Pennsylvania Turnpike Commission

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Welcome to the 2004 International Bridge Conference. The Pennsylvania Turnpike Commission is proud to be this year's Featured Agency and the first "Agency" to be featured by this prestigious Conference in its history. We are excited to share the many chapters of our history, and to present our current and future plans to reconstruct, improve, and expand the Turnpike.

The origin of the Pennsylvania Turnpike Commission (PTC) goes back to the glory days of the railroads. A new east-west passage through Pennsylvania called the South Penn Railroad was to be constructed to compete against the formidable Pennsylvania Railroad. The alignment was cleared, the railroad bed surveyed, and the boring of nine tunnels started. However, due to a settlement between the competing railroad owners, work on the South Penn Railroad was stopped and the rail line was never completed. One of the design engineers, bitter over ending the project, wrote "And here, for the time being, and probably for a long time to come, is buried the best route ever devised, or that can be devised, between the Ohio Valley and the Atlantic." The abandoned railroad bed sat idle for many years. Then, in 1934, two individuals, one from the Pennsylvania State Planning Commission, and the other from the Pennsylvania Motor Truck Association, proposed the idea of building a four-lane, all-weather, toll road utilizing the old abandoned South Penn Railroad bed. Many thought the idea of building a highway, and a toll road at that, through the rugged barriers of the Alleghenies and across so many waterways, was "hairbrained". Especially, since two trans-state highways already existed in the Lincoln highway (U.S. 30) and the William Penn Highway (U.S. 22).

South Penn Railroad construction, 18??

On May 21, 1937, Act No. 211 was signed into law, authorizing the construction of a 160-mile toll highway between Middlesex, Cumberland County, and Irwin, Westmoreland County, both termini linking to existing roads (U.S. 11 and the Lincoln highway). It also created the Turnpike Commission to supervise the project. The law stipulated, however, that not a cent of State tax money should be spent; it was up to the Commission to handle the financing through the sale of bonds. The bonds were to be paid off by revenues generated through tolls.

Ground was broke on October 27, 1938, and in 23 months time, motor vehicles were traveling the "Dream Highway". The original section employed over 1,100 design engineers and 155 contractors from 18 states for a total work force of 20,000. More than 5,000 men worked on seven tunnels at one time, an engineering and construction feat never again known to man.

It was an exciting time to be an engineer or constructor involved with the project. The engineers developed and used design criteria and safety standards that were only dreamed about before in this country. Some of the new criteria included a maximum grade of 3 percent and a maximum curvature of 6 degrees. Travelers were provided with super-elevated curves and a minimum sight distance of 600 feet.

Pennsylvania Turnpike, circa 1940

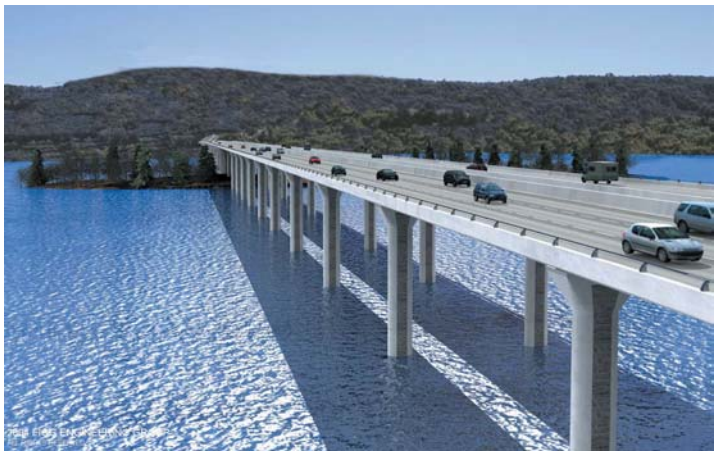
On October 1, 1940, the road built on the South Penn Railroad alignment was officially opened to traffic at a total cost of $70 million. America's first long-distance superhighway was an immediate success. More than 26,000 vehicles were using it daily. That skyrocketed to over 2.4 million in twelve month's time. This was far more than the 715 cars per day estimated in a 1939 study by the Bureau of Public that also stated toll roads would be big money losers (so much for studies).

For the first time in the history of roads in Pennsylvania a superhighway existed which provided free flow of traffic 160 miles across the State. The Turnpike was termed the foundation of a nationwide system of superhighways and sixteen years later the National System of Interstate and Defense Highways was legislated and funded by Congress. The PTC was the forerunner of all other toll roads in the country.

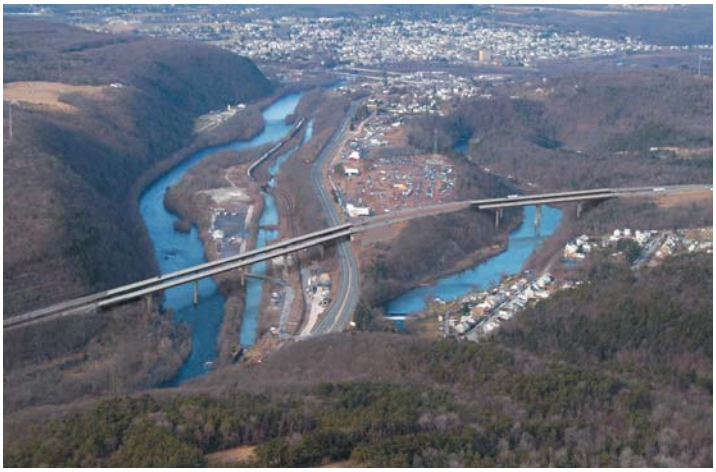
Due to the success of the original section of the Turnpike, other extensions followed. It was extended to Valley Forge in the east in 1950, and then onto the New Jersey border in 1954. To the west, the Turnpike was extended to the Ohio line in 1951. The Northeast Extension opened in 1957, and took the Turnpike north to Scranton. In 1992, the Beaver Valley Expressway was completed, and in 1993, the Amos K. Hutchinson Bypass was completed, both in the western part of the state, bringing the total mileage to approximately 500 miles of toll road.

The original section of the Turnpike contained 307 bridges and culverts. The current Turnpike system has over 1300 structures, many of which are original construction. We are currently rehabilitating or replacing of many of these original structures including some of our largest bridges.

The Susquehanna River Bridge, in the middle part of the state, is the longest span on the Turnpike at over 4,500 feet, and will be replaced in its entirety starting next year by dual concrete seg-



The Susquehanna River Bridge



Lehigh and Pohopoco River Bridges

mental bridges. These will be the first major concrete segmental bridges in Pennsylvania.

The Allegheny River Bridge is located in western Pennsylvania, and is approximately 2,600 feet long. It is currently in preliminary design for total replacement.

The Lehigh and Pohopoco River Bridges, two of our larger structures on the Northeast Extension of the Turnpike, are in final design and will also be replaced in their entirety.

Many of our other lesser bridges are being replaced as part of our Total Reconstruction Program. Just like many of our bridges, the Turnpike roadway is nearing the end of its life expectancy, and has to be rehabilitated or replaced. Our Total Reconstruction Program calls for completely rebuilding the Turnpike roadway from the sub-grade up. The original Turnpike provided for two 12-foot wide travel lanes in each direction with 10-foot shoulders and a 10-foot median for a total width of 78 feet. The reconstructed roadway section provides for a future third lane in each direction, full 12-foot shoulders, and a wider median for a total width of over 110 feet. This requires almost all the bridges crossing over the Turnpike to be replaced with longer structures. The majority of the mainline brides are also being replaced for the wider widths.

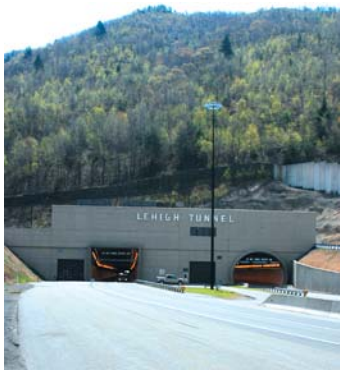
To date, over 24 miles have been reconstructed and another 21 miles are in construction. Future plans call for over 16 miles to be reconstructed every year for the next ten years. Many things have changed since the Turnpike was originally constructed, most noticeably the cost. Today, reconstruction of one mile of Turnpike roadway is averaging at $10 million compared to $500,000 per mile when the Turnpike was originally constructed, which included the construction of seven tunnels.

From the original seven tunnels, only four remain operational. A duel tube was constructed at each of the remaining four tunnel locations to handle the increased traffic volume. The other three original tunnels were bypassed at some time to reduce operational expenditures. The Northeast Extension also has a set of tunnels in Lehigh County, for a total of five active tunnel locations on the current Turnpike system. We are currently studying the feasibility of bypassing the Allegheny Tunnel and major rehab is planned for the other tunnels.

Today, the Turnpike continues to expand with its newest sections of toll highway in western Pennsylvania. The Mon/Fayette Expressway will stretch about 65 miles south of Pittsburgh and connect to Interstate 68 in West Virginia. The Southern Beltway will form an arc about 30 miles long with a radius reaching approximately 15 miles out from Pittsburgh's Golden Triangle.

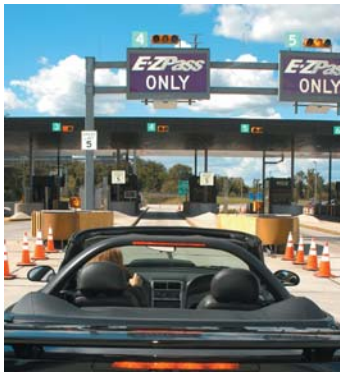
At the eastern end of the state, a new connection between the Turnpike and Interstate 95 is being designed by way of a high-speed interchange. The project will involve widening nine miles of the Turnpike and the construction of a new bridge crossing the Delaware River. The project will also incorporate the latest in intelligent transportation systems.

Electronic Toll Collection (E-Z Pass) is another relatively new feature to be implemented throughout the Turnpike system providing for efficient traffic movements at all interchanges. And an even newer "high-speed" E-Z Pass system is currently being planned and installed at certain locations.

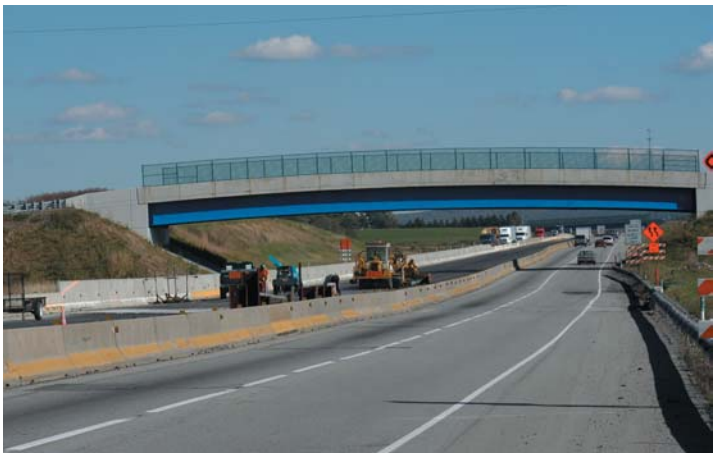


Lehigh County Tunnel

All these projects, the large bridge replacements, the total reconstructions, the new expansions and interchanges, and many others, make it an exciting time again at the Turnpike. We welcome you to hear more about Turnpike and these projects during our Featured Agency Session and by stopping by the Featured Agency Room. We hope you enjoy the Conference!



E-Z Pass System



Bridge Name?

Pennsylvania Turnpike - Interstate 95 interchange

Patrick Connors

The Brown Collection, Ohio County Public Library, Wheeling, WV

The Brown Collection of Photographs

Dunlap's Creek Bridge. After penetrating the mountain barrier, the National Road made a beeline for the Monongahela River community of Brownsville, at that time the largest city of western Pennsylvania. The Dunlap's Creek Bridge, within the city of Brownsville, was a scene of particularly unfortunate bridge accidents; until 1839, several bridges crossed this small 80-foot gorge including a chain suspension bridge, which collapsed under the weight of snow. In 1839, the use of an arched iron bridge was conceived by Capt. Richard Delafield due to the close proximities of the Brownsville Foundries. "The Neck" (nickname of downtown Brownsville due to high traffic congestion) was crossed with America's first iron bridge, which remains in vehicular use to this day and is designated as a National Historic Civil Engineering Landmark.

Monongahela River Crossing. The Monongahela River was a laborious river crossing in the early days of the National Road; by heard for miles, and spectators along the bank were soaked by the mighty splash!

"S-Bridge". As the toll road followed the winding ridges and valleys to the Ohio River, many small tributaries were crossed. As typical of the era, the streams were crossed in their shortest direction, regardless of the general path or direction of the roadway. An entire series of stone "S-bridges" were built along small tributaries such the "S-bridge" located 5 miles west of Washington, Pennsylvania over Buffalo Creek. For this two-span arch bridge, the main span was aligned at right angles to the stream; the minor span and approaches were aligned in the east to west direction of the roadway, confronting the likely weary traveler with a contorted "S" pathway.

Elm Grove Stone Bridge. As the National Road entered present-day West Virginia, it followed the tributary system of Wheeling Creek and crossed this branch of the Ohio River with a

Wheeling Suspension Bridge. Originally the National Road ended near the mouth of Wheeling Creek along the Ohio River, the destination for travelers continuing by water to the interior of the country. The city of Wheeling was quickly extended across the main channel of the Ohio River to Zane's Island (now known as Wheeling Island) by a 1010-foot long suspension bridge, but it was not an easy task. The Commonwealth of Pennsylvania led by Edwin M. Stanton (later to become Abraham Lincoln's Secretary of War) filed a suit in the U.S. Supreme Court to prevent construction because the bridge would obstruct river traffic. The designer, Charles Ellet, Jr., the father of suspension bridges, pressed forward with the design and construction of this wrought iron structure and managed to complete and open the bridge in 1850. Stanton, upset about the bridge, drove the steamer "Hibernia No. Two" into it to prove the bridge was a hindrance. The court ordered Ellet to substantially raise his bridge, but he succeeded to have the bridge declared a post road, which has seniority over all transportation arteries. Tragically, after this fight, the suspension bridge collapsed when a severe gale induced undulatory motion in the superstructure on May 17, 1854. This increasing twisting motion, caused by aerolastic instability, directly led to collapse of the superstructure in a violent and sudden state. The superstructure was promptly reconstructed in 1860, and in 1872 further strengthened with stayed cables by John A. Roebling and Sons. The structure remains in service to this day.

Zane's Crossing. Zane's Island was a strategic location for crossing the Ohio River. This large island made a natural crossing point for early settlers seeking a path to the west. From 1830, the Zane family maintained a ferry service across the main channel (which ended when the Wheeling Suspension Bridge was completed). Across the back channel of the Ohio River at Zane's Island, the Zane family constructed a wooden, covered toll bridge in 1836. The toll keeper lived on the bridge at the Ohio end.

Ohio and Beyond. As the National Road extended from the hilly provinces of western Ohio to the gently sloping farm country of eastern Ohio, Indiana and Illinois, many vestiges of the National Road era remain intact. These bridges lie almost immediately adjacent to US 40 and are easily visible to all travelers. These bridges include the three-span stone arch in Blaine, Ohio (pictured above) and the "S-bridges" in Cambridge and New Concord, Ohio.

Jay W. Mohney

The Brown Collection, Ohio County Public Library, Wheeling, WV

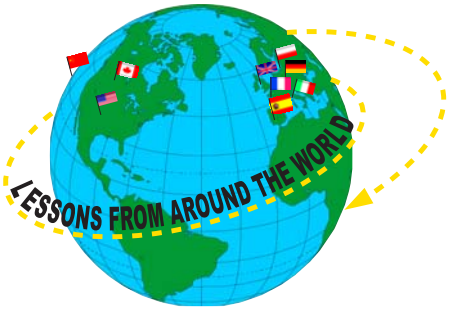
1830, the ferry was replaced with a three-span wooden covered bridge. This remarkable structure with approximately 200-foot wooden arch spans was the first bridge across a major river west of the Appalachian Mountains. In 1910, the bridge was declared an obstruction to river traffic and was pulled down by a cable wrapped around its timbers connected to a moving steamboat. The sound of the cracking wood was series of unusual stone elliptical arches for its time of construction. Built in 1818 by Moses Shepherd, it is also known as the Monument Place Bridge due to the memorial nearby dedicated to Henry Clay by Shepherd for his support of the National Road. The bridge remains intact to this date; however, the beautiful stonework has been covered by a rather sterile concrete facing.

Conclusion

Today, U.S. 40 extends from Atlantic City to San Francisco. In 2002, our first tollroad earned the status of National Scenic All-American Byway, one of the highest honors bestowed on a traveled route. With its spectacular scenery, breathtaking bridges, and historic charm, the National Road possesses the unique ability to transport present-day society back into time, relive the birth our transportation industry, and appreciate the milestones encountered along the way.

2004 IBC Bridge Awards

ESWP in association with Roads and Bridges Magazine, Bayer Corporation, Bridge design & engineering Magazine and the International Bridge Conference®, will host the Sixteenth Annual International Bridge Conference® Bridge Awards at the Pittsburgh Hilton on Monday, June 14. The following honorees will be recognized:



John A. Roebling Medal
William Brown

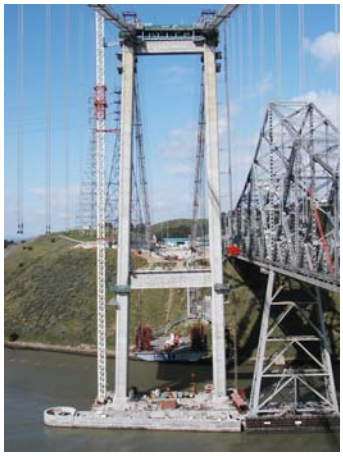
Brown Beech & Associates Ltd.

A lifetime commitment to bridge engineering and a recognized world expert on long span suspension bridges.

Photograph courtesy of Ian Masterton

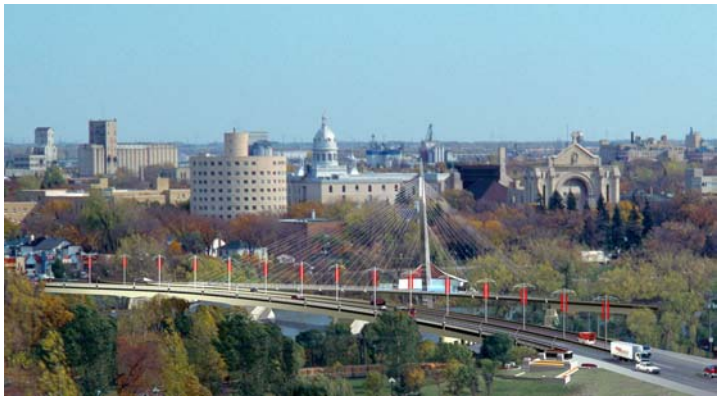
Eugene C. Figg Jr. Medal
Lupu Bridge, China

The world's largest arch bridge was chosen by the city of Shanghai because they wanted a design that was different; a landmark bridge and a structure that would act as a symbol for the city.



George S. Richardson Medal
Al ZampaMemorialBridge (New Carquinez Bridge), California

The first suspension bridge to be built in the USA in almost 3 decades, the New Carquinez Bridge incorporates the latest advancements in seismic analysis and design criteria balanced with an aesthetic and graceful appearance that is in perfect harmony with the surrounding environment and communities.



Aurthur G. Hayden Medal
Esplanade Riel Pedestrian Bridge, Canada

Winnipeg's exciting new foot bride creates a dramatic addition to the city's skyline. The concept for the bridge was the result of an unprecedented level of public consultation for a public works project.

Gustav Lindenthal Medal
Mingo Creek Viaduct, Pennsylvania

The Mingo Creek Bridge's rustic setting required a harmonious balance with the surrounding hillsides. The rise-to-span and height to thickness ratio of the piers created a perfect proportion to its environment. The passing drivers are presented with panoramic views.

The Keystone Shortway — Providing Mobility and Economic Opportunity to the Nation

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I-80 over Allegheny River looking North

Overview

Interstate 80 in Pennsylvania, commonly known as the Keystone Shortway, is one of the most heavily traveled interstate highways in the Commonwealth of Pennsylvania, and is often referred to as the "Gateway to the West". This 313-mile divided highway, with two travel lanes in each direction, is one of most important thoroughfares for the transport of people and goods in the entire country. This vital East-West connector was constructed in only 12 years, after more than 30 years of detailed planning, design and coordination.

Daily traffic varies from 22,000 to 66,000 vehicles on Interstate 80. Most who have traveled this highway will attest that a large percentage of this total traffic volume is trucks. Commercial truck traffic accounts for 18 to 44 percent of the traffic volume, evidence of the importance of Interstate 80 as a vital link for the movement of goods and services, not only within the Commonwealth of Pennsylvania, but also to destinations in the Northeast and west to Chicago and beyond.

In the Keystone State, there are 55 interchanges connecting Interstate 80 to numerous North/South Interstates (I-79, I-99, I-81, I-380), State Routes, the Northeast Extension of the Pennsylvania Turnpike (I-476), and other important arterials and collectors. Significant components of the Keystone Shortway are its 486 bridges totaling nearly 85,000 linear feet. Several of these structures are among the highest and longest in the state. At the time of its construction, the Allegheny River Crossing (Emlenton Bridge), 270 feet above water, was the highest bridge in the state and spans nearly 1670 feet. In addition to the statistical fame of the Keystone Shortway's bridges, several have won national awards for their design components and aesthetic treatments that complement the surrounding environment.

I-80 over Allegheny River looking South

Geological Considerations

The 313 miles of Interstate 80 pass through various types of geological formations. From the gorge cut by the Delaware River on the eastern terminus, to the glacial deposits of the Appalachian Plateau on the west, the topography encountered along Interstate 80 tells a history of geologic activity millions of years in the making. Sand, gravel, pebbles, cobbles of glacial till, boulder fields, tilted and folded beds of sandstones, limestone, shale, quartzite, conglomerates and coal — any and all of these materials may be encountered along the line and grade of this interstate highway.

44 Bridge Studies Evaluated for Widening

Pennsylvania Department of Transportation Engineering District 10-0 commissioned DMJM+HARRIS to perform conceptual-level bridge widening studies to determine if oversize vehicles could be accommodated on 44 bridges carrying I-80 in Butler, Clarion and Jefferson Counties during future rehabilitations. The rehabilitated bridges were required to meet current PENNDOT Design Manual, Part 2, roadway criteria for lane and shoulder width, and must provide a single 18-foot wide traffic lane (in each direction) during staged reconstruction of the bridges. These criteria negate the need for the time-consuming detour of oversize vehicles normally required during bridge rehabilitation or deck replacement. Eliminating detours also eases the burden placed on local municipalities and state roads used as detour routes. Widening options were evaluated with respect to geometry, construction methods, and safety criteria established in coordination with the Department. Of the 44 bridges investigated and evaluated in the three counties, it was determined that 40 bridges required widening in order to satisfy the Department's criteria.

The 44 bridges were divided into two broad categories by DMJM+HARRIS: single structures carrying four lanes of I-80 in both directions, generally over major rivers such as the Clarion and Allegheny; and dual structures carrying the eastbound and westbound lanes

on separate, parallel structures. The bridges studied included single and multiple spans in various configurations of steel and prestressed concrete structure types.

Constructibility and Design Issues

The study included several major long span bridges: three (3) single-structure steel deck-truss bridges; two (2) dual-structure steel multi-girder bridges; and four (4) dual-structure steel girder-floorbeam-stringer system bridges.

A multitude of constructibility and design issues were considered in development of the widening feasibility studies. Geometric and geographic constraints such as horizontal and vertical clearances, site distances, median-versus-outside shoulder widening, and the presence of interchange ramps could impact the proposed widening. Through numerous site reconnaissance field trips, the varying geological conditions were noted. Design issues such as time-dependent behavior, differences in material strengths, fatigue performance, and structural capacity were also key elements of the widening investigations. Various methods of superstructure and substructure widening were considered as part of the study for each bridge. Construction phasing and constructibility were evaluated, including site access, contractor staging and material laydown areas, material availability and transportation requirements. Cultural, environmental, and right-of-way issues were identified and addressed; and, where applicable, administrative issues regarding railroads, permits, and coordination with the Public Utility Commission were also considered.

Beyond the Keystone Shortway

This project is an important first step toward improving I-80, but attention must be focused beyond the 44 bridges of this study – there are 486 bridges on I-80 alone within Pennsylvania's borders. We must have the commitment of all stakeholders in order to provide a transportation network that significantly improves our nation's competitiveness in the world economy.

Most bridge engineers are keenly aware of the relationship between a well-planned, well-designed and well-built transportation infrastructure system and the economic growth and prosperity of our nation. In spite of the sincere and dedicated efforts of many transportation agencies, the condition of our roads, bridges and transit systems is, in many cases, deplorable, and development of new facilities has not kept pace with demands to reduce traffic congestion, provide access, and improve mobility for the motoring public.

I-80 east-bound over Canoe Creek looking East

The following facts and figures illustrate the need for dedicated funding to enhance our infrastructure system in Pennsylvania and other parts of the country.

- The existing transportation network is **fragile** and minor mishaps result in gridlock
- Urban area infrastructure is operating **at or near capacity** in many communities
- Level-of-service **demands exceed capacity** of the existing transportation system
- Roadway closings due to reconstruction, delays, accidents, bridge failures, storms, landslides and other emergencies frequently result in users' "road rage"
- As a nation we have been **underinvesting** in transportation infrastructure for decades

The No. 1 transportation problem in the country is **congestion** — 82% of all goods are moved by trucks. Manufacturers are adopting just-in-time delivery as a way of doing business. To illustrate the magnitude of the funding problem, there are **2,114 bridge**s in Allegheny County — more than in Venice, Italy.

- 1,154 owned by PENNDOT
- 512 owned by Allegheny County
- 85 owned by City of Pittsburgh
- 66 owned by PA Turnpike Commission
- 80 owned by Port Authority of Allegheny County
- 107 locally owned
- 80 railroad-owned
- 30 privately owned

We can address these problems in two ways: Provide a **multimodal transportation system** that is seamless between modes of transportation; and secure **additional revenues** to address shortfall of available transportation funding

As engineers and bridge industry professionals, we need to stress the need for dedicated funding, not only to fellow bridge engineers, but to elected officials and others with influence to secure such funding. Action taken today will ensure a better tomorrow for us, and for future generations.

I-80 west-bound over SR 0338 looking West