The Mingo Creek Viaduct
(Joe Montana Bridges)
WASHINGTON COUNTY, PA

OWNER
Pennsylvania Turnpike Commission

ENGINEER
Gannett Fleming, Inc., Pittsburgh

GENERAL CONTRACTOR
Dick Corporation, Pittsburgh

STEEL FABRICATOR/DETAILER
High Steel Structures, Inc., Lancaster, PA (AISC member)

CONSTRUCTION MANAGER
Trumbull Corporation Construction Management Services, Pittsburgh

ENGINEERING SOFTWARE
BSDI 3-D finite element analysis

DETAILING SOFTWARE
MicroSystem

The Mingo Creek Viaduct, also known as the Joe Montana Bridges, carries Toll Road 43 over the Mingo Creek Valley and State Route (S.R.) 88 in Washington County, PA. It is the signature structure on the northernmost segment of the Mon-Fayette Expressway. Completed by the Pennsylvania Turnpike Commission (PTC) in April 2002, this 17-mile section of the Mon-Fayette Expressway connects S.R. 51 with Interstate 70 (I-70), closely paralleling the winding path of the Monongahela River. The bridge's rural setting is characterized by deeply incised stream valleys that reach depths of nearly 400'.

The PTC's goal was to build an expressway that would stimulate economic growth in the Mon-Valley, alleviate much of the traffic congestion in Southern Allegheny County, and provide an efficient route for commercial traffic to and from Pittsburgh. Design challenges included: overcoming topographic and geological conditions; mitigating the effects of extensive room-and-pillar coal mining; maintaining operations within the project limits, and spanning the active, 200' Wheeling & Lake Erie Railroad Trestle, listed on the National Register of Historic Places.

PROJECT LOCATION

The chosen alignment carries four lanes of Turnpike traffic 2,400' from hilltop to hilltop, while towering above the valley about 260' below. This makes the viaduct the tallest structure on the Pennsylvania Turnpike system, and the second tallest roadway bridge in the state. The designed height also maintains the 30' vertical clearance above its active trestle mandated by the Wheeling & Lake Erie Railroad Company. The clearance is required to provide space for the rail-mounted crane cars that perform maintenance atop the 200' trestle.

HPS

The Mingo Creek Viaduct was constructed using a new generation of high performance steel (HPS) known as TMCP, or thermo-mechanically controlled roll processing. Because of the excep-

tional strength of HPS, the designer could specify a lower weight structure, which yielded cost savings. HPS's weathering characteristics and toughness ensure that the superstructure's steel girders will be durable and maintenance-free. Plate girders were constructed of A709 Grade 50 and A709 Grade 70 HPS in the positive and negative moment regions, respectively. The PTC realized material savings from this configuration though the elimination of haunches and longitudinal splices. It was the first time the PTC used Grade 70 girders, and turnpike officials implemented a yearly monitoring and testing program focusing on girder corrosion and fatigue.

REPEATABLE CONSTRUCTION DETAILS

The viaduct design incorporated repeatable construction details, which resulted in time and labor savings. The designer found that most local yards carried standard 8'-by-4' forming panels. These dimensions were incorporated into the substructure units of the bridges. Since the footprints of all the piers were nearly identical, the contractor could move and reset the formwork instead of rebuilding it. As the first pour was dried, the forms could be slid up the pier shaft in preparation for the next concrete pour.

EFFECTS OF MINING

The bridge's substructure consists of 16 slender, flared piers and four stub abutments. The piers were founded on drilled shafts and the abutments on piles to transfer the vertical design loads through the mine voids below into competent bedrock. During a two-phase remediation program, mine voids were grouted full at the substructure units to further reduce the threat of localized mine subsidence. The piers were tapered in profile to streamline materials and provide concrete thickness only where the design required it. These elements were proportioned in response to the high thermal forces generated by the viaduct's long, continuous-span, fixed-pier configuration. These durable substructure units were the prototype for all bridges in the 17-mile Mon-Fayette corridor from S.R. 0051 to I-70.

CONSTRUCTION AND ERECTION SIMULATION

To ensure constructability, a complete construction and erection simulation was conducted in the design phase. The simulation included cranes and delivery vehicles, stationed at key locations along the alignment. It located hypothetical haul roads within the project right-of-way and assigned realistic construction gradients to them. These measures provided all construction machinery with adequate access to the entire job site despite difficult terrain.

ERECTION OF GIRDERS

The erection of the 10'-deep weathering steel girders was an intricate process. The field lengths of the Grade 70 and Grade 50 girders were 90' and 120' respectively, and were based on the length of the flatbed trucks that brought them to the site. The Grade 70 girders had a plate-rolling maximum of 50', but shop splices allowed longer lengths to be shipped. The size of the plate girder, the nearly 300' lift, and the slight curvature of the girders combined to make steel erection a challenge.

Erection proceeded with a Manitowoc 21000 crawler crane, which has a capacity of 1,000 tons and a boom height of more than 300'. The crane was brought to the site on 65 tractor-trailer beds. Erection continued without delays for nearly 10 months.

It took 251 truck trips to bring all of the necessary steel to the project site. The resulting structure is a pair of nine-span, parallel-flange girder viaducts on a half-degree horizontal curve, with span lengths varying from 220' to 300'. The bridge is composed of more than 6,154 tons of partially coated weathering-steel. It consists of four, 10'-deep girders in each travel direction, with extra width on the flared piers for a fifth girder. This extra space will facilitate the addition of an extra lane for future re-decking.

AESTHETIC CONSIDERATIONS

The Mingo Creek Valley's rustic setting meant the structure had to be in harmony with the hillsides, while neither obscuring nor being dwarfed by them. The Viaduct relies on the repetition of coherent, structurally efficient forms to blend in with the surrounding forest.

Careful attention was paid to the rise-to-span and height-to-thickness ratios of the piers, so the structure would be proportionate to its environment. The passing driver is presented with panoramic views. ★