Bridges

EXECUTIVE SUMMARY

There are more than 617,000 bridges across the United States. Currently, 42% of all bridges are at least 50 years old, and 46,154, or 7.5% of the nation's bridges, are considered structurally deficient, meaning they are in "poor" condition. Unfortunately, 178 million[1] trips are taken across these structurally deficient bridges every day. In recent years, though, as the average age of America's bridges increases to 44 years, the number of structurally deficient bridges has continued to decline; however, the rate of improvements has slowed. A recent estimate for the nation's backlog of bridge repair needs is $125 billion. Estimates show that we need to increase spending on bridge rehabilitation from $14.4 billion annually to $22.7 billion annually, or by 58%, if we are to improve the condition. At the current rate of investment, it will take until 2071 to make all of the repairs that are currently necessary, and the additional deterioration over the next 50 years will become overwhelming. The nation needs a systematic program for bridge preservation like that embraced by many states, whereby existing deterioration is prioritized and the focus is on preventive maintenance.

CONDITIONS & CAPACITY

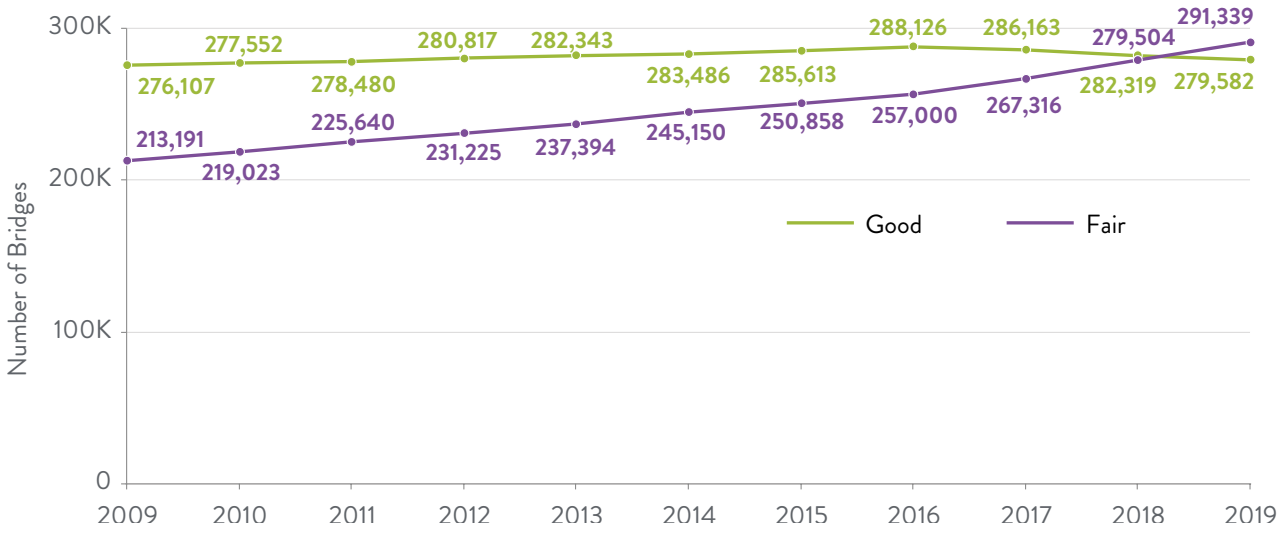
Over the past decade, a concerted effort has been made involving all levels of government to reduce the number of structurally deficient bridges across the nation. While structurally deficient bridges are not inherently unsafe, they require substantial investment in the form of replacement or significant rehabilitation, and they present higher risk for future closure or weight restrictions.

Encouragingly, as of 2019, just one in 13, or 7.5%[2] of highway bridges were designated structurally deficient, or poor, representing a significant improvement from 12.1% recorded a decade ago. Also encouraging is that the total percentage of bridge deck area that is classified as structurally deficient, or poor, has decreased over the past several years, totaling just 5.5% in 2019, compared to 6.3% in 2016.

Even with this renewed focus, nearly 231,000 bridges, in all 50 states, still need repair and preservation work. Unfortunately, the annual rate of reduction of structurally deficient bridges for the past two years has slowed considerably to just 0.1% annually, while the number of bridges that are slipping from good to fair condition is increasing annually. Though higher traffic volume bridges tend to receive more attention and are therefore less likely to be structurally deficient, on average 178 million trips occur over structurally deficient bridges every day. At the current rate of improvement, it is estimated to take more than 50 years, stretching to the year 2071, to repair all of these bridges. This is not a sustainable model. The rate of deterioration is exceeding the rate of repair, rehabilitation, and replacement, all while the number of bridges sliding into the "fair" category is growing. However,

bridges categorized as fair are a concern and an opportunity, as they are potentially one inspection away from being downgraded in classification, but they can also be preserved at a fraction of the cost required to address a structurally deficient bridge.

Bridge Condition By Year



Source: U.S. Department of Transportation, Federal Highway Administration, InfoBridge: Data: https://infobridge.fhwa.dot.gov/Data/Dashboard

While recent improvements show a positive trend in addressing our poorest bridges, progress is not universal because states face different challenges when maintaining, repairing, and replacing bridges. For example, in 2019, the percentage of structurally deficient bridges ranged from 1% in Nevada to 22% in Rhode Island.[3]

Less encouraging is that 42% of the nation's 617,084 highway bridges are over 50 years old, an increase from 39% in 2016. Notably, 12% of highway bridges are aged 80 years or older. Structurally deficient bridges specifically are nearly 69 years old on average. Most of the country's bridges were designed for a service life of approximately 50 years, so as time passes, an ever-increasing number of bridges will need major rehabilitation or replacement.

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To protect the public's safety, the federal government mandates national bridge inspections for all bridges on a periodic basis. The amount of time between inspections can range from 12 to 48 months and is based on the bridge condition, type of bridge, traffic, location, and age of the structure. If the bridge inspector finds any deficiency in the structural capacity or with an element of the bridge, that bridge could be posted for load, weight, or speed restrictions; temporarily repaired; and/or closed to the traveling public to ensure their safety. In 2019, just over 10% of bridges had such restrictions, a number that has remained stagnant over the past several years. Outside of direct safety concerns, posted bridges can dramatically increase driving time for larger vehicles such as school buses, ambulances, fire trucks, and delivery trucks, in

addition to interstate trucking. In rural areas, posted bridges can prohibit the passage of emergency service vehicles, which can slow response time and impede rescue efforts.

Finally, while the National Bridge Inventory no longer tracks functionally obsolete bridges, there are still over 94,000[4] bridges nationwide with inadequate vertical or horizontal clearances or inadequate approach roadway geometry. Such bridges do not serve current traffic demand or meet current standards, and many of these bridges act as bottlenecks, increasing congestion and crash vulnerability due to inadequate widths, lanes, or shoulders, substandard vertical clearance, or insufficient lanes for traffic demand.

Photo Courtesy of WSP USA

FUNDING & FUTURE NEED

In recent years, all levels of government have prioritized bridge repairs through investments. To make many of these investments, 37 states have either increased or reformed their gas tax since 2010. However, despite states' increased investments, overall spending in the country's bridges remains insufficient. The most recent Conditions and Performance Report from the Federal Highway Administration estimates the bridge backlog for repairs for existing bridges at $125 billion and also estimates that we need to increase spending on bridge rehabilitation by 58 percent from $14.4 billion annually to $22.7 billion annually if we are to improve the condition.[5]

While state and local governments have demonstrated initiative, federal investment in bridges remains stagnant. As a result, the Highway Trust Fund, which historically funds many of the nation's road and bridge projects, has been teetering on the brink of insolvency for over a decade. The trust fund's primary funding source is the federal motor fuels tax, which has remained at 18.3 cents per gallon since 1993. *(See the Roads chapter for more information regarding public spending.)*

INNOVATION

As the nation's bridges continue to age, America's emphasis has slowly evolved from building new bridges to maintaining existing ones. New technologies, materials, evaluation techniques, and construction methods have advanced in recent years to meet this challenge. Additionally, the industry manual provided by the American Association of State Highway and Transportation Officials now requires new bridges to be designed with a 75-year service life, compared to the customary 50 years, meaning bridges are now being built to last longer.

Bridge engineers are now using materials such as ultra-high-performance concrete, corrosion-resistant reinforcement, high performance steel, composites, and improved coatings to increase resilience and add durability, higher strengths, and longer life to bridges. Additionally, minimal-impact, non-destructive evaluation methods are being used more widely, while new technologies such as infrared thermography, ground-penetrating radar, and remotely operated surveillance devices like flying and submersible drones are being deployed to assess bridge conditions and to facilitate safer, more efficient engineering decisions. Additionally, engineers are designing "living bridges" where sensors are being embedded into new and existing structures to provide continuous feedback on structural conditions. Finally, prefabricated bridge elements and Accelerated Bridge Construction are being used with more frequency to reduce the amount of time traffic needs to be disrupted while a bridge is repaired or replaced. All of these innovations, technologies, and evaluation methods are effectively allowing engineers to identify problems earlier, increase the lifespan of the nation's bridges, stretch limited resources, and prioritize public safety.

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CONCRETE COLUMNS AND RUSTY METAL OF THE OLD BRIDGE.

OPERATIONS & MAINTENANCE

Our nation's bridges comprise a vast, complex system of unique structures, each of which is deteriorating at its own pace and in need of specific treatments at specific times. In order to manage this large array of assets, states are now required to develop and use Transportation Asset Management Plans (TAMPs). The federally required TAMPs outline a systematic, data-based approach for states to manage their inventories. Each TAMP is required to predict and set targets for the bridges that will be in good or poor condition over the next 10 years. Strategic asset management is one of the most cost-effective ways that the nation is addressing its aging and deteriorating bridge inventory.

One critical component of asset management is life-cycle cost analysis (LCCA). When the cost of a bridge replacement, rehabilitation, or repair project is estimated for budgeting purposes without considering the long-term costs of maintenance, operation, replacement, and retirement, decision-makers end up with an underestimated value for their planning purposes. Because bridges are costly and complex assets that provide decades of service, the use of life-cycle cost analysis can minimize long-term costs with a broad, upfront picture of the costs over the infrastructure's lifetime.

RESILIENCE & PUBLIC SAFETY

As investments are made in the nation's bridges, a systematic approach should be taken to make them more resilient. Many of the country's older bridges are susceptible to extreme weather events and more prevalent flooding, which can result in overtopping, washout, and other storm-related damage. In fact, nearly 21,000 bridges were found to be susceptible to overtopping or having their foundations undermined during extreme storm events. In seismic regions, earthquakes are a significant threat, and a bridge's ability to withstand these extreme events is a significant safety issue.[6]

Additionally, bridges are being subjected to trucks that are heavier than those they were originally designed to sustain. These heavier trucks, which can surpass 40 ton loads, threaten to overstress bridge elements, cause metal fatigue and cracking, and decrease the service lives of bridges. The U.S. Department of Transportation found that the introduction of double 33-foot trailer trucks results in a projected 2,478 bridges requiring strengthening or replacement at an estimated one-time cost of $1.1 billion.[7] As future opportunities to platoon connected or autonomous trucks become more commonplace, bridges could see further stress. Engineers are using new design requirements, materials, and technologies to enhance the security and resilience of bridges as they are being built. The great challenge moving forward is to address the hundreds of thousands of existing bridges so they can provide decades of continued, safe service despite a greater frequency in extreme weather events or an increase in design loads.

Bridges

RECOMMENDATIONS TO RAISE THE GRADE

- Increase funding from all levels of government to continue significant bridge repair, rehabilitation, and replacement.
- Prioritize rehabilitating and preserving bridges in fair condition, as these bridges can often be preserved at a fraction of the cost of replacement if the work is performed in a timely manner. This approach can reduce the number of structurally deficient bridges to below 5%, decrease the maintenance backlog, and address the large number of bridges that have passed or are approaching the end of their design life.
- Develop a balanced approach for our current aging bridge inventory that emphasizes preservation, rehabilitation, and replacement where necessary, while also setting aside funding for critical operation and maintenance. Bridge owners should consider the costs across a bridge's entire lifecycle (LCCA) to make smart design decisions and prioritize maintenance and rehabilitation.
- Fix the Highway Trust Fund by raising the federal motor fuels tax by five cents a year over five years. In addition, to ensure long-term sustainable funding for the federal surface transportation program, the current user fee of 18.4 cents per gallon on gasoline and 24.4 cents on diesel should be tied to inflation to restore its purchasing power, fill the funding deficit, and ensure reliable funding for the future.
- Urge states to prioritize investments on bridges that are most critical, for example those that experience the highest daily traffic volume, are on critical freight corridors, evacuation routes, and develop multi-variable prioritization formulas for the bridges in their state.
- Advise states and the federal government to consider long-term funding solutions for transportation infrastructure and potential alternatives to motor fuels taxes, including mileage-based user fees.
- Continue to fund research into the use of innovative technologies, materials, and construction techniques to extend the life of bridges and ensure they are climate resilient.

DEFINITIONS

STRUCTURALLY DEFICIENT – Effective January 1, 2018, the Federal Highway Administration (FHWA) changed the definition of "structurally deficient" as part of the final rule on highway and bridge performance measures published on May 20, 2017, pursuant to the 2021 federal aid highway bill Moving Ahead for Progress in the 21st Century Act (MAP-21). Two measures that were previously used to classify bridges as structurally deficient are no longer used. This includes bridges where the overall structural evaluation was rated poor or worse condition, or with insufficient waterway openings. The new definition limits the classification to bridges where one of the key structural elements – the deck, superstructure, substructure, or culverts – are rated in "poor" or worse condition. Based on the new definition of structurally deficient, there are 6,533 bridges that would have been classified as structurally deficient in 2017 but did not meet the new criteria in 2018.

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SOURCES

1. American Road and Transportation Builder's Association, Bridge Report, 2020.
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3. U.S. Department of Transportation, National Bridge Inventory, 2020.
4. U.S. Department of Transportation, Federal Highway Administration, InfoBridge: Data.
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