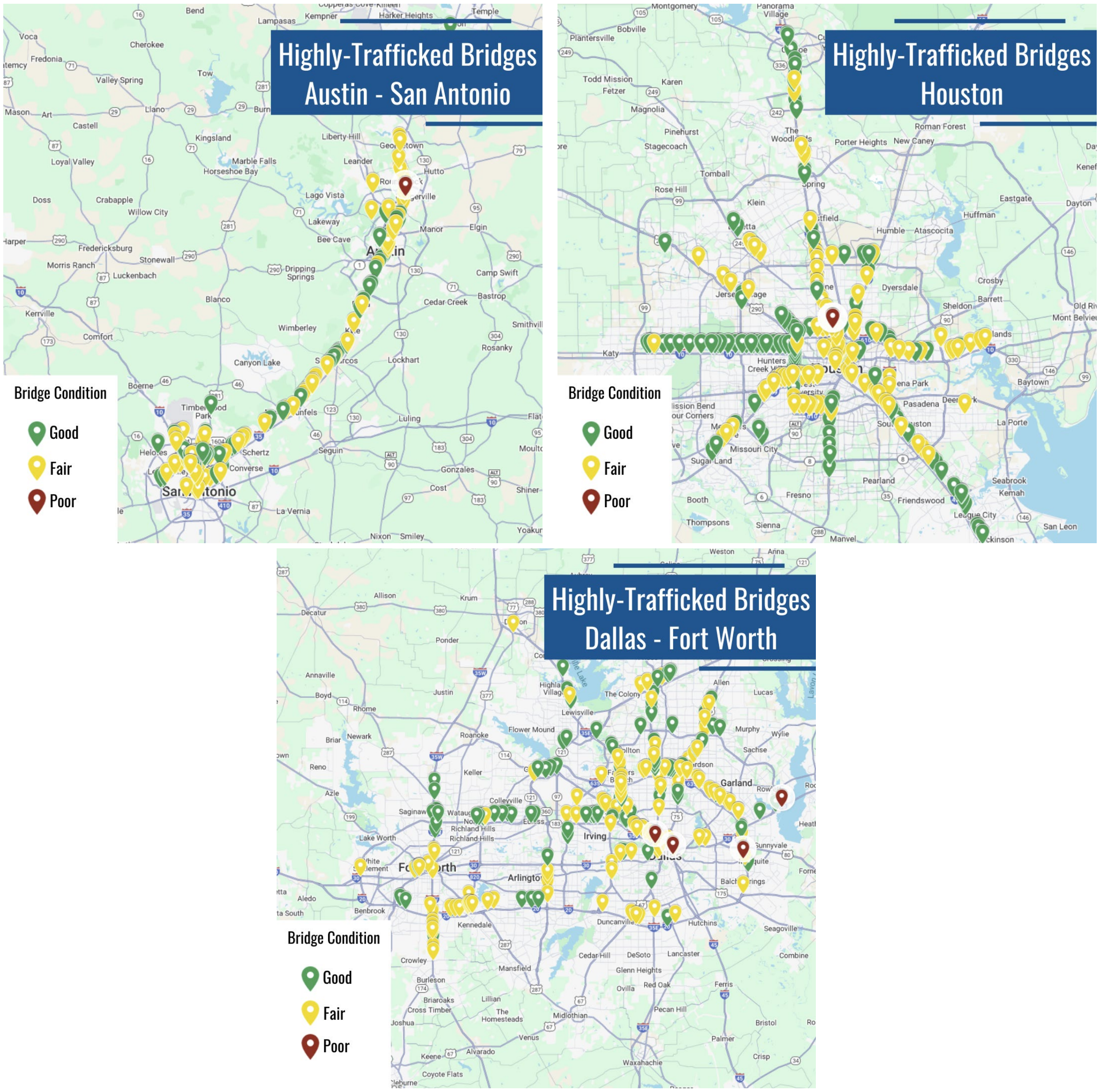
The Texas population is projected to grow significantly by 2050, with an increase of up to 38 percent.[25] The addition of 10 million new residents will undoubtedly put more cars on the road, leading to more traffic and road wear. Any bridge or highway disruption, structural or otherwise, creates spillover effects into other parts of the economy. Crucially, the addition of so many new citizens will increase demand for freight transport, necessitating thousands of additional trucks on the road—posing particular risks in regions where poor bridge conditions already exist.

Deficient bridges are spread across the entirety of Texas, but there are many that run through highly populated and economically vital regions. The most traveled structurally-deficient bridges run through Dallas, Fort Worth, and Houston – three of the top 12 most populated cities in the United States. Some of these bridges are part of the interstate highway system, while others are heavily used for local travel.



Highly Trafficked Bridges in Texas by condition. Data from NBI.

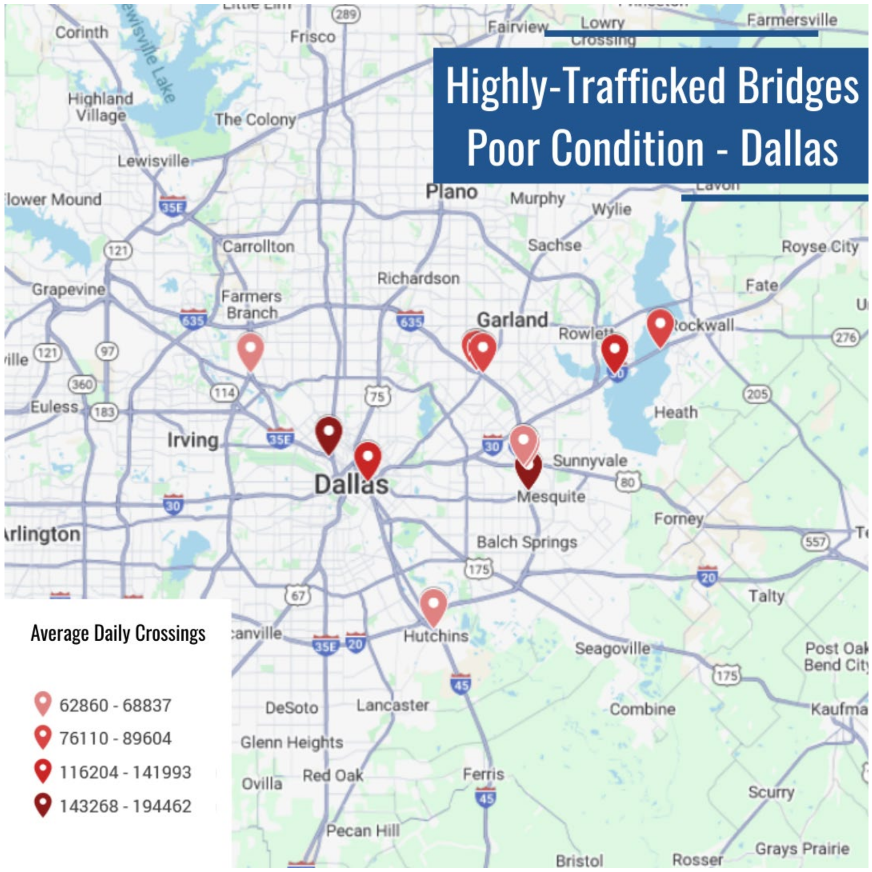
There are three main areas in Texas with numerous bridges that average over 100,000 vehicles traveling across them every day:[26] Dallas-Fort Worth, Houston, and Austin-San Antonio, which together house a majority of the state's population. The most significantly trafficked bridges are part of Interstate highways. These are the areas where a bridge closure or collapse would cause the most disruption, and therefore must be prioritized for economic and security needs. There are 86,400 seconds in a 24-hour day, meaning that these bridges average more than one vehicle crossing per second. Unexpected disruptions to bridges with this volume of traffic could be catastrophic for congestion and freight transport.



Highly-Trafficked Bridges in Texas Cities. Data from NBI.

The images above show these primary regions with bridges that average over 100,000 daily crossings. Green bridges were rated by the National Bridge Inventory (NBI) as “Good”, yellow bridges were rated as “Fair” and red bridges were rated as “Poor”.[27]

Unsurprisingly, cities host the most traveled and economically crucial bridges, followed by the interstate highways that connect them. Between Austin and San Antonio, Interstate-35 is a strategic corridor of enormous importance to Texas. In 2018 the I-35 was estimated to carry 137 million tons of freight valued at $307 billion, with an annual economic impact of $335 billion in Gross State Product (GSP).[28] The highway averages well over 100,000 daily vehicles, and any disruption or closure would force travelers onto small, rural highways that typically see a fraction of I-35 traffic.



Map of structurally deficient bridges with over 50,000 average daily crossings in Dallas.

The Dallas metroplex hosts 12 of the 16 bridges with over 50,000 average daily crossings rated as structurally deficient in the National Bridge Inventory, highlighting the need to address this region in particular. Important deficient bridges in this area include parts of Interstate-635 and Interstate-30, including two bridges over lake Ray Hubbard. Combined, over a million vehicles cross these bridges every day. If something happened that necessitated a closure or prolonged maintenance, it would cause major disruptions to regional traffic flow and interstate commerce. In 2018, the estimated freight value in DFW was estimated at $539 billion combined.[29]

Security Risks and Solutions

In the case of a bridge closure or collapse, the effects to the economy could be immediate. A closure of a section of highway like Interstate-35 would immediately stress alternate routes using side roads, which see just a fraction of the traffic. Closure of city highways in Dallas, Fort Worth, and Houston would create similar rerouting traffic problems that would create cascading effects across the greater metropolitan areas. Even partial closures can have major impacts on traffic flow.

After the Francis Scott Key Bridge collapsed into the port of Baltimore, there were significant impacts to the regional economy. The collapse blocked access to the port, and immediately caused traffic disruptions. Before the collapse, 34,000 vehicles crossed the bridge each day, significantly less than several structurally deficient bridges in Texas.[30] The economic cost to the port was estimated at $15 million per day, and cargo trucks that used the bridge were forced to make lengthy detours, increasing transportation costs.[31] Additionally, Maryland officials have estimated that the bridge will not be replaced until 2028 and cost between $1.7 billion and $1.9 billion.[32]

Extended bridge and highway closures can also have significant economic impacts, which is why efficient maintenance and preparation is so important. A recent study on bridge closures found a significant economic impact in interstate commerce as a result of a recent two-week bridge closure between Arkansas and Tennessee.[33] Traffic and congestion on an alternative bridge increased substantially, increasing total freight transportation times and vehicle accidents. For bridge closures in general, the report found that multi-purpose vehicles and heavy-duty trucks would be the most affected—causing disruptions to supply chains that reverberate across a region and the nation.[34]

Bridges and highways sometimes require significant upgrades or maintenance to keep them safe. When temporary closures are needed, it is crucial that state and local governments communicate effectively and make plans to minimize economic impact. Data collection can enhance the accuracy of planning efforts and helps ensure that mitigation efforts are effective. Collected data can also help identify the most crucial bridges and corridors to the Texas economy and population, informing authorities in response planning.

Proactive measures are also important in preventing the necessity of invasive repair or construction. Older bridges and highways in Texas may have been constructed without fully considering the explosive growth of the state's population, not to mention the increased weight of freight trucks. New bridges should be constructed with future capacity in mind, as well as improved safety monitoring systems. A study in 2017 found that integration of permanent structural health monitoring systems in bridges reduced operating costs of inspections and maintenance by 25 percent and reduced the overall life costs of a bridge by 10 percent.[35] These structural health monitoring systems have advanced significantly in recent years, with a wide array of technologies now available, including fiber optic sensors.[36, 37] These sensors can help measure structural load and plan effective preventative maintenance, and can be installed on both new and existing infrastructure.

Considerations

To guide strategic investment and ensure the most impactful use of limited resources, Texas policymakers may consider adopting or refining an existing tiered prioritization framework that evaluates bridges based on a combination of structural condition, average daily traffic, economic throughput, and redundancy within the transportation network. High-risk bridges—those in poor condition with high traffic volumes and limited alternative routes—should be designated as Tier 1 assets for immediate intervention. By integrating these criteria into a formalized risk matrix, transportation officials can align maintenance schedules, monitoring technologies, and emergency planning with the corridors most critical to public safety, economic continuity, and state security. This approach enables data-informed decision-making and ensures that both funding and operational focus are directed where they will yield the greatest return in resilience and risk mitigation.

In addition to prioritizing investments, emergency planning officials must ensure that contingency plans are in place for every high-volume roadway and bridge corridor, enabling swift, informed responses to disruptions rather than reactive decisions made under pressure. These plans should incorporate dynamic, real-time data—such as traffic flow and structural health insights provided by smart infrastructure technologies—to support accurate situational awareness and efficient rerouting during emergencies. Integrating this level of intelligence into emergency operations will strengthen coordination, minimize economic fallout, and enhance the resilience of the broader transportation network.

While prioritizing bridge infrastructure is essential, state and local leaders must also weigh these investments alongside other pressing infrastructure needs, ensuring that limited resources are allocated where they offer the greatest overall public benefit.

Conclusion

Texas is a national leader in transportation infrastructure. With the most bridges of any state, Texas demonstrates clear commitment to safety, mobility, and economic vitality by keeping its bridges in good condition—ranking second best in the nation in its low total proportion of bridges rated as structurally deficient. While reducing that share further—and ultimately eliminating it—is a clear priority, focusing solely on repairs overlooks a broader reality about transportation infrastructure. Structurally sound bridges can present vulnerabilities too.

As Texas experiences rapid economic and population growth, the pressure on existing infrastructure will intensify. Aging bridges, growing congestion, and heavy vehicles create new risks that cannot be addressed through aggressive maintenance alone. Modernizing inspection and monitoring systems with technology like fiber optic sensors and thorough data analysis will improve efficiency, reduce long-term costs, and support informed responses to emerging threats. Just as important is the development of proactive and contingency planning for key corridors and bridges across the state, focusing on economic hubs. Disruptions—whether from natural wear, necessary repairs, or malicious actions—can ripple across regions and cause significant human and economic harm. To mitigate these cascading effects, Texas should prioritize real-time monitoring, schedule repairs strategically, and implement detailed emergency response plans with statewide coordination. Following through on these steps will require sustained investment and ongoing agency preparedness.

Urban regions like Dallas-Fort Worth, Houston, and San Antonio face particularly acute risk, with some of the highest daily bridge crossings in the nation concentrated in small geographic footprints. These chokepoints, if disrupted, could halt freight, emergency services, and regional economic activity with national consequences. Additionally, workforce shortages in infrastructure management—such as the 3,000 FTE gap identified by ASCE—may hinder the state's ability to meet future needs without strategic workforce development and resource planning. Likewise, innovative technology can help reduce personnel gaps by providing more intelligence and real-time data to inform preventative maintenance and offer situational awareness for infrastructure use and threats.

Well-maintained and secure roads and bridges will build public confidence, induce more business development, and promote both safety and economic prosperity in Texas. By continuing to approach bridge infrastructure management broadly with safety and economic consequences in mind, Texas can set a national example in infrastructure resilience. Sustained investment, innovation, and preparation will ensure the bridge network can continue to support the growing population.

Bios

Benjamin Dierker is the Executive Director of the Alliance for Innovation and Infrastructure, specializing in economic, administrative, and legal aspects of American energy, transportation, infrastructure, and innovation. His goal is to analyze and explain the economic and legal realities underpinning public policy at the state and federal level. He strives to bring a balanced, accurate, and accessible perspective to enable students, specialists, the public, and elected representatives to make the best-informed decisions on these critical issues.

Mr. Dierker is a graduate of Texas A&M University, where he earned a Bachelor of Arts in Economics and a Master of Public Administration at the Bush School of Government and Public Service. He then earned his Juris Doctor from the Antonin Scalia Law School at George Mason University. He is admitted to practice law in Washington, D.C. and South Carolina.

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