The Third Ohio Historic Bridge Inventory, Evaluation, and Management Plan for Bridges Built 1951-1960 and The Development of Ohio’s Interstate Highway System

The Ohio Department of Transportation in cooperation with The Federal Highway Administration and The Ohio Historic Preservation Office

2004

Photo: Montecello Road Bridge, South Euclid, Cuyahoga County, crossing Euclid Creek, Built in 1954. SFN: 1830082
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Ohio Department of Transportation
Ohio Historic Bridge Inventory

HISTORIC TRANSPORTATION CONTEXT
FOR
OHIO’S HIGHWAY BRIDGES
1951-1960
Executive Summary

The Historic Transportation Context for Ohio’s Highway Bridges, 1951-60, was developed as part of the 2002-04 ODOT Historic Bridge Inventory Update. The purpose of the project was to update Ohio’s ongoing historic bridge inventory for bridges built from 1951 to 1960 by identifying which of those bridges of non-excluded types or those with Interstate highway associations meet the National Register criteria for evaluation. As such, this context builds upon the important scholarship and work that ODOT, the Ohio SHPO, FHWA, and others have sponsored and conducted on the state’s historic bridges for more than 20 years. This context was one of two contexts prepared for the update project; the other context dealt with the bridge-building technology of the 1950s.

The historic transportation context addresses the role and significance of federal and state policy in advancing road and bridge construction in the post-World War II era. Of particular interest and focus was the development of Ohio’s comprehensive Interstate highway system including the role of standardized bridge types and designs in the system. The context considers how Ohio’s Interstate highway system originated, how it was designed and built over four decades beginning in the early 1950s, and how it has continued to evolve and change to the present day. The context identifies Ohio’s comprehensive Interstate highways as a technological system that was highly standardized and has continued to constantly change.

The project was conducted over two phases. During the first phase, the transportation context was researched and produced in draft form recognizing its purpose of aiding the evaluation process. At the same time, criteria for determining significance and thresholds of integrity were developed for Interstate highway bridges. As a result of the Phase 1 draft context and criteria for determining significance, it was decided that the Interstate highway bridge population, while having few bridges of individual historic significance, merited further consideration of possible significance in association with the overall development of Ohio’s comprehensive Interstate highway system. An Interstate highway workshop was conducted and attended by representatives of ODOT, FHWA, and the Ohio SHPO.

The workshop addressed the complex nature and potential significance of Ohio’s Interstate highway system. Participants were presented with additional information gathered through field work and reconnaissance-level survey of pre-1961 sections of Ohio’s Interstate highways and its standardized bridges. During the workshop, the National Register guidelines and criteria for evaluating significance and aspects of integrity were applied to Ohio’s Interstate highway system as a whole and to its standardized component parts. It was agreed by all participants that while Ohio’s Interstate highway system is an engineering achievement, it does not meet National Register eligibility criteria in several ways. These ways include loss of vital aspects of integrity due to numerous alterations to design and materials, lack of preservation worthiness under Criterion Consideration G for properties less than 50 years old, and,
in general, being a huge technological system of individually undistinguished, and frequently altered or replaced components, that does not fit within the usually understood definitions of a historic place or district. As a result, all of the bridges of excluded bridge type built before 1961 that carry or cross over Interstate highways in Ohio have been evaluated not eligible.
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Table 1: Ohio’s Interstate Routes and Dates of Construction.
Historic Transportation Context for Ohio’s Highway Bridges, 1951-60

The significance of the highway bridges of the State of Ohio constructed during the decade after 1950, either as individual structures or as part of the larger highway systems of the state, can be determined only by considering a variety of historical contexts. These include both a national and state context and a specific pattern and history of bridge work within the Ohio Department of Highways.

National Context: Standards

An essential element that must be understood about the bridge and highway construction programs of every state in the U.S. was the basic administrative and organizational structures that guided highway decisions in the U.S. The most basic point is that American highway administration is a premier example of federalism, the governmental system in which authority is shared between the states and the central authorities in Washington. This means power and authority have been shared between state highway departments (which appeared in most eastern and midwestern states by 1910) and federal authorities in the Bureau of Public Roads (BPR) and its successor agency, the Federal Highway Administration (FHWA) within the Department of Transportation. The BPR was created in 1893, but a coordinated program of federal funding did not take shape until 1916, when Congress established the federal-aid highway program. Under this program, which remains basically intact today, state highway departments are responsible for planning, building, and maintaining roads, while federal engineers oversee and approve state construction plans, specifications, and estimates, and inspect the finished work. Until the 1950s, costs on most roads were split 50/50 by the federal and state governments.

Importantly, standards for construction were specifically identified as a state concern under this federalist structure, for even in 1916 Congress was worried about intrusive federal bureaucrats. Federal road engineers were expected only to inspect and approve state decisions. In reality, a very different relationship developed between state and federal highway engineers, one in which the states were not exactly equal partners. The simple fact was that most state engineers and their agencies lacked the knowledge and expertise about road design and materials, while the BPR staff in Washington knew a great deal about such matters. But those engineers at the Bureau of Public Roads, directed first by Logan Waller Page (1905-1919) and then by Thomas MacDonald (1919-1953), adopted a variety of cooperative mechanisms for disseminating the knowledge and ideas developed in federal laboratories. By 1905, for example, BPR engineers were issuing their findings through the committees of the American Society for Testing Materials (ASTM), which included representatives of industry, universities, as well as government agencies. And after 1916, the BPR supported the creation of committees within the American Association of State Highway Officials (AASHO) as a venue for the development and adoption of construction and materials guidelines for state highway projects supported by federal funds. BPR engineers remained the key sources of technical information during committee
deliberations, and the BPR also supported and funded the development of state testing and research laboratories. Such a cooperative structure meant that the leadership of the BPR could not dictate standards to their state counterparts, and fostered instead a genuine sense of partnership among the state and federal engineers who jointly designed and built the federal-aid system. Similarly, BPR chief Thomas MacDonald was a vital force behind the organization of the Highway Research Board (HRB) within the National Research Council in November 1920. Once again, BPR engineers provided the core leadership of HRB committees, usually serving as secretaries of the research committees and sections, which issued results that often were widely adopted by state highway departments.

Why is this significant? Most importantly, it meant that each state had latitude, within limits, to develop its own approach to road design and materials standards. The BPR never sought to impose uniform national standards, and tolerated sometimes dramatic variation in standards among the states, compromising on items where state officials could justify variations for local conditions or precedent. BPR officials judged this approach critical to maintaining a shared commitment (partnership) to the federal-aid program, for imposing uniformity would have demanded a battle federal highway engineers would have won only at a high cost. Instead, uniformity remained a long-term goal pursued through AASHO, while 48 – later 50 – different state highway specification books were developed. Thus, Ohio had its own construction, materials, and bridge specifications, although like many midwestern highway departments, the Ohio department prided itself on a competent engineering staff that conducted research (sometimes with the Ohio State University), participated in the AASHO committee structure, and adopted the highest standards. The result was a department that sought to maintain the best practices of the highway engineering field. And while doing so, Ohio highway engineers adopted their own style and tendencies in solving highway and bridge construction problems.

**National Context: The Interstate Highway System**

The other crucial national issue that provides an essential context for understanding the Ohio road program of the 1950s was the emergence of the National System of Interstate and Defense Highways. Congress approved this program and the means for funding it in 1956, but the program has a much longer history. That history helps explains a number of key decisions and actions within the state of Ohio and the Ohio Department of Highways during the 1950s.

There is little doubt about the significance of the Interstate highway program. Congress authorized it in 1956, calling for some 41,000 miles of high-standard express highways to be built across the U.S. in about fifteen years at a projected cost of $25 billion. There may never have been a larger public works project, nor one that has so influenced people’s lives and the nation’s economy. But it is not correct to view this enormous construction program simply as a product of the 1950s and the Cold War. The roots of the effort are found in the Depression of the 1930s, when several...
Congressmen repeatedly proposed legislation authorizing a scheme of six north-south and three east-west cross-country toll roads, justified mainly as a way to put people to work. The German *autobahnen* program influenced these plans, which never came into being, in large part because BPR officials had always opposed toll financing and double taxation against motorists, whose gas taxes were viewed as supporting road programs. In fact, officials at the BPR were beginning to find that the largest challenge facing road builders was increasing urban traffic congestion, a problem highlighted by state-wide highway planning surveys mandated by the BPR. The two ideas came together in a BPR report issued in 1938, *Toll Roads and Free Roads*, that proposed a system of about 25,000 miles of free roads connecting and running into the nation’s cities.

The war in Europe quickly distracted attention from highways, but President Franklin Roosevelt appointed a National Interregional Highway Committee in 1940 to study this and other ideas. The committee’s 1944 report – *Interregional Highways* – endorsed the BPR’s vision of high-standard, high-speed express highways to and through the nation’s cities. The report gained a sympathetic hearing among Congressmen worried that the nation might slip back into a depression at the end of hostilities. But political bickering about the cost of the programs led Congress to ignore most of the special plans presented in *Interregional Highways*, a move that foreshadowed more than a decade of political uncertainty about the size and shape of the American highway program. Thus the 1944 highway bill simply doubled the federal appropriations for highway construction, but only authorized formation of a national system of interregional highways not to exceed 40,000 miles without providing special funding.

From this beginning emerged the nation’s Interstate highway system. During the last year of the war, BPR engineers worked with the state and municipal officials to prepare plans for road construction in the postwar period. Many state highway departments undertook preliminary planning for the tentative interregional routes shown in *Toll Roads and Free Roads* and *Interregional Highways*. Many cities, either on their own or with the assistance of highway departments engineers, started planning expressways inside cities, building upon tentative and piecemeal experiments of a few urban areas during the 1930s. Indeed, the BPR’s leading design engineer, Joseph Barnett, reviewed or discussed plans from more than 100 cities during the war. With the end of the war, more serious planning began, and in 1947 the states and the BPR released the first official map identifying the routes of an Interstate highway system.

Unfortunately, many states struggled to move beyond preliminary plans, even when more detailed construction plans were ready. First, agreed-upon construction and design standards did not exist. There had been significant experimentation with limited-access express highways in cities and states across the country during the 1930s, but the codification of that experience into formal standards required time. Such roads were still new to many engineers. AASHO’s design committee did not release its specifications for express rural highways until 1954, and the standards for urban highways were not ready until 1957. Second, many states encountered difficulty
acquiring necessary materials – especially steel for bridges – or paying for it. In the late 1940s, the problem was first caused by rapid inflation that constantly raised prices, but then the Korean War saw a return of priorities for steel in the early 1950s that delayed many highway construction programs. A third factor that challenged state road organizations was a shortage of civil engineers. Engineering “manpower” had been affected by the war, but even as the G.I. Bill led to dramatic increases in student populations, many new fields of engineering (computers, materials, aviation and aerospace, nuclear power) seemed more attractive – and better paying than civil engineering. Thus as state construction programs geared up to meet traffic demands and to spend larger appropriations from Washington, state highway departments, including Ohio’s, scrambled for enough trained engineers and bridge designers.

Many of the most difficult problems facing the states, however, were financial in nature. The equation was rather straight-forward – state highway budgets simply did not grow as fast as federal-aid appropriations, and with the costs of construction on federal-aid projects shared 50/50, this was a formula for real problems. Highway departments everywhere faced public demands for improvements on the existing rural, secondary, and urban federal-aid systems, and rarely could give attention to the new Interstate routes – the most expensive projects of all. In fact, even as the number of vehicles registered set records year after year and serious traffic congestion increased, many state highway departments failed to claim all of their federal-aid highway funds for 1947 and 1948, leaving an unobligated backlog of more than $500 million. This situation prompted President Harry Truman to eliminate all federal-aid highway funds from the 1949 budget, and to propose sharp reductions in the appropriations for 1950 and 1951 – despite the demands of motorists.

One answer to the financial challenge facing the states was adoption of toll financing – a funding mechanism that had gone out of style in the nineteenth century except on a few large bridges. The success of the Pennsylvania Turnpike that opened in 1938 proved that motorists and truckers were willing to pay for the convenience of faster, limited-access, divided highways. Revenue bonds backed by future toll receipts offered an almost painless way of expanding highway construction budgets, although federal engineers argued that on some roads the traffic would never generate sufficient revenue to pay off the bonds. Nonetheless, in 1945, New York proposed a toll thruway across the state, while Maine actually started building a 47-mile toll highway from near the New Hampshire line to Portland. In 1947 New York officially created the Thruway Commission, while New Hampshire, West Virginia, and Maryland followed suit. Pennsylvania announced plans to expand its turnpike to the Ohio and New Jersey borders, and both of those states and Oklahoma created their own turnpike commissions. By 1953, 762 miles of toll road had opened, with another 1,077 miles
under construction.\(^1\) The peak of toll road construction came in 1954, and by 1963, 3,550 miles of toll roads were in use.

That so many states resorted to toll financing provided an indication of serious disarray in the nation’s highway policy in the late 1940s and early 1950s. Highway and motor vehicle lobbying groups ever more loudly demanded improvements for every element of the system – the main routes between cities, farm-to-market secondary roads, urban highways, and the new Interstate system. But Congress – distracted first by the challenges of returning to peacetime, and then by the cost of meeting the demands of the Cold War – could not find a way to pay for a truly massive highway program. The highway appropriation bills totaled $550 million in 1950 and $575 million in 1952, but offered no solution to the problems states faced in matching those larger amounts. And not until 1952 were the first federal-aid funds earmarked specifically for Interstate construction – a token amount of $25 million.

Slow progress toward a political and financial solution was made in 1954, when total funding jumped to $875 million with $175 million earmarked for Interstate highways. Yet a plan proposed by General Lucius Clay, who President Dwight Eisenhower had asked to tackle the highway problem, failed to win Congressional support. Compromises were worked out during 1955 and 1956 that finally allowed the funding of a very large Interstate program while at the same time increasing allocations for the categories of federal-aid construction to more than $800 million per year after 1956. Paying for the road program were increased taxes on highway users – gasoline levies, excise taxes on tires, and so forth – that Congress locked into a highway trust fund. Crucially, the federal government agreed to provide ninety percent of the cost of Interstate projects, a step that finally allowed states to make real progress on a network of very expensive, high-standard, express highways between and into the nation’s cities. After overcoming lingering political bickering, the legislation funding a National System of Interstate and Defense Highways passed in 1956 amid Cold War rhetoric that attracted attention but had no impact whatsoever on the engineering or design of the system. The real reason for success in 1956 was political exhaustion after years of squabbling and public insistence on the need for building a better national highway system.

With the passage of the Federal-Aid Highway Bill of 1956, the states launched the largest highway program in history. All was not perfect as they pursued this effort during the final years of the 1950s, as challenges remained. Some states had little experience in building such large projects in urban areas. The shortage of engineers continued to hamper some states, while others just were not well prepared and took a long time to develop construction plans and to let contracts. Political corruption plagued some states, providing Congress with a prime target for hearings in the late 1950s,

especially as the pace of construction on Interstate roads lagged. Finally, by the late 1950s, the first complaints began to surface from residents being displaced by the swathes of concrete cutting through urban neighborhoods. Many felt they did not receive fair value for their condemned property, while others were angry about the lack of public involvement in planning processes. This was a prelude to the “Freeway Revolt” that emerged in the 1960s. But for most highway departments, the late 1950s was a time marked by immense pressure to get the plans prepared, the contracts issued, and the roads and bridges built and opened to traffic.\(^2\) Ohio proved to be in the vanguard of this effort.

**Context: Road and Bridge Building in Ohio**

Like most state highway agencies, the Ohio Department of Highways spent the years immediately after World War II struggling to get a large-scale construction program moving. The national problems noted above—rapidly increasing demands for road and bridge improvements, restrictions on access to materials, shortages of engineers, and funding limitations—all were apparent in Ohio. Perhaps symbolic of the challenges facing Ohio in 1950 was an inventory of the state’s highway bridges. The department had jurisdiction over 9,700 bridges more than 10’ long, 240 of which crossed railroads. There were 87,000 smaller structures, and 2,073 railroad grade crossings.\(^3\) Many were not in good shape, as the study found 25 percent were too weak or too narrow for present day traffic. Some 500 bridges had been posted, with another 2,000 ready to be added to the list of inadequate structures.\(^4\) Echoing this assessment of insufficiencies was the report produced on the state of Ohio highways under the auspices of the Automotive Safety Foundation in 1949 and 1950.\(^5\)

Responding to these problems and the general pressure for more and better roads was not easy. First and most important, the department lacked the financial resources to pursue a much larger road and bridge program. One signal came from the formation of the Ohio Turnpike Commission in 1949 to develop a road across northern Ohio from the western terminus of the Pennsylvania Turnpike to the Indiana line west of Toledo. The department of highways hoped that this toll-financed project would help take some pressure off other main roads and allow it to catch up with demands elsewhere.\(^6\)

\(^2\) Some of these difficulties are discussed in Mark Rose and Bruce Seely, “Getting the Interstate System Built: Road Engineers and the Implementation of Public Policy, 1955-1985” *Journal of Policy History* 2 (Winter 1990), pp. 23-56.


More direct evidence of the financial problems came when T. J. Kauer, Director of the Ohio Department of Highways, reported in 1951 that his department was curtailing work on most state roads in order to match federal-aid appropriations. Kauer believed there was no alternative because of the present state fiscal situation, and he had no intention of allowing federal funds to lapse. “Although Ohio’s allocation of federal aid funds might appear disproportionate to our overall fiscal program, in view of the urgent postwar increase in traffic, adding to a previous tremendous backlog, not only should the present allocation of federal aid be continued, but very logically the amounts of such federal aid should be increased.” In 1949 the General Assembly had provided special funds to enable the department to match federal-aid appropriations, but legislators failed to take such a step in 1951. The planning bureau estimated $39 million in federal funds might not be matched during the 1952-53 biennium. Legislators had rejected bills to increase the diesel fuel tax, to impose a one-cent increase in the gas tax, and to create a weight-distance tax for commercial vehicles. They had increased vehicle registration fees for commercial vehicles, but only 23 percent of this increase ($7.5 million) went to state highways; the rest went to the counties. As the planning bureau explained, “This failure to obtain additional revenues has made it impossible for this Bureau to provide an adequate highway program.”

The situation looked little different in early 1953, as the department reported it had no funds for improving nearly 5,000 miles of state highways, or for routine resurfacing and minor projects on the entire state system. And the backlog of unmatched federal funds reached $25 million on projects that would be delayed until 1953. Worse, the department received word it needed to construct an access road to a new plant for the Atomic Energy Commission (AEC) in Pike County, even as it needed to start developing plans for road improvements at planned exits on the new turnpike in northern Ohio.

Finally, however, the cavalry arrived in 1953, as the legislature finally agreed to provide a major increase in funding. A $500 million bond issue passed the General Assembly, providing $125 million per year for four years. Also available was the revenue from a penny increase in the gas tax ($23 million), an axle-mile tax ($20 million), and an emergency appropriation for the AEC plant access road ($15 million). At last, the department could easily match the federal share of projects.

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7 Ohio Department of Highways, Annual Report (1951), introduction.
8 Ibid., p. 16.
9 Ibid., (1952).
Indeed, the department had few financial problems for the remainder of the decade. The 1956 legislation, which cut the state share in Interstate projects to ten percent helped a great deal, but the legislature also acted to provide sufficient funds. In 1957, the bond issue ran out, and the legislature voted a two-cent increase in the gas tax that provided $62 million for road work.\(^\text{11}\) The results of this showed when the department could boast in 1962 that Ohio had spent a record $1.35 billion over the previous four years. Ohio had spent $107 million more on its Interstate roads than any other state and had allocated $100 million more than any other state.\(^\text{12}\) And at the same time, the department could also undertake a major bridge improvement program, after a survey in 1959 found 1,083 deficient bridges. Three years later, more than half of the too-narrow or too-weak bridges (601) had been improved.\(^\text{13}\) In short, the Ohio Department of Highways was in a vastly stronger financial situation at the end of the decade than in 1950.

A somewhat similar story can be told concerning the challenges posed by shortages of materials and of engineers. The materials problems that marked the Korean War were largely out of the hands of the Ohio engineers, since priorities were set in Washington. Even the BPR could secure only one-third of the structural steel shapes it needed for bridges in 1951, and a short steel strike in 1952 did not help matters.\(^\text{14}\)

These problems largely disappeared by 1953 with the winding down of the war in Korea, but the challenge of finding enough engineers to design the roads and bridges, survey routes, and oversee construction was much harder to meet. The Ohio Department of Highways began sounding concerned as early as 1949, the year it launched an engineer training program that served as a graduate program to introduce young civil engineers to all aspects of highway construction. By 1951, the department requested permission to use consulting engineers for some work, indicating that such a move would allow the department to wipe out a backlog of 150 projects within a year. Even so, the annual report concluded that the lack of money was the serious bottleneck, for “Master long-range plans, programs, and detailed plans, and specific projects now rest upon the shelves of the Ohio Department of Highways, ready to be sold the instant that the money to pay for their construction is provided.”\(^\text{15}\)
The bridge bureau was especially hurt by this problem, since bridge design was not entrusted to beginning civil engineers. In the 1952 report, the bureau reported “The principal problem of the Bureau continues to be the need for additional trained personnel.” That year alone, one engineer, five engineers-in-training, thirteen engineering aides, and four bridge mechanics left the department, in part because of low pay scales. A year later, three engineers, one engineer-in-training, one engineering aide, and a stenographer resigned, to be replaced by one returning engineer, five engineers-in-training, and four engineering aides. With the passage of the bond issue that year, the bridge bureau pinned its hopes for more engineers on the in-house training program. But a more important assist came from a provision in the bond issue allowing the department to use consulting engineers to design projects worth more than $1 million. The bridge bureau almost immediately benefitted from this decision. In 1954, 32 of the 141 bridges placed under contract had been designed by consultants, while 141 of the 234 bridges contracted for in 1955 were prepared by consulting engineers. And even this approach did not remove problems, for the department still had to inspect and approve the plans prepared outside the department, and as the statistics suggest, senior bridge engineers were diverted to this task and away from design work.

All the while, the bureau’s personnel problems continued, for the low pay scales translated into serious problems retaining good engineers. In 1954, the bridge bureau alone hired fifteen new employees (one engineer, seven engineers-in-training, five part-time draftsmen, and two stenographers) but twelve employees left the department, including six engineers-in-training and one draftsman who went into the military. Another engineer retired and one died unexpectedly. A year later, 16 new hires were offset by 14 departures, including three men with 18-25 years of experience. The bureau planned to promote junior engineers more quickly, but added that they lacked the experience to qualify for engineering registration. “The performance of the younger engineers and engineers-in-training has been very commendable and the bureau’s ability to continue to meet the requirements of the expanded program will depend upon the department’s ability to recruit many additional engineers and engineering graduates.”

In the end, the department just barely managed to find enough engineers to accomplish its tasks. The training program was an important element in this outcome. During its first six years, 599 engineers entered the program, while 109 left for the military, and

228 resigned for various reasons. Of those remaining, 101 gained engineering registration, and 147 were still in the program in mid-1955. The department as a whole had 430 registered engineers in 1949 and 506 in 1955.\textsuperscript{20}

Even after the department passed substantial amounts of design work off to consulting engineers, this gain in engineering talent was not enough to carry out all of the work required for supporting the state highway system while at the same time expanding substantially the mileage of roads and bridges on the federal-aid system. The Ohio Department of Highways was forced to rely on two strategies that increased the productivity of the design staff, especially in the bridge bureau. The first step involved an expansion of a tendency that had begun with the first state highway departments at the turn of the century: the use of standard designs. Obvious savings were associated with avoiding the use of a custom design for every structure, and most departments developed books of basic designs that could be adopted or adapted easily to many situations. Such designs were most appropriate for smaller bridges, as long spans continued to need detailed adjustments to fit local conditions. Such a strategy not only saved design costs, but also allowed the state highway departments to insure that sound designs were used by county and local road building agencies, even if those jurisdictions could not afford full-time designers.

Ohio’s bridge bureau had followed this practice for years. In the late 1940s, the department was working on updating its bridge designs, introducing 18 new drawings in 1947, and preparing standard drawings for capped pile abutments and for capped pile piers in 1949, along with two sets of standard drawings for continuous steel stringer superstructures. Then in 1951 the bridge bureau released a new bridge design book, \textit{Design Specifications for Highway Structures}, which was based an entirely new method resting upon the frequency of heavy vehicles.\textsuperscript{21}

This emphasis upon standard specifications proved very important in Ohio by the mid-1950s, especially as the department faced the task of designing bridges to carry the new Interstate highways over or under adjoining roads. The requirement that the Interstates not encounter cross traffic at grade meant many more bridges were needed than on other federal-aid highway projects. But since most of these structures were similar in length and load requirements, they provided a perfect opportunity for developing and applying standard designs. And by 1954, the department was reporting that the use of standard bridges was an important means of keeping up with the demand for many bridge plans while not sacrificing quality.\textsuperscript{22}

\begin{footnotesize}
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\item S. O. Linzell, "The Highway Challenge: Providing Adequate Highways Now," \textit{The Ohio Engineer} 13 (July 1955), pp. 5, 17-20. The department also employed 1,191 engineering aids.
\item Ohio Department of Highways, \textit{Annual Report} (1954), p. 36.
\end{itemize}
\end{footnotesize}
The statistics of bridge construction in Ohio bear out this approach, which clearly suggests that the department favored the use of continuous steel stringer bridges. This approach also was applied on the Ohio Turnpike, where almost all of the bridges fit this same pattern. Indeed, there was only five large bridge structures on the entire 241-mile toll road, and only one of them was an arch bridge. This style of bridge engineering on the turnpike was understandable because of the close ties between the engineers at the Ohio Department of Highways and the Turnpike Commission. When the commission was established in 1949, state highway engineer T. J. Kauer was appointed an ex officio member of the commission and became its first secretary-treasurer. This made sense, since Kauer’s staff provided the initial location surveys and other engineering work for the commission in 1950. Kauer resigned from the department to become the turnpike’s chief engineer in 1952, and when he moved onto private industry in 1955, his successor was Ralph J. Lehman, assistant chief engineer for design and location of the Ohio Department of Highways.23

The Ohio Department of Highways also relied upon the use of technology to increase the ability of its cadre of designers to provide the plans needed for the expanding highway program of the 1950s. The crucial step came in 1946, when the department of highways acquired a war surplus Beechcraft airplane to establish a photogrammetry unit, the first highway department in the country to take this step. Photogrammetry was an aerial mapping technique that relied upon two cameras in the plane to produce images that when viewed together created stereo images that could be turned into accurate plans and drawings. The department initially used the equipment to produce photo mosaics that allowed highway locations to be laid out. But by the early 1950s, the bridge bureau was using photogrammetry images to prepare bridge site plans. The bridge bureau adopted the technique for 36 bridge site plans in 1950, 89 in 1951, 96 in 1952, and 176 in 1954. In short, almost all bridge location and site work was performed from aerial photography rather than on-site surveys. The savings in time and costs were substantial, since the amount of field surveying required was much reduced. The bridge bureau estimated that it cost about $200 to prepare location plans from aerial images, compared to more than $1,000 per bridge for survey and mapping with traditional methods.24 But the real advantage was the way this technique limited the

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23 “Lehman Succeeds Kauer at Turnpike,” Ohio Engineer 14 (January 1956), p. 15. Nor were bridges the only example of standard designs on the Turnpike. The commission specified that all roads be concrete, a decision that led to a lawsuit by asphalt suppliers and contractors, but the courts upheld the commission’s right to make such a selection. See Ohio Turnpike Commission, 5th Annual Report (1954), pp. 8-9; also “Suit to Open Ohio Turnpike to Asphalt Nears Climax,” Engineering News-Record (November 27, 1952), p. 24; “Ohio Ruling Favoring Asphalt Goes to State Supreme Court,” Engineering News-Record (April 2, 1953), p. 21; Holger Ridder, “Asphalt vs. Concrete Battle in Ohio May affect Future Turnpike Paving,” National Paving News 45 (April 22, 1953), pp. 60-61; “High Court Reverses Lower: Ohio Turnpike to be Concrete,” Engineering News-Record (June 11, 1953), pp. 21-22.

need for trained engineers on an otherwise time-consuming activity. As a result, the department specifically identified its aerial engineering and photogrammetry unit as a primary means of coping with the need to expand bridge construction activities during the 1950s. Indeed, the department continued to expand its capability in terms of harnessing new technology to bridge and highway design. By 1956 and 1957, the department was experimenting with linking computers to the process of turning stereo aerial photographs into accurate measured maps. The department acquired an IBM 650 and developed a program that calculated earth volumes on excavations, for example. Again, the Ohio Department of Highways was in a pioneering role as the only highway agency to be pursuing this activity on its own. As department director Everett Preston concluded, “Ohio stands in the vanguard of the effort to fit computers -- and other modern tools -- to the total highway design picture.”

But this approach also led the department to produce bridges that looked almost identical. Unlike the early express highway builders, such as Robert Moses in New York who ordered that every bridge on the Long Island parkways to be given a different treatment resulting in a slightly different appearance, the highway overpass bridges that dominated the concerns of Ohio’s bridge designers looked largely the same. Indeed, the goal of the department was to produce these roads and their associated bridges as fast as possible. Uniformity and standardization were the name of the game. Indeed, the adoption of standard drawings and specifications simplified the process of getting the approval of the federal highway bureaucracy, since there were few variations to be concerned about and inspected. What worked for one could be viewed as working for all. But it also meant that the department was not seeking to develop innovative or distinctive designs; it focused on serviceable and durable designs closely related to the AASHO standards.

These changes in highway design procedures clearly enabled the department to meet the challenges of the 1950s. The biennial report for 1957-1958 reported a balanced set of accomplishments, with the department vigorously pursuing the Interstate program while also launching resurfacing efforts and construction activities for other state roads, and tackling pressing bridge needs. The state spent $381 million on highway improvements in 1958 alone, and worked on 810 bridges during the two years. And in

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27 This point emerged in conversations with department engineers during the late 1970s. See Rose and Seely, “Getting the Interstates Built.”
its report for 1959-60, the department boasted of opening 522 miles of Interstate highway, and placing 615 bridges under contract. But like most state highway departments in the late 1950s, Ohio’s engineers made better progress on the rural sections of their Interstate projects than in the cities. This outcome was not the product of a deliberate desire to ignore cities. Indeed, since the end of the war, federal and state highway engineers in most states acknowledged that the most pressing problems were found in urban areas. Indeed, even in 1957, as the state’s Interstate program got underway in earnest, the Ohio department reported that its most pressing problem concerned urban traffic congestion. But even though this had been true for more than a decade, rural roads had received much more attention. Indicative of the relative priorities was the amount of attention that the department paid to the effort to identify a second turnpike.

The legislation creating the Ohio Turnpike in 1949 had allowed for the possibility of a second road, with the proviso that any extensions had to stand on their own financial merits. By mid-1953, the Turnpike Commission was requesting that the department of highways conduct an engineering study and begin a traffic survey. During 1954, plans were firmed up for a major express highway from Cincinnati to Cleveland, and then on to Conneaut at the New York state line. Also added was a 107-mile spur running from Columbus to Toledo. But problems soon emerged, for the consulting firm of Coverdale and Colpitts reported that its revenue study suggested Turnpike 2 would pay for itself only over a 74-mile stretch from Springfield to Cincinnati. The estimated cost was $425 million, and the bankers wanted earnings of 1.5 times the interest charges, while the study expected a return of 1.27 times interest. A sometimes bitter debate followed, as efforts were begun to reduce construction costs. The spur from Toledo to Columbus was an early casualty, but in fact by 1956 the whole project was in jeopardy because of the improved prospects for a major federal highway bill. Turnpike Commission Chairman Shocknessy and Department of Highways Director S. O. Linzell disagreed about how to proceed. Linzell wanted the project to begin as a toll road, while Schocknessy felt it better to wait and see what happened in Washington. The governor gave a go-ahead to proceed, if the bankers would approve the financing, since federal-aid would not cover all costs. But in July 1956 the route from Cincinnati to Conneaut was designated part of the Interstate system, and Turnpike 2 was finished.

This effort required substantial energy from the Ohio Department of Highways, and reflected the almost subconscious preference of the state engineers for rural projects. Not only was the land easier and less expensive to acquire, but these rural projects could be built more quickly and with fewer complications. The department’s whole focus on standardized designs and rapid approval of plans worked best on these rural sections of Ohio’s Interstate highway system. Urban projects, on the other hand, were much more demanding, since the land cost much more to buy and it took time to condemn the property of thousands of residents. Planning was constrained by existing roads, buildings, and utilities, and everything was more complex, from setting design parameters to locating exits. Not least of the complexity was the involvement of more political jurisdictions – and politicians – in the decision-making process. Not surprisingly, the department of highways’s map of Interstate roads open or under construction in 1959 showed major construction work on rural parts of IR 71, IR 75, and IR 70, but little work in any of the cities. In 1959 and 1960, 18.5 and 15.4 miles of urban Interstate were opened in Ohio, while 133 and 119 miles of rural highway came into use. The pattern was national, and the maps showed significant changes in the early 1960s. By 1962, the totals in Ohio were 310 miles of rural and 61.1 miles of urban Interstate completed. Clearly, rural Interstates moved along noticeably faster in the 1950s, meaning that most of the bridges were built on those types of roads as well.32

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32 Ohio Department of Highways, 4-Year Report to the Governor (1959-1962), pp. 38-44.
Physical Development of Ohio’s Interstate System and Its Bridges

In order to evaluate the significance and integrity of the pre-1961 Interstate highway bridges, it is important to have an understanding of how the bridges fit into the history of the physical development of Ohio’s comprehensive Interstate highway system, of the role bridges play in that system, and typical alterations to both the roadways and the bridges.

History of Physical Development

When Ohio embarked on the development of its comprehensive Interstate highway system in 1956, state engineers and planners had a well formed “vision” and approach to its physical development. This vision included general ideas and agreement on where most of the routes would be located and a clear idea of the types of specifications and standards required to carry out a huge project initially thought to be staged out over about 15 years. The basic outline of what was planned in 1956 is what is in place today with remarkably few modifications, although Ohio’s Interstate system was considerably more expensive and took longer to complete than originally projected.

Currently, Ohio’s comprehensive Interstate system is comprised of 1,580 road miles and 3,829 bridges carrying or spanning Interstate highways. In terms of road miles, Ohio has the fourth longest system of Interstate highways within its borders. Exclusive of the routes carried by the Ohio Turnpike, Ohio Department of Transportation (ODOT) estimates that motorists logged over 74 million annual vehicle miles in 2002.\(^{33}\)

In simplest terms, Ohio’s Interstate highway system is a series of interconnected, limited-access highways that were opened to traffic in stages from 1950 to 1992. With the exception of about 60 miles later added to the system, the routes that exist today were all in the state highway department’s plan by the end of 1956. Construction was staged out with an estimated 549 different construction sections built over more than forty years. A majority of the system was open by 1978, but a number of urban sections took longer to complete and were not opened to traffic until the 1980s and early 1990s. The system was built to high design standards, yet work to improve the system has never stopped – it has continually evolved to meet modern safety and capacity requirements.

Ohio’s comprehensive Interstate system consists of twenty numbered routes. Route numbers were originally assigned by the American Association of State Highway

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The route numbers have remained the same since 1958 with the exception of a few routes. IR 76 between the Ohio Turnpike and Akron was originally designated SR 18, then IR 80S, before becoming IR 76. Congress originally authorized 1,521 route miles in Ohio, but today there are 1,580 route miles. Most of this difference is due to rerouting of IR 80 over the section of Ohio Turnpike between Streetsboro (Portage County) and North Ridgeville (Lorain County). The original IR 80 took the route of what was later designated IR 480.

Figure 1: Map of Ohio’s comprehensive Interstate Highway System, showing progress as of Jan. 1, 1963. Sections marked in yellow were those completed as of Dec. 31, 1960. Source: Ohio Department of Highways, Biennial Report, 1963.
route location, including actual survey and acquisition of right of way. The Ohio Department of Highways reported that it had surveyed all but 49 miles of the comprehensive Interstate system by the end of 1962, although the staged construction continued for another 30 years.35

The year 1956 is generally taken as the “birthyear” of the federal Interstate program, but most states, including Ohio, incorporated earlier highways in the system.36 Some of these highways were dualized highways and others were two-lane highways that were later dualized as part of the Interstate construction program. In Ohio, approximately 279 miles (18 percent) of the original 1,521 route miles authorized by Congress were already complete or under construction in 1956. Of the 279 miles taken into Ohio’s comprehensive Interstate system in 1956, 206 miles were on the Ohio Turnpike. Other pieces of pre-1956 dualized highway taken into the system included the Toledo-Detroit Expressway (IR 280) and the eastern part of Cleveland’s Memorial Shoreway (IR 90).37

In Ohio, the greatest period of Interstate construction occurred between 1956 and 1978. During these years most of the major cross-state routes in Ohio were brought to completion in stages (Table 1). The years after 1978 saw a slower pace of continued work on the system, particularly construction of the final stages of the urban loop and radial roads. The last section on IR 275 was opened to traffic in 1992.


36 Nationally, the Interstate system includes such significant features as the main stem of the Pennsylvania Turnpike (IR 70/IR 76), built from 1936-1941, and the George Washington Bridge (IR 80, New Jersey-New York), completed in 1931. The system continues to grow with periodic authorizations of additional mileage by Congress. An end date for the physical development of the national Interstate system is just as problematic as a beginning date since construction and improvement has never stopped. Some have suggested that the National Environmental Policy Act (NEPA) of 1970 so altered the entire process of road building, requiring environmental impact statements and curbing the pace of new construction, that it is an appropriate end date. The first transcontinental Interstate route to be completed was IR 80, with the last section in Utah opened to traffic in 1986. That year some three percent of the Interstate system was still considered incomplete by FHWA. Congress commemoratively renamed the ‘completed’ system the “Dwight D. Eisenhower System of Interstate and Defense Highways” in 1991. Tom Lewis. Divided Highways: Building the Interstate Highways, Transforming American Life (New York: Viking Press), 1997, pp. 259-60, 294.

37 Not all states were starting from the same status of development. Nationally, about twenty percent of Interstate mileage was built on pre-1956 roadway locations. Ohio’s percentage (18 percent) was average, although much of it was already built close to Interstate standards and did not require significant improvements. The physical development of the Interstate system varied from state to state based on the status of prior development and each state’s ability to match the federal funds, perception of which Interstate highway routes were a priority, and technical and organizational capabilities of its highway department to gear up for the program. U.S. Dept. of Transportation, Federal Highway Administration, America’s Highways 1776-1976 (Washington, D.C.), 1976, p. 475.
<table>
<thead>
<tr>
<th>Interstate Route</th>
<th>Date Construction Began on First Section</th>
<th>Date Construction Completed on Last Section</th>
</tr>
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<tr>
<td>IR 70</td>
<td>November 1955</td>
<td>August 1975</td>
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<tr>
<td>IR 71</td>
<td>October 1957</td>
<td>November 1972</td>
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<tr>
<td>IR 74</td>
<td>December 1959</td>
<td>August 1973</td>
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<tr>
<td>IR 75</td>
<td>August 1955</td>
<td>November 1972</td>
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<td>IR 76</td>
<td>December 1953</td>
<td>August 1970</td>
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<td>IR 77</td>
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<td>IR 90</td>
<td>August 1952</td>
<td>July 1978</td>
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<td>November 1974</td>
</tr>
<tr>
<td>IR 271</td>
<td>1960</td>
<td>July 1974</td>
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<td>IR 275</td>
<td>August 1958</td>
<td>1992</td>
</tr>
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<td>December 1964</td>
<td>September 1972</td>
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<tr>
<td>IR 480</td>
<td>October 1962</td>
<td>1983</td>
</tr>
<tr>
<td>IR 670</td>
<td>November 1955</td>
<td>1990(^{38})</td>
</tr>
<tr>
<td>IR 675</td>
<td>June 1972</td>
<td>1984</td>
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<tr>
<td>IR 680</td>
<td>June 1960</td>
<td>October 1975</td>
</tr>
</tbody>
</table>


\(^{38}\) This does not include the new section of IR 670 in downtown Columbus between SR 315 and Grandview Avenue that is scheduled for completion in 2004.
Design of Ohio’s Interstate System

Development of Ohio’s Interstate system was achieved through application of high design principles and tested bridge types. It was rarely innovative in the areas of new pavement materials, bridge types, or highway geometrics. Neither limited access nor dualized (median-divided) highways were new in 1956. Both had been built prior to World War II, and senior planners and engineers in Ohio, as in several other states, had a good understanding of what needed to be done based on prior experience, such as that with the newly completed Ohio Turnpike in 1956. This led to a rapid consensus on what the basic standards of the system should be nationally and in Ohio.

The national design standards for the Interstate highway system were set down by AASHO in a uniform design policy in July 1956. This was the national design standard for Interstate highways. The major items of the policy were:

- complete control of access throughout the entire system. Access to and from the Interstate is prevented except at designated locations, i.e., interchanges.
- design speeds of 50, 60, and 70 mph respectively for mountainous, rolling, or flat terrains. Curvatures, super-elevation, and gradients to match design speeds. Design speeds are the maximum safe speeds under which the design features of the highway govern.
- capacity based on projected 1975 traffic counts (changed to a 20-year design standard in 1963. The 20-year standard is still in use for new Interstate construction and reconstruction.)
- 12’ minimum travel lane width.
- 10’ minimum graded shoulder width.
- elimination of all at-grade intersections with highways and railroads.
- separated traffic lanes with medians. Variance was allowed in median width and type (barrier, grass, etc.).

The uniform design policy was an example of “balanced design.” Balanced design meant that every element — curve radius, sight distance, super-elevation, and gradient — was determined by speed so that drivers could easily anticipate road conditions and not encounter surprises.

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39 Interestingly, the four-lane minimum design standard was not adopted until 1966. This allowed states, especially those in sparsely populated areas of the West, to build two-lane routes during the first years of the system’s development. Ohio built all of its Interstate routes to a minimum of four lanes. FHWA 1976, pp. 476-485.
Balanced design was a crucial step in the evolution of safe, high-speed highways. The leading developer and advocate of balanced design was Joseph Barnett, an engineer with the federal Bureau of Public Roads (BPR) who had as much to do with the standardized geometrics of the national Interstate system as any individual. Barnett cut his teeth on the Westchester County (New York) parkways during the 1920s and early 1930s. He joined the BPR as a senior engineer in 1933, and he quickly became its high-speed highway specialist. Barnett’s influence was enormous. In 1937, to facilitate acceptance and popularization of the balanced-design concept, he developed a table for transition curves. Between 1938 and 1944, in his capacity as secretary of AASHO’s Committee on Planning and Design Policies, he was the primary author of seven policies on geometric design, ranging from highway classification to sight distances. The AASHO policies were developed cooperatively by the state highway officials, but the influence of Barnett and the BPR was as unmistakable as it was profound and ubiquitous. The committee officially approved the policies in 1945 and published them in 1950 as its *Policies on Geometric Highway Design*. The policies were the basis for the one issued by the committee for the national Interstate highway system in July 1956. Shortly thereafter, the Ohio Department of Highways officially adopted AASHO’s uniform design policy “as the minimum requirements of good design” on Ohio’s Interstates. Over time, the uniform design policy has evolved, but the guiding principles of balanced design have remained the same and continue to define the Interstate system in Ohio and the nation.

*Figure 2: Balanced design features of Interstate highways. Source: Ohio Department of Highways, Annual Report, 1957-58.*

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Construction Methods and Materials

The Ohio Department of Highways planned, surveyed, designed, and supervised the construction of the state’s Interstate highways with the exception of the Ohio Turnpike, which although built between 1952 and 1956 by a separate commission, was also significantly influenced by AASHO and Ohio Department of Highways design policies and specifications. State engineers and staff surveyed Interstate routes, prepared plans, let contracts, and oversaw and approved construction. Federal engineers approved the plans and inspected the work.

Interstate highways were built in construction sections with an average section length of two to three miles. By a recent ODOT count, Ohio’s Interstate system (exclusive of the Ohio Turnpike) consisted of 549 original sections. Construction of the huge system had to be in sections because of its size, the problems of managing a large number of contractors at once, and, perhaps most importantly, the multi-year financing worked out by the federal government. In Ohio, as well financed and prepared as any state, work progressed in an orderly fashion advancing each section step-by-step. Dozens of private contractors performed the actual construction and supplied materials, machinery, and labor.\(^{42}\)

Aerial photogrammetry was the preferred survey method in Ohio because of the time and labor savings over ground crews.\(^{43}\) Ohio’s early and extensive use of photogrammetry was innovative. Sections were plotted on photo mosaics and followed up by location on maps. Acquisition of right of way paralleled this work. Final location surveys and design work consisted of preparing plans and profiles and establishing center lines and grade lines on the ground. Ohio’s *Manual of Location and Design, Interstate Projects* (1957) stipulated a minimum 250'-wide right of way for Interstates.

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\(^{43}\) An added advantage of aerial photography, not frequently mentioned but well understood by state highway officials, was that it avoided unduly alarming property owners, who were known to engage survey crews in attempts to influence stake lines or inflate property values. Thomas F. Hickerson, *Route Location and Surveying*, 3rd ed. (New York: McGraw-Hill), 1953, p. 17.
exclusive of extra widths needed for medians above 36' wide or required for deep cut or fill sections. Although most sections were on new alignments, some sections were placed on the alignments of earlier roads and streets; a few old roadways were even used as the subbase for Interstate pavements.\textsuperscript{44}

The Interstates required massive amounts of earthwork to achieve shallow curves and grades with smooth transitions that met the uniform design policy. This work included cutting and filling the natural highs and lows in the landscape to conform to the ruling grade, established at a desirable maximum of two percent by the Ohio Department of Highways in 1957. This low ruling grade was made possible by Ohio’s generally rolling to flat topography where there were few mountains. In practice, some sections of highway were allowed grades of three to four percent in hilly areas, which was the national standard. Sight distances were also taken into careful consideration with changes in grade and curvature checked against charts developed to ensure that drivers had sufficient length of roadway to stop safely at the given design speeds.\textsuperscript{45}

Even with Ohio’s favorable topography, the earthwork was a big part of any Interstate job. It included clearing and grubbing, roadway and drainage excavation, cut and fill, embankments and borrow. Indeed, in terms of outright material, the earthwork is the largest manmade feature associated with Interstate highways. Engineers calculated earthwork in terms of cubic yards on plan and profile sheets and used the measurements as a factor in determining the prices of contracts. Standard guidelines specified slope ratios and the placement of drainage features.

Nationally and in Ohio, Interstate contractors benefitted greatly from advances in earthmoving machinery. Most modern-day earthmoving equipment traces its technological origins to product sidelines of farm equipment manufacturers of the late nineteenth and early twentieth centuries. Industry leaders, such as Caterpillar and International Harvester, did not establish separate production divisions for earthmoving equipment until the 1930s and 1940s, but once they did they were soon marketing new lines of hydraulic front-end loaders, excavators, and wheeled tractor-scrapers. The new machines replaced power shovels as highway contractors’ machines of choice in the

\textsuperscript{44} ODOT recently investigated a section of IR 75 in Allen County, presumed to have been built on a new alignment but actually built on the alignment of an old section of US 25. It was even discovered that old US 25’s brick pavement, dating from prior to 1912, had been used as a subbase for the northbound lanes. This brick subbase, which flexes too much under heavy loads, was traced as the source of high pavement maintenance costs for this section of highway. A similar condition has been identified on IR 70 in Guernsey County. ODOT, Office of Urban & Corridor Planning, “Ohio’s Interstate System, 50 Years of Service,” April 2000, pp. 55-68.

\textsuperscript{45} Ohio’s topography, especially in comparison to the Appalachian states to its south and east, gave it significant advantages and in some measure helped keep Ohio ahead of its neighbors in percentage of the Interstate system complete through the late 1950s and 1960s. Typical mountain gradients were four to five percent. Ohio Department of Highways, “Manual of Location and Design,” 1957.
The decline of the power shovel had happened just before the Interstate system and is popularly captured in the children’s classic by Virginia Lee Burton, *Mike Mulligan and His Steam Shovel* (Houghton Mifflin), 1939.

William R. Haycraft, *Yellow Steel: The Story of the Earthmoving Industry* (Urbana: University of Illinois Press), 2000, pp. 141-145. Haycraft points out that the Interstate program pumped billions of dollars into the construction industry, but that it disappointed, at least initially, equipment manufacturers. High expectations in 1956 were premature because of the failure to reckon with the long lead times entailed in major highway projects.

Highway pavements serve two purposes – they provide resistance to the wear of traffic, and they transmit the weight of vehicles to the underlying soil. During the early twentieth century, pavement engineering and construction evolved from rule-of-thumb methods to an applied science that carefully analyzed everything from the weight-supporting properties of different soils to the durability of various pavement materials, from asphalt to reinforced concrete. By mid-century, highway engineers had at their disposal a large amount of information and options for pavement design, construction, and maintenance. Pavement materials were one of the least standardized areas of highway design because of geographic variations in climate, soil, and the local cost and availability of bulk materials, like sand and stone.

In 1957, the Ohio Department of Highways adopted two pavement types for its Interstates. Both pavements were designed to sustain the wheel loads of trucks (18,000 lb. wheel load) and prevent damaging frost action. The standard “rigid” pavement consisted of a 10”-thick reinforced-concrete pavement set atop an approximately 6”-thick granular subbase. The standard “flexible” pavement consisted of courses of asphaltic concrete, bituminous macadam and waterbound macadam up to 15” thick atop an approximately...
The subbase is a granular material of sieved stone, slag, sand, or gravel, selected to meet the requirements of a frost-free material (to prevent frost heaves), permit drainage, and prevent upward action of soils. A history of every Interstate section’s pavement is contained in the Perpetuation Books on file in the ODOT Office of Technical Services. They document the specifics of the work, including changes made by project engineers in the field.  

Paving equipment advanced greatly after World War II in time to have a significant impact on the ability of contractors to pave long stretches of Interstate quickly and efficiently. A major change in this area was the use of central mixing plants with electronic instrumentation, simplifying and giving better control over batching. This, along with the development of air-entrained concrete, permitted longer hauls of slower-setting concrete to meet demands for larger volumes. Another innovation was the development of the slipform paver, which carried its side forms, thus eliminating the need for hundreds of steel forms. The slipform paver and other machines, like the self-propelled asphalt mixing plant, multi-lane spreader for hot mix, and vibratory roller, made it possible to pave long stretches of highway at a time, sometimes at a rate of more than one mile per day.  

AASHO’s uniform design policy required 10’ minimum graded shoulder widths. Ohio adopted an even higher standard of 12’ graded minimum shoulder widths for exterior

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47 The subbase is a granular material of sieved stone, slag, sand, or gravel, selected to meet the requirements of a frost-free material (to prevent frost heaves), permit drainage, and prevent upward action of soils. Rigid and flexible pavements are a common terminology used to differentiate pavements of Portland cement (rigid) from those of macadam, bituminous, and other materials (flexible). Ohio Department of Highways, “Manual of Location and Design Interstate Projects,” 1957, Section I-600.

shoulders in rural areas. The purpose of shoulders was to provide sufficient space for vehicles that might have to stop for an emergency and to keep clear of the travel lanes without becoming an obstruction. Shoulders were not a new idea in the 1950s, they had been in use nationally since at least the 1910s, but they had become progressively wider as motor vehicle and design speeds increased. Ohio’s *Location and Design Manual Interstate Highways* (1957) stipulated that the shoulders would have a bituminous surface treatment, but not for their entire width. The exterior shoulders were to be treated with bituminous macadam for 10’ of their 12’ width, and the interior shoulders for 5’ of their 10’ width.\(^{49}\)

Medians in Ohio’s rural areas were grass medians gently sloping away from the travel lanes with a gutter near the center line for drainage. The original purpose of the medians was to prevent interference with opposing traffic, but forward thinking also planned for the day that the median might be used for future lanes. Standards provided for 16’, 36’, 50’, 60’, and 84’ wide medians (inclusive of interior shoulders) with preference given to 60’ and 84’ widths, which gave ample room for the addition of lanes. When medians were restricted to less than 20’, a steel beam guide rail barrier, was placed in the median. Steel beam guide rails were also required outside the shoulders where adjacent downslopes exceeded a 6:1 ratio.\(^{50}\)

Signing on the Interstates was standardized at the national level. AASHO adopted the familiar pattern of white-on-green destination information signs, white-on-blue service information signs, and red-white-and-blue route number markers in 1958. AASHO’s signing manual also specified the message sizes and general placement of signs so that uniformity would prevail nationally. Color selection, size, and placement were predetermined as the result of field tests and studies by BPR engineers.\(^{51}\)

In the early years, roadside amenities and landscaping were not high priorities in Ohio. Federal legislation authorized the use of funds for these purposes but they came from amounts otherwise available for construction, so most states, including Ohio, made only limited use of them in efforts to open as much mileage to traffic as quickly as possible. The Ohio Turnpike had service plazas, but the other Interstates had rest areas with simple bathrooms, picnic tables, and parking areas. The pre-1961 rest areas have been significantly upgraded and original facilities replaced with buildings and parking areas meeting modern requirements.


\(^{50}\) Ibid., Sections I-305, I-405. The W-shaped beam guide rail dates to the 1920s and was heavily promoted by the steel industry during the 1930s. It had become standard by the 1940s and is still widely used.

In 1957, Ohio Department of Highways Director Charles M. Noble commented that the first order of landscaping business on Interstate highways was “to get grass on them, or some other cover, to prevent erosion.” Ground cover, standard shallow slope ratios, and drainage systems to control run-off were the main landscaping features of the early Interstate highways. From the system’s inception, Ohio’s engineers expressed the opinion that Interstates were not parkways, where scenic vistas and naturalistic landscaping should co-exist in harmony with the highway. They worried that vegetation would block drivers’ sight lines, and that trees planted too closely to the roadway would become deadly fixed objects that motorists might hit if they happened to leave the road. Nationally, roadside beautification did not begin to pick up momentum until the completion of significant sections of Interstate and the resulting reaction against long monotonous stretches of highway often cluttered by billboards. The landmark event in this regard was passage of the federal Highway Beautification Act of 1965. The legislation, advocated by Lady Bird Johnson, promoted the removal of billboards within 660’ of an Interstate right of way by threatening states that did not comply with loss of ten percent of their federal aid. The law also included provisions for screening or removing junkyards and limited funds for scenic enhancements, but these appropriations were quite small at first and did not increase significantly until the 1970s.

The Role of Bridges in Ohio’s Interstate System

Ohio’s Interstate system bridges are best understood as mostly standardized components that facilitate limited access, elimination of all grade crossings, and traffic movements at interchanges, in addition to their common role of carrying traffic over natural and manmade barriers. Bridges play a collective role in defining the character of Ohio’s Interstate system. It is the unvarying and repetitive application of the uniform design policy to bridges and use of a limited selection of bridge types – mostly continuous steel stringer and reinforced concrete slab – that reflected Ohio’s Interstate engineering from the beginning to the end of construction. It is the large number of bridges required to maintain the system’s high standards that is most conspicuous. In Ohio, there are an average of twenty-four bridges for every ten route miles of Interstate.

Bridges that carry Interstates over streams or manmade features, such as other highways or railroads, reflect without variance balanced design for safe, high-speed travel. The bridges are matched to the lane and shoulder widths of the travel ways so that they do not “pinch down.” Bridges are frequently paired (a separate structure for

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54 NBIS Data, 2001.
each direction of traffic) thus maintaining uniform median widths. Interstate bridges are designed to fit the alignment and profile of the highway, rather than fitting the highway to the alignment of the bridge (the latter was the practice in early road building where bridges often met streams at right angles to achieve the shortest crossing). Interstate bridges are often skewed and given a vertical or horizontal curvature to conform to the overall highway alignment and grade, and thus match the design speed. All of these factors are intended to increase the safety of the highway and increase drivers’ confidence in the roadway. In most cases, the bridges fit so seamlessly with the highway, that except for railings, motorists have no idea that they have crossed a bridge.

![Figure 6: Typical welded girder overpass, IR 71 over IR 76, Medina County (SFN 5202914), built in 1959. Source: Lichtenstein Consulting Engineers, 2003.](image)

Interstate planners in all states had several options when a local road crossed the right of way of an Interstate. The first option was to terminate (make a dead end) the local road. A second option was to detour the local road onto a frontage road that fed it to the nearest over or underpass. The third option was to build a grade separation structure. A high percentage of Interstate bridges in Ohio are overpasses that carry local streets and county highways over an Interstate. In most instances, if grades allowed, an overpass to carry the local road over the Interstate was a less expensive solution than higher capacity bridges to carry the Interstate highway over the local road. A minimum of 14.5’ vertical clearance was required for overpasses in Ohio. Interstate highways typically pass over railroads because of the difficulties and costs associated with changing railroad grades.

Traffic enters and leaves Interstates at interchanges spaced out at intervals along the route, usually where it intersects a primary state highway, local collector road, or another Interstate route. Nationally, most of the pioneering work in interchange design was done in the 1920s and 1930s, with early examples of interchange types, such as the cloverleaf and the diamond, worked out by highway engineers designing urban parkways and expressways. The idea behind an interchange is simple – achieving turning movements while minimizing the cross over of conflicting directions of traffic. The interchange achieves this by use of ramps and bridges. As design speeds increased, highway engineers also adopted acceleration and deceleration lanes as part of interchange design. The acceleration lane permits motorists to pick up speed before merging with through traffic. The deceleration lane is for motorists to exit the main stream of traffic and slow down for a turning movement at an interchange. Standard widths, grades, and curvatures also governed the details of ramps, acceleration lanes,
and deceleration lanes, and these were first specified by the Ohio Department of Highways in its *Manual of Location and Design, Interstate Projects* in 1957.

Bridges are integral to interchange design. An interchange is defined by a system of interconnecting roadways in conjunction with at least one grade separation. The most common type of Interstate interchange in Ohio and most states is the conventional diamond where a single bridge spans the main stem of the Interstate route and ramps are placed at its quadrants. The diamond interchange is the simplest type formed by one-way diagonal ramps in each quadrant and at grade intersections at the minor crossroad. The cloverleaf is an interchange with loop ramps and outer ramps at the quadrants. They may be partial (three or less loop ramps) or full (four loop ramps). Cloverleaf interchanges are usually provided at interchanges where a high percentage of left turns are involved or development prohibits construction in one of the quadrants.

Interchange design became more complex at the junction of two or more Interstates, or in urban settings because of high traffic volumes, dense land-use, closely-spaced interchanges, and numerous pre-existing adjacent surface streets and other transportation facilities, such as railroads. These type of interchanges usually required considerable advance planning and individualized solutions with numerous ramps, elevated or depressed sections, and bridges. In cases where it is desirable to have direct connections for all movement, a “directional” interchange with more than one grade separation was built. Directional interchanges are the highest type and most expensive, but they do permit vehicles to move from one highway to another at relatively fast and safe speeds. One such pre-1961 interchange is the “Willow-Inner Belt Interchange” at the north end of the Central Viaduct in Cleveland where modern routes IR 77, IR 90, and surface streets meet. Planned in 1956, the final interchange design required twelve grade-separation bridges.\(^{55}\)

In Ohio, the role of a bridge on the Interstate system had very little impact on the selection of bridge type. The vast majority of bridges are standard continuous steel stringer or reinforced concrete slab bridges (see Historic Context for Bridge-Building Technology). The standard bridge drawings used on Ohio’s Interstate system were the same as those used on all of the state’s primary highways and secondary roads. No distinction was made except to allow the project engineers to adapt the standard drawings to fit the loads, widths, and geometrics, such as the lane widths and shoulders, required on Interstate highways. Here, once again, it was the uniform design policy for balanced design that governed.

\(^{55}\) Ohio Department of Highways and the City of Cleveland, “Cleveland Inner Belt Freeway, Preliminary Designs, Fairfield Avenue to East 22nd Street,” April 1956.
History of Alterations

Ohio’s Interstate system is an active highway system. No original mileage in Ohio has been taken out of service, except for brief periods of maintenance and improvement, since opening to traffic. As a result, nowhere can one find a “pristine” section that looks exactly as it did when built. Naturally, given the heavy and constant use, and advances in safety and design of roadside appliances, Ohio’s comprehensive Interstate system has been upgraded and improved. Perhaps the most important change has been the need to accommodate ever-increasing volumes and weights of traffic using the system; by one estimate, it now carries thirty times the truck volume and six times the weight it was projected to handle in 1956. As of 2000, more than 1,300 lane miles have been added to the system through widening of the roadways. Nearly all, if not all, of the pavements over thirty years old have been reconditioned or replaced. The uniform design policy has evolved with periodic revisions at the federal and state levels to address specific areas of concern, particularly addressing capacity and safety.56

Alterations to the Ohio’s Interstate system generally fall into one of four categories: (1) roadway widening for greater capacity of traffic volume; (2) pavement reconditioning or replacement; (3) additional interchanges or improvement of existing interchanges; and (4) safety improvements, like safety-shape barriers. Each of these has had an impact on the aspects of integrity of the system and its bridges.

Between 1980 and 2000, an estimated 1,300 lane miles have been added to Ohio’s Interstate system. Over twenty percent of the Interstate route miles have been widened. State planners use traffic data (ADT) to help decide which sections to widen, thus the majority of widening projects have occurred on the most heavily traveled sections of Interstate, especially those in urban and suburban settings.57 Examples of

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57 ODOT, Office of Technical Services, Mileage Report, June 2002. The exact lane mileage additions have not been calculated but are estimated based on comparisons of original center-line route mileage and current lane miles.
widening projects are the progressive widening from four to six lanes of IR 71 north of Columbus in Franklin and Delaware counties or of IR 70 in Licking County, etc. The additional lanes have usually been taken from the medians or outside the exterior shoulders, or a combination of both, resulting in significant changes to the median treatments and geometrics. Widening has had a significant impact on the integrity of bridges that carry Interstate roadways since to maintain balanced design they must also be widened, usually entailing extensions to both sides of the original bridge and replacement deck and railings/barriers. Approximately twenty percent of the pre-1961 Interstate-carrying bridges in the inventory have been widened.

It is unlikely that any pavements over thirty years old remain unimproved on Ohio’s Interstates. A review of ODOT records identified no sections that did not have a history of improvement.58

The most common improvement is known as “reconditioning” where the original pavements have been milled and resurfaced by a process which grinds off a few inches of material and replaces it with new material. In many cases, sections have been reconditioned repeatedly. Thus, what remains of the original pavement is often buried underneath several or more inches of newer paving material. Reconditioning projects do not usually result in significant alterations to the geometrics as lane widths are maintained. Major pavement reconstruction (i.e., complete pavement replacement down to the subbase) is less common; it is estimated that only about ten percent of Ohio’s original Interstate mileage has had major pavement reconstruction, although the percentage is rapidly increasing.59

Figure 10: Rural sections of IR 71 in Medina and Ashland counties illustrate typical before (top) and after (bottom) views of reconditioned and widened highways. Note the widened and surfaced shoulders, safety-shape barriers on the bridges, and narrower median in the later bottom view that have changed the design, materials, and character of the highway. Source: Lichtenstein Consulting Engineers, 2003.

58 ODOT, Office of Technical Services, Straight-Line Diagrams.

Modern national Interstate design standards are applied to sections of Interstate that are widened or have major pavement reconstruction. Lane widths are still 12', but design speeds have increased slightly from the 50 to 70 mph range of the original 1956 uniform design policy to the 65 to 75 mph range. This change has been in effect since 1990. Exceptions are made for a minimum design speed of 50 mph in urban settings where additional right of way costs would be prohibitive, and the legal speed is 50 mph. In reconstructed sections with higher design speeds, curvature and super-elevation have been adjusted accordingly. Nationally and in Ohio, minimum shoulder exterior widths of 10' are still required, but higher standards are used over much of Ohio's system. Most shoulders have been upgraded from the original standard bituminous surface treatment to paved surfaces wide enough and strong enough to accommodate temporary traffic. In rural areas, a treated shoulder width of 12', instead of the original 10' treated and 12' graded, is now preferred in Ohio, especially in areas of heavy truck traffic. Under some conditions, such as sections of roadway with barriers adjacent the shoulders or steep foreslopes, 15'-wide graded shoulder widths are now required.

Another common area of change has been the addition and improvement of interchanges. The addition of interchanges began relatively early and continues to this day. Usually, new interchanges have been a response to suburban growth, commercial development, or other improvements such as a new airport or construction of a new state or county highway. A typical example is the Mall Road Interchange on IR 70 in Belmont County, built in 1978 in direct response to the construction of the shopping mall. Improvements to existing interchanges

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60 ODOT, Location and Design Manual 1990, as revised 2002.
interchanges have also been ongoing, most often to improve their efficiency and capacity. Typical improvements have included widening of overpass bridges and the addition of lanes and traffic-control devices at the top of ramps to handle increased traffic volumes. ODOT design guidelines now cover such items as multi-lane entrance and exit ramps that were uncommon in the early years of the system. Ohio’s *Manual of Location and Design Interstate Projects*, published in 1957, called for 1,200'-long acceleration and deceleration ramps, and these lengths have generally proved adequate and have not been lengthened.

Safety features have been a significant area of evolving and widespread changes to the Interstates in Ohio and nationally. Prior to the mid-1960s, lights and signs were placed on rigid posts and supports. These eventually proved hazardous when struck by motor vehicles. Federal engineers supported research into several collapsible post designs that proved quite successful in tests and were eventually recommended on the system. In response, the Ohio Department of Highways began a wholesale Interstate lighting and signing upgrade project beginning in the early 1970s. Most, if not all, of the original lights and signs were removed. Attenuators (crash cushions) are another safety feature that began to appear in the 1970s and are a common non-original component found today at bridge piers and at the ends of barriers.⁶¹

Changes in railing and barrier design have had the greatest impact on bridges. The original, state standard railing found on Ohio’s Interstate bridges is based on Standard Drawing AR-1-57. The railing is a 2'-8" to 3'-high, reinforced-concrete parapet with tubular aluminum hand rail. The railing is set atop a concrete curb or safety walk. The tubular hand rail can be one- or two-rail high, with the two-rail used with a minimum 3' wide safety walk. These railings have been systematically replaced since the early 1980s, so that today few examples are found on the pre-1961 bridges that carry the main Interstate travel ways; they are still found frequently on overpasses. The replacement railing of choice in Ohio has been the “Jersey barrier” railing or safety-shape barrier, developed in New Jersey during the late 1950s as a median barrier to prevent head-on collisions. The safety-shape barriers, found not only on bridges but protecting the bent columns of overpass bridges, have a sloped base that on impact will turn the car away from the barrier before full impact. About fifty percent of the pre-1961 Interstate bridges in the study population have replacement railings/barriers.

The appearance of the approaches to the state’s Interstate bridges has also changed greatly in the last decade with improvements in guide rail design. Guide rails at bridges and elsewhere have been retrofitted with support posts that allow the rail to give way when struck, but not to break, thereby deflecting the car back onto the highway. The

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ends of the rails have also been turned down and buried to prevent the railing from piercing motor vehicles.\textsuperscript{62}

The national concept of a “clear zone,” an area along the highway and beyond the edge of the pavement where an errant vehicle will not encounter inherently unrecoverable conditions, has had an impact on the character of the state’s Interstate roadsides and original earthwork. During major reconstruction and widening projects, roadside areas are checked that they have safety grading (6:1 or flatter slopes within the clear zone area and 3:1 or flatter slopes and recoverable ditches extending beyond the clear zone). This has not had a direct impact on Ohio’s Interstate bridges, but it has changed adjacent slopes and resulted in the placement of barriers near bridges where slopes are typically steeper.

**Summary**

Ohio’s pre-1961 Interstate bridges are standardized components in a comprehensive system that was planned in the 1950s and built with staged construction over more than forty years, reaching construction of the last of the originally proposed sections in the early 1990s. Basically, the same bridge types and uniform design policies were applied to the bridges throughout most of the comprehensive system’s construction history. From its outset, the state’s Interstate system was built using a uniform design policy. This policy followed national AASHO guidelines supplemented by the high standards established by the Ohio Department of Highways. The principles behind that policy – design speeds, ruling grades, adequate sight distances, constant lane widths, limited access, grade separations – continue to be used. In some cases, such as lane width, the guidelines have not changed, but in other cases, such as design speeds and multilane ramps, they have been modified for modern traffic conditions. Numerous safety features have been changed since the early days, including guide rails, signing, lighting, usable shoulders, clear zones, median barriers, and attenuaters. Pavements have been reconditioned or replaced. Over twenty percent of the route mileage as originally constructed has been widened. The system has lost a high percentage of its original fabric. A very high percentage of the original bridges remain in use, but about twenty percent have been widened and fifty percent have replacement railings/barriers. Despite these changes, complete, unaltered examples of standard continuous steel stringer and reinforced concrete slab Interstate bridges built before 1961 are not uncommon with ± 300 complete examples identified.

**Summary of Methodology Used for Evaluating the Significance of Ohio’s Interstate Highways and Their Bridges**

The study population for ODOT’s Historic Bridge Inventory Update of bridges built from 1951 to 1960 includes over 680 bridges that carry or cross over Interstate highways. To evaluate the significance of the bridges with Interstate highway associations, the

\textsuperscript{62} Seely, 2000, pp. 15-16.
The scope of work included preparation of historic contexts that addressed the history and significance of Ohio’s comprehensive Interstate highway system and the mostly standardized bridge types and designs used in its construction. The National Register criteria for evaluation were applied to the whole system and its individual components through the development of “Criteria for Determining Significance and Thresholds of Integrity for Pre-1961 Interstate Bridges.” In addition, the highways and their bridges were studied collectively through the development of a database and reconnaissance-level field survey of pre-1961 sections of Interstate highway and bridges throughout the state.

These contexts, criteria for determining significance and thresholds of integrity, and data gathered over the course of Phases 1 and 2 of the historic bridge project were presented and discussed over a series of meetings (6/18/2002, 12/18/2002, 10/22/2003) of representatives of the consulting team, ODOT, FHWA, and the Ohio State Historic Preservation Office. As a result, the three agencies agreed that Ohio’s comprehensive Interstate highway system represented an engineering and political achievement, but Ohio’s Interstate highway system as a whole, and individual examples of its standardized components such as standard steel stringer bridges, reinforced concrete slab bridges, and culverts, do not meet the National Register criteria for eligibility.

Phase 1

The eligibility of each 1951-1960, Interstate highway bridge was assessed using the standards for significance and integrity as enumerated in the National Register of Historic Places criteria for evaluation (30 CFR 60.4). Under the criteria, to qualify for the National Register a bridge must have both significance and integrity. Significance means that a resource must represent a significant part of the history, architecture, archeology, engineering, or culture of an area. Significance is evaluated within historic contexts, which are studies which place an event, occurrence, property, or site within a larger framework, providing it meaning. Historic contexts assist with understanding what aspects of associative and technological history are significant. The bridge technology context defines what features make each bridge type significant for its technology and engineering, and which features are ubiquitous and thus not significant. It also defines what are rare, uncommon, and common details. The application of the National Register criteria and aspects of integrity to Ohio’s Interstate highway bridge population is further elaborated in “Criteria for Determining Significance and Thresholds of Integrity for Pre-1961 Interstate Highway Bridges in Ohio.” Please refer to that document for further information.

Two historic contexts were researched and prepared to address the issues that must be considered when assessing eligibility of highway systems and their related bridges. They provided a clear understanding of the role and significance of federal and state policy in advancing road and bridge construction in the post-World War II era. The bridge-building technology context assessed the history of bridge engineering and
bridge design during the period, and the transportation context considered the historical development of Ohio’s highways and the role and influence of the state highway department from 1951 to 1960. Both contexts included sections with an emphasis on understanding the significance of the Interstate highway system and its bridges. Dr. Bruce Seely of Michigan Technological University, a nationally recognized scholar on the history of America’s Interstate highways, assisted with the preparation and review of the contexts. He was the primary author of the first half of the “Historic Transportation Context for Ohio’s Highway Bridges, 1951-60,” and he also presented and facilitated discussion at the Dec. 18, 2002 meeting of the historic bridge committee.

The contexts were supported by the MS-Access 2000 historic bridge database (filename: OHBridge.mdb) that includes data and linked photos for all pre-1961 bridges carrying or crossing over Interstate highways. This data was analyzed to determine which types and designs of bridges were used on Ohio’s pre-1961 Interstate highways and to assess the population’s aspects of integrity. As a result of this data, it was determined that a no more than a half dozen standard bridge types and designs were used in the development of Ohio’s Interstate highway system and that complete examples of the standardized bridges were still common.

As the result of the Phase 1 draft contexts, criteria for determining significance and thresholds of integrity, and database analysis, the historic bridge committee agreed at its Dec. 18, 2002 meeting to carry all of the bridges associated with Ohio’s Interstate highways into Phase 2 for further research to determine if they meet the National Register criteria for evaluation. Phase 1 research supported the conclusion that the excluded types of 1951-60 Interstate bridges did not meet Criteria B or D. The considerations associated with the eligibility of the bridges under Criteria A and C, however, were complex and required further analysis.

Phase 2

To facilitate ODOT, FHWA, and OSHPO participation in considering the issues and evaluating the historical data that is particular to the development of the comprehensive Interstate highway system and its bridges in Ohio, the Lichtenstein consulting team conducted a workshop on October 22, 2003.

Bruce Seely presented an historical overview of Interstate highway development nationally and in Ohio. This was followed by a presentation based on field conditions and a reconnaissance-level survey of pre-1961 sections of Interstate highway throughout the state. Common alterations were illustrated included those related to reconditioned pavements, widened travelways, improved or added interchanges and ramps, replaced roadway materials and fabric, shoulder improvements, widened bridges, bridges with replaced railings, roadside appliances, and rest areas. A series of discussion and decision points considered whether the Interstate highway system and its pre-1961 components meet the regulatory definition of a National Register property. National Register guidance and definitions were applied.
The workshop participants, including representatives of ODOT, FHWA, and OSHPO, came to agreement that Ohio’s comprehensive Interstate highway system was planned and executed in a way that emphasized standardization and development of the system over any one component part. Development of the system began in the early 1950s, most of the links in the system were complete by the mid 1970s, the final pieces of the system were not completed until the early 1990s, but the system has continued to evolve to meet modern traffic conditions. Clearly, Ohio’s Interstate highways were highly standardized and composed of materials with definite life cycles. The system was meant to evolve and its parts to be replaced over time as they wore out or their capacity was exceeded. The committee came to the conclusion that Ohio’s Interstate highway system possesses little integrity. It is not the kind of property envisioned when the National Register was created nor does the National Register guidance easily accommodate such a resource. Furthermore, the group agreed that the majority of Ohio’s Interstate highway sections are less than 50 years old and the system does not rise to the category of exceptional importance and preservation worthiness as stated under Criterion Consideration G. For these reasons, ODOT, FHWA, and OSHPO agreed that the comprehensive Interstate highway system in Ohio does not meet any of the National Register criteria. The pre-1961 excluded bridge types carrying or crossing Ohio’s Interstate highways have been evaluated not eligible.
Ohio Department of Transportation
Ohio Historic Bridge Inventory

Bridge Building Technology in Ohio
1951-1960
Executive Summary

The Historic Context for Bridge Building Technology in Ohio, 1951-60, was developed as part of the 2002-04 ODOT Historic Bridge Inventory Update. The purpose of the project was to complete the update of Ohio's ongoing historic bridge inventory for bridges built from 1951 to 1960 by identifying which of those bridges of non-excluded types or Interstate highway associations meet the National Register criteria for evaluation. As such, this context builds upon the important scholarship and work that ODOT, the Ohio SHPO, FHWA, and others have sponsored and conducted on the state's historic bridges for more than 20 years. This context was one of two contexts prepared for the update project; the other context dealt with the development of Ohio's Interstate highway system in the 1950s. Please see that report for further details.

The historic context for bridge building technology assesses the history of bridge engineering and bridge design during the period, considering the role and influence of the Ohio Department of Highways, county and municipal bridge builders, and the private bridge-building industry from 1951 to 1960. The context addresses the issues that must be considered when assessing the eligibility of bridges, and it provides a clear understanding of the role and significance of federal and state policy in advancing road and bridge construction in the post-World War II era. Of particular significance to this context has been the introduction and development of prestressed concrete, an important new material that was first applied to bridge construction in Ohio and the nation during the 1950s.

An important source of information about bridge development and design, especially the 1950s, is the oral tradition. State and county bridge engineers, consulting engineers, and private contractors provided significant insights and background history that contributed significantly to the value and completeness of this context. Additional information was located in the ODOT library, bridge inspection files, period engineering journals, collections of the Ohio Historical Society, county engineering offices, and local libraries.

The project was conducted over two phases. During the first phase, the technology and transportation contexts were researched and produced in draft form for the purposes of aiding the evaluation process and informing decisions about bridge eligibility. The contexts helped to define, within the study population of more than 1,200 bridges of non-excluded types or with associations to Ohio's pre-1961 Interstate highways, which bridges were clearly not historically or technologically significant, and therefore not eligible, and which required further research to reach an eligibility recommendation. Each of the bridges in the study population was reviewed using state and county bridge inspection records. Throughout the project, basic information about the bridges and supportable justifications for eligibility recommendations were compiled in a searchable database with scanned, appended photos when available.
During Phase 1, criteria for determining significance and thresholds of integrity for non-excluded and interstate bridges were prepared, discussed, and agreed to by the historic bridge committee. The eligibility of each 1951-1960 bridge was individually assessed using the standards for significance and integrity as enumerated in the National Register of Historic Places criteria for evaluation (30 CFR 60.4). Under the criteria, to qualify for the National Register a bridge must have both significance and integrity. Significance means that a resource must represent a significant part of the history, architecture, archeology, engineering, or culture of an area. Significance is evaluated within historic contexts, which are studies which place an event, occurrence, property, or site within a larger framework, providing it meaning. The historic contexts were designed to assist with understanding what aspects of associative and technological history are significant. The bridge technology context in combination with the criteria for determining significance define what features make each bridge type significant for its technology and engineering, and which features are ubiquitous and thus not significant.

As a result of the Phase 1 effort, eighty (80) bridges were identified as requiring further research and field inspection during Phase 2. A meeting held at the end of Phase 1 among representatives of ODOT, Ohio SHPO, and FHWA reached concurrence on the recommendations of not eligible and further research for the non-excluded bridge types.

During Phase 2, the historic context for bridge building technology was further refined based on research and field work specific to those bridges requiring further research. Each bridge was field inspected, photographed, and researched. The draft survey forms were updated and the two contexts revised to reflect important examples.

A total of 13 bridges have been recommended and agreed to as eligible representing historically and/or technologically significant examples of highway bridges built in Ohio from 1951 to 1960. A list of the eligible bridges is included with this document (Table 9). Further in-depth discussion of each of the eligible and not eligible bridges included in the inventory update are available electronically through the database, and as hard-copy survey forms/reports printed from the database. The survey forms for the eligible bridges are attached as Appendix A of this report.
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Bridge Building Technology in Ohio, 1951-1960

Ohio’s highway bridges built between 1951 and 1960 reflect national trends that were marked more by the continued use of standardized bridge types than by use of new or innovative designs. Bridge engineers of the Ohio Department of Highways exercised a conservative approach to bridge type selection, relying heavily on steel stringer and reinforced concrete slab bridge types. Standard drawings, specifications, and materials helped the Department to achieve economy, to overcome problems of engineering manpower shortages, and to meet the demands of improving the state’s highway systems, including construction of the Interstate highways. The state bridge standards incorporated national guidelines developed by the federal Bureau of Public Roads (BPR), the American Association of State Highway Officials (AASHO, now AASHTO), and the suppliers of steel and concrete. As a result, thousands of highway bridges from this period across Ohio, and, indeed, across the nation from Maine to California, were outwardly indistinguishable from one another.

Ohio’s counties and municipalities built a greater variety of bridge types overall than did the Ohio Department of Highways. Ohio’s county and municipal engineers also relied heavily on steel stringer and reinforced concrete slab bridges, but also built most of the non-excluded bridge types, such as pony truss, steel thru arch, and prestressed concrete bridges. This is reflected in the study population – county and municipal-owned bridges account for 440 of 459 (96 percent) of the bridges of non-excluded type dated from 1951 to 1960. Many counties favored the continued use of traditional truss bridge technology, albeit with mid-20th-century details like welded connections and rolled section members. A few other counties demonstrated an interest in emerging technology, particularly prestressed concrete bridge applications introduced nationally during the 1950s. Although the Ohio Department of Highways undertook a modest trial program of prestressed concrete bridges, it was the counties that built most of the pre-1961 prestressed concrete bridges in the study population. Those bridges reflect a collaborative effort of county engineers and Ohio’s burgeoning prestressed concrete industry.

Bridge Types Found on Ohio’s Interstate Highway System

The pre-1961 bridges on Ohio’s Interstate highway system are, with few exceptions, steel stringer or reinforced concrete slab bridges. All bridges on the system were built by the Ohio Department of Highways, with the exclusion of the bridges on the Ohio

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1 The non-excluded bridge types are steel truss, steel and reinforced concrete arch, timber slab and stringer, prestressed concrete box beam and stringer, and movable bridges. In comparison to the 467 non-excluded bridges dated from 1951 to 1960, there are 4,579 excluded bridges dated from 1951 to 1960. The majority of the excluded bridges are steel stringer and reinforced concrete slab bridges. Source: National Bridge Inspection (NBI) database, 2001.
It is worth noting that the bridges on the Ohio Turnpike, completed in 1956, are similar to those on the other Ohio Interstate routes. Strictly speaking, the turnpike was the first cross-state route of interstate character completed in Ohio. Most of the other routes were staged construction not officially "complete" until the 1970s or 1980s. All structures on the turnpike, although designed by consulting engineers, were built in compliance with the Ohio Department of Highways "Construction and Materials Specifications" (1946) and "Specifications for Design of Highway Structures" (1951). The turnpike's chief engineer was Theodore J. Kauer, previously Director of the Ohio Department of Highways. He promoted the turnpike's use of the design standards then current in the Department. According to his final report, "... no rigid policy was established to control selection of structural types. However, in general, for grade separation structures preference was given to continuous rolled steel beam spans with spill-through type abutments." It is not a coincidence that the same policy was applied by the Ohio Department of Highways to the other Interstate routes. Theodore J. Kauer, An Engineering Report of the Planning and Construction of the Ohio Turnpike, Project No. 1, Engineering Monograph Series (Columbus: Ohio State University), 1956, p. 74.

Of the 688 inventoried pre-1961 Interstate bridges (defined as either carrying or crossing), 522 are steel stringer bridges, and 120 are reinforced concrete slab bridges. An additional 29 bridges are box culverts or pipe culverts, measuring more than 20' long, and thus included in the inventory based on their type and length, which meets the definition of a bridge. The remaining 17 bridges represent a variety of other bridge types commonly in use in the mid 20th century including steel deck truss, reinforced concrete rigid frame, reinforced concrete tee beam, steel girder-floorbeam, bascule, and steel thru arch (Table 1).

<table>
<thead>
<tr>
<th>Bridge Type</th>
<th>Total No. of Pre-1961 Examples on Ohio's Interstate Highway System</th>
</tr>
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<tbody>
<tr>
<td>Steel Stringer</td>
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<tr>
<td>Reinforced Concrete Slab</td>
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<td>Culvert (over 20' long)</td>
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<tr>
<td>R. C. Rigid Frame</td>
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<tr>
<td>R. C. Tee Beam</td>
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<td>Steel Deck Truss</td>
<td>3</td>
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<tr>
<td>Steel Girder-Floorbeam</td>
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<td>Bascule</td>
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<tr>
<td>Steel Thru Arch</td>
<td>1</td>
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Table 1: Pre-1961 Bridge Types on Ohio’s Interstate Highway System. Source: NBIS database, 2001. There were no identified pre-1961 prestressed concrete bridges on Ohio’s Interstate highways.
Steel Stringer Bridges

The steel stringer bridge type (also known as multi-beam or girder) is a series of parallel longitudinal steel beams supporting a deck, usually of reinforced concrete (Figure 1). Since the steel stringer bridge type had a long history of use prior to the 1950s and the Interstate system, some background history on its technological development is required.

![Figure 1: Cross section of typical steel stringer bridge. Source: Lichtenstein, 2003.](image)

The principle behind the stringer type is ancient, dating to time immemorial when felled trees were laid across streams. A stringer bridge relies on the bending strength of the beam to resist loads whether the material is wood or metal. From the 1890s to 1910s, successive innovations allowed steel mills to roll longer and deeper beams. By 1920, most of the major hurdles in producing wide-flange steel beams of up to 36" depth and 60' long had been overcome. Prices for the rolled beams fell through the following years, increasing competitiveness with other materials such as wood, reinforced concrete or built-up steel beams (see below). The beams were a boon to bridge builders and proved ideally suited for the highway-building campaigns of the 20th century. Rubber-tired trucks and improved heavy-construction equipment eased the problems of transporting beams and on-site erection. With primarily accessible flat surfaces, stringer bridges were easier to clean and paint than trusses. They also did not require the labor, form work, and curing time of cast-in-place reinforced concrete bridge types, like tee beams or closed-spandrel arches. The rolled steel stringer bridges also had the advantage of being easy to widen, and the beams could be salvaged and reused if a bridge were replaced.  

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3 J. A. L. Waddell, *Bridge Engineering*, Vol. 1 (New York, 1916), pp. 410-411, 463-64. Waddell, one of America’s leading bridge engineers, wrote that the rolled beams were quickly becoming an important bridge-building material because of the above listed advantages.

A brief review of the 2001 NBIS database shows just how dominate the steel stringer bridge type was in Ohio. The state has 5,580 steel stringer bridges dated from 1900 to 1960. They account for approximately 41 percent of the state’s total pre-1961 bridge population of 13,608 bridges. A high
Since the mid-19th century, when bridge builders wanted beams of greater depth than the available rolled sections, they have turned to built-up beams. Beam depth is determined by the length of span, beam spacing, and design load – the longer the span, wider the spacing between the beams, and/or the heavier the load, the deeper the required beam. The technique of building up beams by riveting plates, angles, and channels had been used by the railroads prior to the Civil War, and riveting was the most common method of building up beams through the first half of the 20th century. With improvements in arc-welding, engineers turned to shop-welded, built-up beams, especially after World War II. These beams, in depths sometimes exceeding 60", became increasingly popular in the 1950s, particularly with the availability of structural steel alloys developed specially for welding. By the early 1950s, state engineers were making expanded use of welded built-up beams citing material and fabrication savings over riveted built-up beams.4

The steel stringer bridge type, whether using rolled beams, riveted built-up beams, or welded built-up beams was the workhorse for the development of the Interstate highway system in Ohio: 76 percent (522 of 688) pre-1961 bridges on the Interstate system are steel stringer bridges (Figure 2).

4 James G. Clark, ed. Comparative Bridge Designs (Cleveland: James F. Lincoln Arc Welding Foundation, 1954), pp. 24-40. Organizations like the Lincoln Arc Welding Foundation in Cleveland actively promoted the use of welding in steel construction. This was done between 1949 and 1952 through a series of competitions. The award winning 1952 entry was by Kiser E. Dumbauld, one of the primary designers in the Bridge Bureau of the Ohio Department of Highways. The eight-span, continuous steel stringer bridge with haunched beams was an archetypal state design of the period. The article stated the bridge was placed under construction in 1952, but did not specify its location. The bridge is not in the Interstate bridge population and no bridge matching this description was identified in the historic bridge database. This could mean either the bridge has been replaced or it is an excluded bridge type that is not on the Interstate system.

Figure 2: Typical steel stringer bridge with built-up welded beams on Ohio’s Interstate highways. IR 71 over IR 76, Medina County. Source: Lichtenstein, 2003.

The viability of welded connections, particularly butt splices, was a matter of some concern during the 1950s, and not all states made as extensive a use of welded beams or splices as did Ohio. Convenient procedures for inspecting welds, in the shop but particularly in the field, and methods of repairing defective welds were frequent topics at engineering meetings. Radiography was the preferred test method of the Bureau of Public Roads (BPR), but the awkwardness and expense of using it in the field made it unattractive to states. When, in 1963, the BPR required the testing of all welds with radiography, it forced states, including Ohio, to eliminate field welding of beam splices and substitute high-strength bolts. “Bridge Engineers,” Mississippi Valley Conference of State Highway Departments, Forty-Sixth Annual Meeting (Chicago, 1955), p. 43; David Hanhilammi, “Jointless Bridges, the Ohio Experience,” no date, typescript in files of David A. Simmons, pp. 5-6.
By the time Interstate highway construction began in earnest in the mid 1950s, the bridge type had demonstrated its many proven advantages: it was easily standardized; it made use of readily available steel from mills in Ohio and neighboring states; and it had a record of economy, ease of erection, and low maintenance costs compared to trusses.

The multi-span steel stringer bridges on the Interstate highway system in Ohio are almost always continuous designs. Continuous designs are those where the beams continue uninterrupted over one or more piers. These bridges have significant economic advantages because they use less material for a given span length than simple (non-continuous) spans. By spanning greater lengths with smaller section beams than comparable simply supported spans, which must accommodate the entire load within each individual span, the continuous spans distribute loads from bearing to bearing over two or more spans. The reinforced concrete deck is also continuous, thus reducing the number of expansion joints, whose failure is a primary source of bridge deterioration. Simple spans require expansion joints at the ends of each span.

The Ohio Department of Highways built its first continuous steel stringer bridge in 1931. Many other state highway departments adopted continuous designs in the 1930s, particularly in light of the need for Depression-era cost savings and the desire to eliminate deck joints, but also in response to advanced research that solved many of the difficulties associated with accurately computing stresses for indeterminate continuous structures. The continuous designs proved so successful that Ohio’s state bridge bureau issued standard continuous steel stringer bridge drawings in 1939 (Standard Drawing # CSB-12-39). At the 1949 Ohio Highway Engineering Conference, Glenn R. Logue, a bridge engineer with the Ohio Department of Highways, highlighted the many continuous steel stringer bridges erected by the state during the previous decade. The number of continuous steel stringer bridges built on state highways in Ohio was close to three hundred by 1950.

During the 1950s, the Department periodically updated its standard drawings for continuous steel stringer bridges. The original 1939 plans had been for 25’ to 55’-long spans and 24’-wide roadways. The 1939 standards also called for riveted splice plates to make the beams continuous, but the 1950 standard drawings (No. CSB-4-50) allowed for welded splices. The updated drawings applied the design to a greater

5 ODOT, “Background of Continuous Steel Bridges in Ohio.” Memorandum. Feb. 8, 2001. In the notebook titled, “Continuous Steel Beam and Continuous Deck Girder Saga.” The first continuous steel stringer bridge was in Adams County (SFN 0101834). That bridge has been replaced.

6 Proceedings of the Ohio Highway Engineering Conference 1949 (Columbus: Ohio State University), 1949. See Ohio Department of Transportation (ODOT), “Second Ohio Historic Bridge Inventory, Evaluation and Preservation Plan” (1990) for a discussion of the history of the continuous steel stringer design during the 1930s. As a result of this inventory, seven prototypical continuous steel stringer bridges from 1931-36 were added to the select group.
variety of lengths, widths, loadings, and roadway geometrics, such as skew and superelevation. For example, the continuous steel stringer standard drawings prepared in 1955 (No. CSB-1-55) covered center span lengths of 30' to 80', roadway widths of 24' to 44', and live-load frequencies of from 30 to 2,000 heavy vehicles (a standard semi-truck) per lane per day. For convenience, the drawings showed a three-span bridge with the chosen center-span length and live load governing the beam selection and the end-span lengths, which were to be four-fifths the length of the center span. Plans noted that “additional interior spans, similar to the middle span, may be incorporated into the structure without change in the size of beams ...”, thus providing engineers the flexibility to design multiple span bridges based on site conditions and the desired overall length of bridge. Most of the continuous steel stringer overpass bridges for the state’s Interstate highways were four or five spans. Often, the overpass piers had ample setbacks from the shoulders for safety and allowed space in the grass medians for future lane widening.\(^7\)

The Ohio State Highway Department’s standard continuous steel stringer bridges had non-composite, reinforced-concrete decks. Non-composite construction is the traditional way of placing the reinforced-concrete deck on the top flanges of the beams. A composite deck is made by use of shear connections, usually studs set in the top flange of the steel stringers and embedded in the deck. The deck is thus mechanically attached to the steel beams and made to contribute to the load-resisting capacity of the superstructure. A composite deck increases the live-load capacity with little additional cost. During the 1950s, American engineers began to make increasing use of composite decks based on a growing body of theoretical and empirical research that demonstrated its advantages, but it was not standard practice until the 1960s. Thus, not surprisingly, composite decks were not adopted by the Ohio Department of Highways as an option for standard continuous steel stringer bridges built in the 1950s. In the long run, the use of non-composite decks has proven to have an important influence on the later serviceability of continuous steel stringer bridges on Ohio’s Interstate highway system. When the original non-composite decks have outlived their usefulness, it has been possible to replace them with new composite decks that increase load ratings to HS-25. This has contributed to the retention many of the original continuous steel stringer bridges on Ohio’s Interstate highway system.\(^8\)

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\(^7\) Standard drawings for continuous steel stringer bridges were reviewed on microfiche in the ODOT Library, Columbus. Standard Drawings for Continuous Steel Beam Bridges (Coded CSB), 1939-1963.

\(^8\) ODOT Library, Standard Drawings for Continuous Steel Stringer Bridges (coded CSB), 1939-1963; Omer W. Blodgett, Design of Welded Structures (Cleveland: James F. Lincoln Arc Welding Foundation), 1966, Section 4.9, documents the widening use of shear connections by the mid 1960s and has some excellent illustrations; Matt Shamis, Division Bridge Engineer, Federal Highway Administration, e-mail communication with David Simmons, Lichtenstein Consulting Engineers, Jan. 2003.
The standard drawings used to design continuous steel stringer bridges for Ohio’s Interstate highways were the same as those used on all of the state’s primary highways and secondary roads. No distinction was made on the plans except to allow the project engineers to adapt the standard drawings to fit the loads, widths, and geometrics, such as the lane widths and useable shoulders required of each road classification. The required loads and geometrics for the Interstate highways were spelled out in other federal and state documents.\(^9\) The continuous steel stringer bridges were by no means unique to the Interstate highways in Ohio. Of roughly 1,250 continuous steel stringer bridges built by the Department in the 1950s, about forty percent were built as part of the Interstate highway system. The other sixty percent were on other classifications of state highway.

The Ohio Department of Highway’s strategy of using standard continuous steel stringer bridges on the Interstate highway system changed little over the years of the statewide Interstate highway construction program. The continuous steel stringer bridges remained the most common bridge type built through the 1970s. Today, more than 2,500 continuous steel stringer bridges built before 1974 are in use on Ohio’s Interstate highway system. The dominance of the steel stringer technology is so complete that even to this day, no other bridge type comes close to being as common. For instance, there are fewer than 25 prestressed concrete bridges on the state’s Interstate system and most of these postdate 1970.\(^10\) As a population, the steel stringer bridges are highly undifferentiated. They reflect the successful and unvarying application of standard bridge drawings and specifications to system building after 1939, but individually they are not remarkable.

Reinforced Concrete Slab Bridges

Although not comparable in numbers to continuous steel stringer bridges, reinforced concrete slab bridges are the second most common bridge type on Ohio’s Interstate highway system. The inventory includes 120 pre-1961 examples. As with the steel stringer bridges, the slab bridges are also frequently found on other classifications of

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\(^9\) Like all states, the Ohio Department of Highways adopted the American Association of State Highway Officials (AASHO), *Policy on Geometric Design of Rural Highways* (1954), *Criteria for the Design of Urban Projects* (1957) and *Criteria for the Design of Bridges* (1957) as the “minimum requirements of good design” of the Interstate highways. The federal Bureau of Public Roads (BPR) used these standards to approve every state’s Interstate plans. In addition, the Ohio Department of Highways prepared its own “Manual of Location and Design Interstate Projects” (1957) that elaborated on the geometric standards to be used in Ohio. The Department’s *Specifications for Design of Highway Structures*, first published in 1918, and revised in 1925, 1928, 1931, 1933, 1946, 1951, and 1957 governed the design of all structures on state highways. These specifications covered such topics as definition of waterway areas, loads and forces, unit stresses, and expansion and contraction. The specifications worked in concert with the state’s standard drawings providing uniform guidance to project engineers.

highway throughout the state. It is not a type particular to the Interstate highway system.

The slab bridge concentrates reinforcing steel, in the form of twisted or deformed rods, in the lower portion and ends where tensile forces and shear are the greatest. The amount of steel and depth of the slab is predicated on length and live-load requirements (Figure 3).

Slab bridge technology developed along with other reinforced concrete bridge types, such as the arch and tee beam, in the late 19th century and matured during the first decade of the 20th century. Advancement in the understanding of reinforcing placement to accommodate tension and shear forces resulted in reinforced concrete slab bridges becoming one of the favored bridge types for short-span bridges (less than 35’ long). The slab bridge type, like the steel stringer bridge type, proved well suited to the preparation of standard drawings with the result that the nation’s state highway departments built literally thousands of nearly identical examples. In 1919, the Ohio Department of Highways issued a standard drawing for slab bridges (Drawing No. 302). The Department continued to update the standard drawings on a regular basis through at least the early 1970s. Ohio currently has more than 4,950 slab bridges with approximately 2,550 of them predating 1961.\textsuperscript{11}

The multi-span slab bridges commonly found on Ohio’s Interstates are of the continuous design, in which the reinforcing bars continue uninterrupted over the piers (Figure 4).

\textbf{Figure 3:} Cross sections of typical reinforced concrete slab bridge. \textit{Source: Lichtenstein, 2003.}

\textbf{Figure 4:} Typical continuous slab bridge on Ohio’s Interstate highway system. IR 75 Northbound over Rush Creek, Miami County (SFN 5503426). \textit{Source: ODOT Bridge Inspection Photos.}

\textsuperscript{11} Ibid.; ODOT Library, Standard Drawings for Slab and Continuous Slab (coded CS) Bridges, 1919-1973.
4). The continuous design offered the same advantages in a slab as it did in steel stringer bridges; namely, use of less material for a given span length than simple (non-continuous) spans and reduction of the number of expansion joints. The Ohio Department of Highways adopted a standard drawing for continuous slab bridges in 1946 (Drawing No. CS-1-46).

The pre-1961 continuous slab bridges found on Ohio’s Interstate highways are typically based on or similar to Standard Drawing No. CS-2-54, approved in 1954. The standard was for bridges with interior span lengths of from 20’ to 55’ and end span lengths four-fifths as long as the interior span. As with the continuous steel stringer drawings, the standard continuous slab design allowed engineers to adapt them to fit the loads, widths, and geometrics required at the site and for the specific classification of roadway.

Slab bridges were a commonly built bridge type on Ohio’s Interstate highway system through the 1970s. More than 390 continuous, reinforced concrete slab bridges are currently in use on the system. As a population, they are highly undifferentiated and reflect the successful application of a standardized design to system building.

Other Bridge Types on Ohio’s Interstate Highway System

The inventory of pre-1961 Interstate highway bridges includes a relatively small number of bridge types other than steel stringer or reinforced concrete slab bridges. The truss, thru arch, and bascule bridge types are addressed in greater detail in the section of this report on non-excluded bridge types. The other bridge types — rigid frame, tee beam, girder-floorbeam, bascule, and culvert — are covered below.

Rigid Frame. The inventory of pre-1961 Interstate bridges includes six technologically late, undistinguished examples of the reinforced concrete rigid frame bridge type. Five of the six examples date from 1956-57 and were built as part of the Toledo-Detroit Expressway (IR 280). The sixth example (SFN 3110621) is in Cincinnati and dates to 1943. It was built to carry a local street (Lock Street) over a short, depressed section of downtown expressway that was later incorporated into the southbound lanes of IR 75.

The reinforced concrete rigid frame bridge, where the top member and the verticals are integral and the legs perform useful work in supporting the loads, is one of the most efficient uses of both steel and concrete. The technology was developed in Europe during the last part of the 19th century. It was not utilized extensively in this country until the early 1920s when engineer Arthur G. Hayden very successfully used it for overpasses on the parkways in Westchester County, New York. The technology requires expensive form work to erect, but it is an efficient use of material and reduces the amount of work in ground because the mass of the abutments is reduced. The intrinsic form of the rigid frame with its typical shallow arch profile is usually well-proportioned and lends itself well to settings where an aesthetic bridge is desired. Rigid
frame bridges often have architectural treatments including stone veneer to achieve the appearance of a traditional stone arch.\textsuperscript{12}

The rigid frame bridge type is an excluded bridge type and is not uncommon in the state. There are more than 106 examples dated to before 1961. According to the state’s 2001 NBIS data, the earliest date of construction for a number of them is 1900, but this date is clearly an estimate and too early given the well-documented history of the rigid-frame technology. NBIS data does clearly show that significant numbers of rigid frame bridges were built in Ohio beginning in the late 1920s: eight examples date to the 1920s, 42 to the 1930s, 22 to the 1940s, and 21 to the 1950s.

The six pre-1961 rigid frame bridges on Interstate highways exhibit no unusual or distinctive details. They are plainly finished and lack the aesthetic treatments usually associated with the most successful examples. Two of the five examples associated with IR 280 in Lucas County have been altered by replacement railings. The rigid frame bridge type did not play a significant role in the development of the state’s Interstate system.

**Tee Beam.** The three pre-1961 tee beam bridges on Ohio’s Interstate highways are, like the rigid frame bridges, in urban settings and were initially designed as part of expressway projects taken into the Interstate system. The examples are a 1943 bridge on southbound IR 75 in Lockland, Hamilton County (SFN 3110567); a 1949 bridge on IR 77 in Cuyahoga Heights, Cuyahoga County (SFN 1806300); and a 1957 example on the Toledo-Detroit Expressway (IR 280) in Toledo, Lucas County (SFN 4805941). The tee beam bridges have no unusual or distinctive features.

Tee beam bridges are cast-in-place reinforced concrete beams with integral monolithic flanking deck sections used for spans of usually 25’ to 50’ in length. The primary reinforcing steel is placed longitudinally in the bottom of the beam stem, and the deck or flange reinforcing is placed perpendicularly to the stem. Tee beams were favored in many states because of their low long-term maintenance and thus overall economy of material. The technology of the tee beam bridge did not change from the 1910s through the 1950s, and it is based on the integral connection of the longitudinal beam and deck section. The tee beam design proportions the deck thickness and longitudinal beam size and spacing to achieve a light, strong, and economical section.\textsuperscript{13}

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\textsuperscript{13} Tee beam bridges are standard fare in most period engineering textbooks. See, for example, Leonard A. Church and Charles Edward O’Rourke, Design of Concrete Structures 2nd ed. (New York: McGraw-Hill), 1926, pp. 105-117; George A. Hool, Reinforced Concrete Construction. Volume III. Bridges and Culverts, 2nd ed. (New York: McGraw-Hill), 1928, pp. 409-413. Numerous statewide bridge surveys and a cursory glance at nationwide NBIS data confirms the ubiquitoussness of the tee beam bridge type.
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The Ohio Department of Highways adopted a standard for tee beam bridges as early as 1913. Standard drawings continued to be produced for the bridge type until at least 1941. The tee beam bridge type is an excluded bridge type. NBIS data (2001) shows that the state has more than 580 pre-1961 tee beam bridges with numerous examples dating to the early decades of the 20th century. The tee beam bridge type declined in use in Ohio and other states during the 1950s and 1960s, in part because of the expanded use of continuous steel stringer and prestressed concrete beam bridges. As with steel stringer and slab bridge types, many multi-span tee beam bridges from the mid 20th century are continuous designs.

**Deck Truss.** The inventory includes three, steel deck truss bridges carrying Interstate highways in northeastern Ohio. Two, 5-span, 868'-long deck truss bridges carry IR 90 over the Grand River in Lake County (SFN 4304950 and 4304985). However, these are dwarfed by the most impressive of Ohio’s pre-1961 Interstate highway bridges, the IR 90/IR 71 continuous-cantilever deck truss bridge over the Cuyahoga River Valley in Cleveland (SFN 1809393), The 42-span bridge, known as the Central Viaduct or Inner Belt Viaduct, measures 5,076'-long and 116'-wide (Figure 5).

The 1954-1959 Central Viaduct is the largest single pre-1961 construction contract ever awarded by the Ohio Department of Highways. The nearly mile-long viaduct embodies the genesis of urban expressways in Cuyahoga County, starting in the late 1930s when federal policy was changed to permit federal funding of urban highway projects, through World War II expressway planning, and culminating with its timely completion because of the 90 percent/10 percent, federal/state Interstate highway construction funding formula put in place with the passage of the 1956 Federal Aid Highway Act. As the most ambitious highway bridge of the post-World War II and early Interstate highway eras in Ohio, the Central Viaduct stands out from all the other 1950s highway projects as the summation and manifestation of how the state and local

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Figure 5: Central Viaduct (SFN 1809393), Cleveland, Cuyahoga County. Source: Lichtenstein, 2003.

For example, Lichtenstein Consulting Engineers, New Jersey DOT Historic Bridge Survey (1993); Georgia DOT Historic Bridge Inventory (1995); Pennsylvania DOT Historic Bridge Survey (1998); Delaware DOT Historic Bridge Inventory Update (2000); Maine DOT Historic Bridge Survey (2000); and North Carolina DOT Historic Bridge Inventory Update (2001).

14 ODOT Library, Standard Drawings, microfiche, 1913-1941.
governments were attempting to solve urban congestion and through-traffic issues for over two decades. Its nearly 20-year history from conception to completion chronicles more clearly than any other bridge or section of highway in the state the evolution of “federalism” and highway planning and design. Given its sheer size and constraints imposed by local conditions, there are several unusual details like its “universal joint” bearings and suspended span connections. Its design and construction was followed in period technical literature.

The Inner Belt was conceived in 1940 as a means to reduce downtown traffic congestion, and its actual planning began in 1941-1944. It was to be part of the master plan of freeways through and around Cleveland that was developed by the city, county, and state during World War II. The plan designated downtown Cleveland as the hub with a series of freeway spokes radiating from it. Concentrically rimming that network of radial freeways would be a 3.2-mile-long Inner Belt from East 30th Street-Shoreway area on the east side to Abbey Avenue and West 14th Street on the near west side. There would also be a central interchange in downtown Cleveland permitting easy access to all of the freeways. The report identified the Inner Belt as the first priority for a new project. The 1941-1944 expressway master plan came out of an important early study of Cleveland vehicular traffic undertaken by the federal Bureau of Public Roads in 1928. That report ranks as one of the earliest comprehensive highway planning studies ever undertaken in this country, and it recommended several dualized expressways, including beltways.

The expensive property acquisition for the Inner Belt alignment was started by the city about 1950, but progress was slow because matching federal funds were provided on a 50-50 formula. Noted consulting engineers Howard, Needles, Tammen & Bergendoff were hired by the city in the fall of 1953 to design the viaduct, and construction began at the end of 1954. The abutments and piers were completed using the pre-1956, 50-50 funds, but completion of the extremely expensive superstructure and related sections of highway would have been considerably slower without the massive infusion of cash available to the states after passage of the 1956 Federal Aid Highway Act. That bill created the National System of Interstate and Defense Highways. The Inner Belt work qualified for 90 percent federal participation for Interstate highway construction, and a May 5, 1959, article in the Cleveland Plain-Dealer summed up what the 1956 legislation meant to this project. “Without this lions’ share of money from Washington, much of the belt would have remained a paper freeway for years to come.” With its 37 ramps (20 entrance and 17 exit), the Inner Belt cost approximately $25 million a mile compared with the Ohio Turnpike, under construction at the same time, that cost $1 million a mile. The Central Viaduct alone cost $18 million.

The Central Viaduct facilitated completion in 1962 of the Central Interchange in downtown Cleveland. The bridge stands basically as constructed and is the
Steel Girder-Floorbeam. There are three examples of pre-1961 steel girder-floorbeam bridges on Ohio’s Interstate highway system. They represent a conventional 20th-century bridge type that was frequently built in Ohio but not used as an Interstate standard. The three examples were built as part of 1950s urban expressways incorporated into the Interstate system. The seven-span, 813'-long, IR 76 viaduct over Kelly Avenue in Akron (SFN 7706332) was built in 1957 as part of the development of the East-West Expressway and has since been significantly altered by widening and replacement railings. The two girder-floorbeam bridges (SFN 4805925 and 4805933) in Lucas County were built in 1956 as part of the Toledo-Detroit Expressway (IR 280). They consist of riveted built-up girders and have no unusual or distinctive details.

Steel girder-floorbeam bridges consist of two or more longitudinal beams (i.e., girders) supporting transverse floorbeams and a deck. The longitudinal girders are typically built-up to achieve a greater depth than economically available from attainable rolled beam sections. The technology developed in the late 1840s and was first used by railroads. In fact, the girder-floorbeam bridge technology was the only serious competitor to metal truss bridges for railroad applications during the 19th century. It also proved advantageous to highway applications and was built in large numbers from the late 19th to mid 20th century. The Ohio Department of Highways adopted standard drawings for girder-floorbeam bridges in 1911 (among the Department’s earliest standards). The technique of building up the girders has historically been riveting. Welding became more common after 1945 with the advancement of welding technology and metallurgy to produce weldable, structural steel alloys.

The girder-floorbeam bridge type has not been the subject of prior ODOT historic bridge inventories. It is a very common bridge type with more than 720 examples dated from 1887 to 1960 in the NBIS database. The three examples with Interstate highway associations have no technologically significant details.

Bascule. The Robert Craig Memorial Bridge at Toledo (Lucas County #4805917), a bascule bridge over the Maumee River, was built by the state in 1956 as part of the


Toledo-Detroit Expressway, one of several pre-interstate, limited-access, urban expressways in the state. Further information about this bridge follows below in the section on non-excluded bridge types.

Thru Arch. A steel, thru arch bridge, built in 1952, carries a pedestrian path over IR 90 in Cleveland’s Gordon Park (SFN 1808370). It is one of two identified steel thru arch pedestrian bridges in the 1951-60 population. The other, built in 1958, is in Cincinnati over US 127 (SFN 3111342). Further information about these bridges follows below in the section on non-excluded bridge types.

Culverts. The inventory of pre-1961 Interstate highway bridges includes 29 culverts. There are thousands of small drainage structures on Ohio’s highways that are culverts. The selection in the inventory are only those over 20' long, which thus meet the federal definition of a bridge. Most are multi-cell (more than one opening) to achieve that length. The number of openings is determined by the requirements of the waterway area and the available vertical headroom. There is no technological significance to the longer span lengths. All are under earth fill and cannot be seen from the roadway. There are two types of culverts: pipe culverts and box culverts.

Pipes have been used since time immemorial to direct the flow of small streams and runoff. Early builders used materials such as wood and terra-cotta, while builders of the 19th century increasingly used cast iron. During the 20th century, pipe culverts have been made of either reinforced concrete or steel. Pipes of either material are characterized by prefabrication at factories and shipment to construction sites. The pipes are manufactured in standard lengths and diameters. The pipes are placed in stream beds and backfilled with earth. Pipe culverts may be single or multiple cells. They may or may not have concrete head walls.

Reinforced concrete pipe culverts in precast units ranging from 15” to 6’ diameters have been available to builders since the first decade of the 20th century. The history of reinforced concrete pipe manufacturing parallels the development of reinforced concrete as a building material and was a mature technology by the 1910s. The amount of reinforcement in the pipe depends on its size and the load to be carried by the pipe. The Ohio Department of Highways issued a standard drawing for pipe culverts in 1931 (Drawing No. 300). State specifications also covered a variety of construction details specific to pipe culverts, such as requiring that the pipe barrel extend to the toe of the embankment and that the end of the barrel be sloped to fit the embankment profile.\footnote{19 ODOT Library, Standard Drawings, microfiche, 1931. Ohio Department of Highways, Specifications for the Design of Highway Structures (Columbus), 1951, p. 63.}

Corrugated steel pipe culverts were introduced in the United States about 1885, but they were not widely available until after 1900. Afterward, they were quickly adopted by
the construction industry, especially as pipe manufacturers increased capacity and the price of pipes fell through the 1910s to 1930s. The pipes were found to resist cracking and disjointing under a load, as well as to have comparatively light weight, ease of handling and installation, freedom from maintenance, and adaptability to extension and reuse. Corrugated steel pipes were produced in diameters ranging up to a maximum of about 9’ by 1930.

Pipe culverts are still built today with little change in the technology of manufacturing or placing pipes. Pipe culvert design has advanced in the last forty years with more sophisticated site analysis, particularly in the area of hydrology, where culvert openings are now more closely sized to match peak stream flows, and in the area of soils analysis, where embankment materials are analyzed to determine lateral soil pressures and the embankment’s ability to support vertical loads.  

Reinforced concrete box culverts appeared on American and Ohio roadways during the first decade of the 20th century, and they were increasingly ubiquitous by the early 1910s. Their history is nearly identical to the development of other standard reinforced concrete bridge types, such as tee beam and slab bridges.

A box culvert derives its name from its similarity to a box with open ends, and it is defined by a cover slab (top) integral with the side walls and floor. Box culverts are adapted to minor streams and locations where headroom is limited. They require little expensive form work or foundation work and may be placed in trenches. The cover (top) slab may directly support the roadway or be placed under earth fill, and it is proportioned to carry both live load and the entire weight of the fill, if any. Box culverts may be single or multiple cells with the single-cell span length rarely exceeding twice the height. Since the 1910s, box culverts have been found to be economical and practical under the majority of conditions for spans in the range of 6’ to 15’. The Department adopted its first standard drawings for box culverts in 1911. The technology has changed little since the early 20th century. The only noteworthy change is the increasing substitution of precast box sections for cast-in-place sections in the last thirty years.

The Ohio Department of Highways commonly used culverts on all of its highway projects. The application of culverts to Interstate highways was no different than elsewhere. The standard drawings and specifications have been regularly updated ever since the 1910s. Then current standard specifications and drawings for culverts


were used for the development of the Interstate highways from the 1950s to 1970s. The culverts are not technologically significant structures.
Non-Excluded Bridge Types, 1951-60

The non-excluded bridge types are steel truss, prestressed concrete box beam and stringer, steel arch, reinforced concrete arch, wood bridges of all types, and movable bridges including bascule (Table 2).

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<th>Bridge Type</th>
<th>Number in Population</th>
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<tr>
<td>Steel Truss</td>
<td>358</td>
</tr>
<tr>
<td>Prestressed Concrete Box Beam or Stringer</td>
<td>88</td>
</tr>
<tr>
<td>Steel Arch</td>
<td>8</td>
</tr>
<tr>
<td>Reinforced Concrete Arch</td>
<td>3</td>
</tr>
<tr>
<td>Wood Bridges</td>
<td>1</td>
</tr>
<tr>
<td>Bascule</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Non-excluded bridge types.

The truss, arch, and wood bridge types are long-lived technologies that matured at least a half-century or more earlier. They continued to be applied with some refinements through the 1950s and, in most instances, they continue to be built to the present day.

The prestressed concrete bridges are representative of the application of a new material to bridge building, which was introduced in the United States and Ohio in the 1950s. Ohio’s prestressed concrete bridges tend to reflect less standardization than the other excluded and non-excluded bridge types. In Ohio, prestressed concrete was met with interest and enthusiasm, as well as with skepticism. Some county engineers demonstrated an interest in trying the material, based especially on success stories from other states, such as Pennsylvania and Florida where prestressed concrete bridges met with early acceptance. In general, the counties relied on Ohio’s private...
concrete casting industry to help them develop the new I-beam and voided box designs. In contrast, key personnel at the Ohio Department of Highways remained unconvinced for some years as to prestressed concrete’s applicability in the state bridge program. The Department only built a handful of prestressed concrete bridges, some as trials, between 1954 and 1959, and it was not until late 1960 that it approved its first standard drawings for prestressed concrete stringer and box beam bridges.

**Steel Truss Bridges**

The steel truss bridges built between 1951 and 1960 represent the continued application of late-19th-century bridge types and designs with 20th-century refinements, such as welded connections and rolled-section members, to meet the bridge needs of some of Ohio’s county and municipal governments. The 1950s were a decade during which trusses prefabricated by the Ohio Bridge Corporation dominate the study population. There were no new truss bridge types or designs introduced in the state during the 1950s. Truss-bridge builders primarily continued using the tried-and-true Warren design. Patented in 1848 by British engineers James Warren and Willoughby Monzani, the straightforward Warren truss is particularly well suited for rigid, riveted or welded connections. The Warren truss is distinguished by its ease of construction with equal-sized members, and by the ability of some of the diagonals to act in both tension and compression. It could be stiffened by the addition of verticals and can also be designed with a sloped, polygonal upper chord.\(^{23}\)

There were no remarkable changes in truss bridge engineering during the 1950s. The decade saw the continued transition to welded connections from riveted connections for most of the prefabricated truss highway bridges supplied to Ohio’s counties. This transition had begun in the 1930s and was well under way by the late 1940s.

The history of weld-connected truss bridges goes hand-in-hand with the development of electric arc-welding technology. Welding, in its simplest terms, is the joining of metal parts by bringing them together at high temperature. Welding had been done for centuries by blacksmiths by heating and hammering together metal parts, but its use for connecting structural members did not begin until the early 20th century and the development of arc-welding where an electric current provides the welding heat. The technology saw its earliest structural applications in steel-frame building construction starting in the late 1910s. The Westinghouse Electric Company of Pittsburgh was a leading promoter of the technology and is usually credited with building the nation’s first weld-connected truss bridge at its Chicopee Falls, Massachusetts, plant in 1927-28. The arc-welding industry heavily publicized the technology, and through such industry associations as the American Welding Society and the American Institute of Steel Construction issued codes and recommendations for its use. The application to bridges

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\(^{23}\) For further information on the historic context and evaluation of the pre-1951 truss bridge types and designs, see ODOT, “Ohio Historic Bridge Inventory” (1983) and “Supplement” (1990).
spread rapidly during the 1930s. The American Welding Society first published specifications for welded truss and girder-floorbeam bridges in 1936. By the 1940s, welded connections had become standard curriculum in engineering textbooks.\textsuperscript{24}

The extant truss bridges built in Ohio from 1951 to 1960 are a continuation of the same designs and connection methods represented by the population of truss bridges built from 1941 to 1950, evaluated by the previous ODOT historic bridge inventory update. The previous update identified as select eight Warren pony truss bridges (seven of them with polygonal top chords), two Pratt pony truss bridges, and one Pratt thru truss bridge. In the 1940s and 1950s, the same few bridge-building companies continued to supply truss bridges to the counties. The most prominent among them were the Champion Bridge Company (Wilmington) that fabricated rivet-connected bridges and the Ohio Bridge Corporation (Cambridge) that built the all-welded pony truss design developed by Herman Rogovin in 1946.

In name, the Ohio Bridge Corporation dates to 1952, but in actuality its history goes back to 1936 when Herman Rogovin, a graduate of Case School of Applied Science with a degree in civil engineering that same year, started the American Culvert Company in Cambridge.\textsuperscript{25} The firm manufactured and sold corrugated pipe culverts to counties and municipalities throughout Ohio. He purchased the property where the plant is still located in 1937, and soon expanded to provide his clients rolled steel stringer bridges. Rogovin purchased all of his materials from Bethlehem Steel. The company did as much or as little of the erection, from substructure to deck and approach roadway work, as the client desired. The company expanded into truss bridges prior to the end of World War II.


\textsuperscript{25} Herman Rogovin Interview with David Simmons and Mary McCahon (Lichtenstein Consulting Engineers, Inc.), November 19, 2002. This historical synopsis of the company is entirely based on the Rogovin interview.
During the war, operations at the American Culvert Company, then styled American Culvert & Fabricating Company, were shut down, and Rogovin moved to Cleveland to assist the war effort by working at the B-29 bomber plant. While there, he developed his own plans for a pony truss bridge that would have no riveted connections that could be built at his plant in Cambridge after the war. He wanted to move away from riveted shop and field connections because of the inherent, moisture-related problem of deterioration between the plates. Rogovin’s trusses were composed of rolled, not built-up members, and welded shop connections, which are not prone to rust. The combination of rolled members and welded connections had been used by other builders since the late 1920s and standards had been adopted in 1936 by the American Welding Society, so the idea was not new. Rogovin was very successful, however, setting up a shop to prefabricate the trusses, and he did an excellent job of marketing the welded trusses to Ohio’s county engineers after World War II.

Rogovin was also looking for a design that could be erected without first placing false work, an expense that he believed could be eliminated and provide an edge over established competitors like Champion Bridge. This was accomplished by shipping the welded trusses as fully assembled as transportation constraints would permit in the late 1940s and 1950s. Field connections were made with Dardelet bolts. According to Rogovin, the Dardelet bolt is a button-head bolt that is serrated in the middle. They automatically seat themselves when driven in with a sledge and are then locked with a nut. Dardelet bolts were manufactured by Bethlehem Steel, and they became unavailable about 1960. Since 1960, Ohio Bridge Corporation has used other types of bolts to make the field connections.

American Culvert’s first welded pony truss bridge, about 90’ long, was erected at Millersburg (Holmes County) about 1946-47. Rogovin was satisfied with his initial design and did not make significant changes to it over time. With the exception of the later practice of galvanizing, the pony truss bridge developed during World War II is the one that continues to be fabricated. Rogovin’s goal was to help the counties get adequate bridges without having to hire consulting engineers. To that end, he hired Sid Rockoff of Varo Engineers (a Columbus consulting firm formed in the early 1950s and named for its two principals, Arthur Vajda and Hyman Sidney Rockoff) to prepare the calculations and specifications for standard designs of spans in 10’ increments between 50’ to 120’ in length. Standard plans were prepared for H12, H15, and H20 loadings so
the counties could purchase the appropriate capacity and not have to purchase a stronger bridge than conditions warranted. The flooring system was also matched to the client’s needs with 7, 5 or 3 gauge corrugated steel floors. The gauge (thickness/weight) of the corrugated, galvanized steel floor is unique to Ohio Bridge Corporation. The corrugated “pans” are welded to the stringers.

All Ohio Bridge Corporation bridges were and still are the pony truss type, and the longest are about 150' because that is the greatest length that the erection shop can accommodate. After that, multiple spans are used. The customer had the choice of Cor-ten or painted steel. Cor-ten is more expensive, high-strength, weathering steel, which does not require painting, and it was not used for the flooring system because it would never dry out and would result in serious corrosion.

In recognition of the company’s diversification, Rogovin separated its various activities to more clearly reflect their purposes in 1952. Ohio Bridge Corporation was the bridge fabricating business while Superior Steel Corporation was the company that purchased and stored the steel used in bridge construction. Only U.S.-made steel was used in Ohio Bridge Corporation bridges, and much of it was purchased from Bethlehem Steel. The company is still successfully marketing its welded pony truss bridges to Ohio’s counties and cities, as well as to others across the country. To reflect the national orientation of its operation, the company is now called US Bridge. The company is currently headed by Herman Rogovin’s son, Arthur. More than 300 of the 340 inventoried pony truss bridges built from 1951 to 1960 are attributed to the Ohio Bridge Corporation.

Next to Ohio Bridge Corporation, the other frequently identified supplier of prefabricated truss bridges to Ohio’s counties during the 1950s was the Champion Bridge Company of Wilmington. Incorporated in 1878, it was among a handful of Ohio’s bridge-building companies that survived from the late 19th century into the latter part of the 20th century. According to the company’s own published history, Champion outlasted many similar companies because of its strong sales in southern states, particularly Florida during the boom years of the 1920s. Even so, the Great Depression brought difficult times, and Champion’s shareholders voted to liquidate in 1934, only no outside buyer could be found. In 1935, three of the company’s long-time employees – general manager Ralph J. Miars, shop superintendent Cash L. Richardson, and sales engineer Edward J. Rose – purchased the assets of the company. Taking any work they could find, including building sidewalks and repairing old bridges, the three partners made it...
through the Depression and World War II. Company history states that Champion had modernized its shops and expanded its business supplying structural steel to coal mines in southern Ohio and neighboring states by the late 1940s, but modernization did not apparently include arc-welding. Extant examples of the company’s bridges from the 1940s and 1950s all have the traditional riveted shop and field connections. The firm continued to prefabricate and erect steel bridges with most of the work in Indiana, Ohio, and Kentucky. Champion reported that it had a reputation among county engineers for its quality work and knowledge of older truss bridges and ways to repair or strengthen them economically, “thus stretching limited county funds.” Champion remains an active steel fabricating company today.  

<table>
<thead>
<tr>
<th>SFN/County</th>
<th>Feature Carried/Crossed</th>
<th>Summary of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>3061043, Guernsey</td>
<td>Campbell Avenue over Wills Creek</td>
<td>The 1958 welded pony truss bridge is historically significant as the longest bridge fabricated by the Ohio Bridge Corporation, a prolific and notable in-state fabricator of stringer and pony truss bridges for Ohio’s counties. This is the only one ever fabricated with this built-up upper chord detail. It was done to make the member stronger, which was required given the length of span, and it stands out from the large population of Ohio Bridge Corp. bridges built in the 1950s in Ohio (Criterion C).</td>
</tr>
</tbody>
</table>

Table 3: Recommended Eligible Steel Truss Bridge

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Prestressed concrete is concrete that is internally stressed in compression, usually by high-strength steel wires or cables, to counterbalance the stresses from bending caused by external loads. The advantage of prestressed concrete is that the designer can make the compressive forces induced into the beam equal to the stresses expected from the dead and live loads and thus counteract the tendency of concrete to develop flexure cracks. Prestressed concrete is a highly economical use of material that results in strong beams that are comparatively lightweight in comparison to conventional reinforced concrete. The beams can be a variety of shapes including I-shaped or T-shaped beams, hollow box beams, slabs, and channel beams.

Prestressed concrete beams are made by either pretensioning or post-tensioning. In pretensioning, the steel is positioned, stretched to develop the required stress, and then held in place while the concrete is placed in the forms. After the concrete has cured, the tension in the steel is released and the load is transferred to the concrete. In post-tensioning, the steel is positioned in the unstressed condition in conduits or sleeves and the concrete placed around the sleeves so that the steel is not in contact. After the concrete cures, the steel wire, which is anchored at one end, is stretched by jacking to achieve the required stress, locked in place, and the force transferred to the hardened concrete using anchorages or end blocks. Grout is then injected into the conduits or sleeves.

Prestressed concrete first appeared in bridge applications in Europe during the first decades of the 20th century. Its most noted developer was Eugene Freyssinnet of France. Prestressed concrete was slow to spread to the United States, but eventually found its first application in prestressed-concrete water tanks before World War II. Philadelphia’s 1949-51 Walnut Lane bridge inaugurated the modern prestressed concrete bridge era in the United States. The bridge had 160'-long beams that were cast at the bridge site and then post-tensioned. Contemporaneous with the construction of the Walnut Lane bridge, several state highway departments, including Pennsylvania and Florida, were developing pretensioned prestressed concrete beams for use as standard designs on their state highway systems with encouragement from the federal Bureau of Public Roads (BPR, predecessor agency to the Federal Highway Administration). Chief federal bridge engineer Eric L. Erickson believed that prestressed concrete could play an important role in standardized bridge construction. The prestressed beams could be cast in factory-like casting yards with savings in forms and falsework, elimination of on-the-job labor, and closer control of concrete mix, placing, and curing. The BPR published its influential Design Criteria for Prestressed Concrete Bridges in 1952, including a complete set of standard plans. A revised and substantially expanded publication and set of plans was issued by the BPR in 1954. Several states promoted the establishment and growth of concrete-casting companies through large contracts and prestressed concrete technology spread rapidly during the
1950s. Prestressed concrete has been an increasingly dominant bridge material since the 1950s.\textsuperscript{27}

In Ohio, it was the counties and municipalities working with bridge contractors and engineers who recognized early on how useful prestressed concrete was as an alternative to steel and reinforced concrete bridges. The Ohio Department of Highways, however, was not at the leading edge of prestressed concrete bridge applications in the 1950s. Their tentative, initial consideration of the material was a 1952-1955 study to verify the capacity and economic application of a relatively short, prestressed concrete composite slab bridge design, but it was not until near the end of the decade that the state began to seriously consider prestressed concrete bridges on state routes. By that time, the counties and the prestressed concrete bridge industry had demonstrated the economy, performance, and viability of the material, a conclusion that is supported by the surviving 1950 population of prestressed concrete bridges in the state. Of the 88 identified pre-1961 prestressed concrete bridges, only ten are state-owned and 78 are county or municipal-owned. This data reflects the collaborative effort of progressive county and consulting engineers and the state’s private concrete industry.

The state-built prestressed concrete bridges from 1954 to 1960 reflect the Ohio Department of Highway’s tentative and conservative approach to the acceptance of a new material at a time when the Department faced manpower shortages and was under pressure to design hundreds of new bridges for the state highway systems. Perceiving that the continuous steel stringer, reinforced concrete slab, and other standardized bridge types had already proven their worth, the Department’s chief engineers and officials had little interest in investing significant manpower or expense into the development of the new technology (see the Transportation Context for more information on the political and economic factors influencing the state highway department in the 1950s).

\textbf{Trial Prestressed Concrete Bridges by the Ohio Department of Highways}

In 1951, D. Henry Overman, assistant chief engineer of the bridge bureau in the Ohio Department of Highways, initiated the Department’s first investigation of prestressed concrete by securing approval for the study and outlining, in general, its objectives.\textsuperscript{28} The study was undertaken at a time of steel shortages and burgeoning interest in this


\textsuperscript{28} Carroll, Robert James. “Load Test and Design of Pretensioned Concrete Beams for Use In Highway Bridges” (M.S. thesis, Ohio State University, 1952), p. iii.}
new material by a relatively new Department employee, Robert Carroll, who was also able to use the study as his civil engineering masters degree thesis at Ohio State University. In actuality the effort was the bridge bureau’s independent check of the capacity and performance of a specific design – a composite prestressed concrete bridge about 40’ long that was developed in Europe in the mid 1940s. Carroll’s 1952 analysis was a joint effort undertaken by the bridge bureau and the Department’s materials testing laboratory. Such independent checks are a common practice in engineering research.

The goal of the study was to determine how the performance of a particular bridge design of a pretensioned, prestressed concrete beam in composite action with the concrete deck would compare in respect to cost and simplicity of construction with conventionally reinforced concrete, cast-in-place slabs then used by the Department for bridges up to 40’ in length. The beams and design tested and checked by Carroll relied on using the bottom flanges of the 12”-wide, inverted, T-shaped prestressed beams (Figure 8) as the forms for field-placed concrete that completely filled the voids between the beams and covered the beams for a 2” or 3”-deep deck. The design was originally developed, analyzed, refined, and constructed in England by P. W. Abeles from the mid 1940s through 1951. Carroll became aware of the design based on a paper presented in the published proceedings of the First United States Conference on Prestressed Concrete held at MIT in August 1951. Based on Carroll’s testing and analysis completed in the spring and summer of 1952, his conclusion was that the prestressed concrete composite slab design was capable of meeting the Ohio Department of Highway’s live load specifications.
In the fall of 1954, two years after completion of the study, 6,771 linear feet of the narrow, 12" wide beams were fabricated by state forces using wood forms at the Marietta division warehouse. Those beams were used by state forces to erect eleven composite prestressed concrete slab bridges ranging from 21' to 31' in length on low volume state routes in Athens, Auglaize, Galena, and Noble counties between 1954 and 1958 (see Table 4 and Figure 9). Franklin County also built one in 1956. And while the bridges mark the first uses of prestressed concrete by the Ohio Department of Highways, they had no effect on bridge design within the Department or the industry as a whole. Interestingly, the design was never used again by the state or the private sector that was already busy constructing other bridge types and designs. In fact, the advances in the knowledge and application of prestressed concrete may be said to have been so fast between the time that Carroll began his thesis in 1951 and the time that these bridges were built in 1954-58, that private industry and other state highway departments had lost any interest they might have had in the composite slab design. The industry’s thinking about design, fabrication, and erection had bypassed the design and had come up with more rationale and economic ways to build short prestressed concrete bridges. In fact, recent discussions with major players in Ohio’s prestressed concrete development, such as Joseph Kelleher and William Roberts, suggests that the private sector was largely unaware of Carroll’s thesis or the bridges. The composite slab did not capture much interest outside of the few individuals who worked on the trial efforts within the Department.

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<table>
<thead>
<tr>
<th>County/SFN No. (Old Bridge No.)</th>
<th>Route/Stream</th>
<th>Date</th>
<th>Overall Length</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens (ATH-130690)</td>
<td></td>
<td>1954</td>
<td>33'</td>
<td>Replaced</td>
</tr>
<tr>
<td>Athens / 0503185 (ATH-144-0699)</td>
<td>SR 144 x Stream</td>
<td>1954</td>
<td>21'</td>
<td>In Inventory</td>
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<tr>
<td>Athens (ATH-144-0845)</td>
<td>SR 144 x Stream</td>
<td>1954</td>
<td>31'</td>
<td>Replaced</td>
</tr>
<tr>
<td>Galena (GAL-233-0081)</td>
<td>SR 233 x Black Fork of Symmes Creek</td>
<td>1954</td>
<td>20'</td>
<td>Replaced</td>
</tr>
<tr>
<td>Noble / 6101860 (NOB-145-0466)</td>
<td>SR 145 x Rocky Run</td>
<td>1954</td>
<td>26'</td>
<td>In Inventory</td>
</tr>
<tr>
<td>Noble / 6104509 (NOB-564-0813)</td>
<td>SR 564 x Stream</td>
<td>1954</td>
<td>24'</td>
<td>In Inventory</td>
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<tr>
<td>Noble / 6104053 (NOB-513-0545)</td>
<td>SR 513 x Stream</td>
<td>1955</td>
<td>23'</td>
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<tr>
<td>Noble / 6104770 (NOB-574-0015)</td>
<td>SR 574 x Stream</td>
<td>1955</td>
<td>26'</td>
<td>In Inventory</td>
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<tr>
<td>Noble / 6104800 (NOB-574-0031)</td>
<td>SR 574 x Stream</td>
<td>1955</td>
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<tr>
<td>Auglaize / 0603636 (AUG-364-1192)</td>
<td>SR 364 x Miami &amp; Erie Canal Feeder</td>
<td>1956</td>
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<tr>
<td>Franklin / 2531305</td>
<td>Reynoldsburg-New Albany Rd. x French Run</td>
<td>1956</td>
<td>39'</td>
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<tr>
<td>Noble / 6103847</td>
<td>SR 285 x Stream</td>
<td>1958</td>
<td>29'</td>
<td>In Inventory</td>
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</tbody>
</table>

Table 4. Prestressed Concrete Bridges built by the Ohio Department of Highways on a Trial Basis, 1954-58. Source: Notes prepared by Martin P. Burke Jr., Burgess & Niple, and in the files of David A. Simmons, Ohio Historical Society. Confirmed by field inspection.

A meeting of Ohio’s state highway officials was held in mid-1955 to discuss the future of prestressed concrete, and the outcome placed significant limits on its use by relegating the material to more trial or replacement efforts. It was concluded that if checking and analysis of prestressed concrete bridge theory and designs were to be continued by the Department, such effort should be limited to a study of a continuous reinforced-concrete deck and simply supported prestressed units. And following the meeting, Ohio Department of Highways Director S. O. Linzell decided to restrict the state's direct participation in prestressed concrete beam fabrication and construction to emergencies or to those projects not lending themselves to "contract lettings."
Ohio officials had been interested in continuity as a way to eliminate joints over piers and decrease long-term maintenance costs since the first continuous steel stringer bridges of the 1930s, and continuity would be the subject of the final study and report on prestressed concrete by Robert Carroll in the spring of 1956.\textsuperscript{30} The effort looked at using a continuous, reinforced-concrete deck composite with simple-span prestressed concrete beams (i.e., the deck is structurally bonded with the beams rather than simply resting on them). The issue of composite deck construction on prestressed concrete beams was a “hot” research subject in the mid 1950s, and the primary worries were about the possible failure of the bond between the top of the beam and the slab deck. Consequently all sorts of keys (raised and depressed) and stirrups extending beyond the top surface of the beams were tried. Finally, in 1957, tests at the University of Florida conclusively showed that a modest number of stirrups and the natural bond between the two concretes was enough to withstand repeated overloads. Tops of beams were left roughened and shear keys eliminated, and before long this practice was followed throughout the United States.\textsuperscript{31}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure10.png}
\caption{The 1959-60 prestressed concrete stringer bridge on US 37 over the Scioto River in Delaware County (SFN 2101351) was one of the two bridges built by the Ohio Department of Highways that marked the beginning of a slow shift in acceptance of standardized prestressed concrete bridges on state highways. Source: Lichtenstein, 2003.}
\end{figure}

The Ohio Department of Highways made plans in 1958 to build a continuous, composite-deck, prestressed concrete I-shaped beam bridge. The plan materialized the following year for a three-span, 236’ long bridge on US 35 over Salt Creek in Ross County (non-extant, demolished in 2003). A second, four-span, 306’ long bridge was built during the winter of 1959-60 by contractors Wander & Mason over the Scioto River on US 37 in Delaware County (SFN 2101351, Figure 10). In the absence of state standards, both bridges relied on AASHO-PCI Type V beams, not the T-shaped beams proposed by Carroll in his 1956 study. The Ross County structure used post-tensioning with draped strands and end blocks while the Delaware County bridge was pretensioned with deflected strands and no end blocks.

The variations, particularly those associated with the presence or absence of end blocks, were indicative of the state’s tentative exploration of the technology, since the merits of these variations were then already under discussion by engineers in Ohio and

\textsuperscript{30} Ibid.

\textsuperscript{31} Reflections on the Beginnings of Prestressed Concrete in America (1981), p. 326.
throughout the nation. Most of the variations are only discernible in the plans, not in the field, because the ends of the beams are not exposed.32

The state’s reluctance to use prestressed concrete was also founded on the professional opinions of Henry Overman, assistant chief engineer of the bridge bureau, and William Rabe, one of the state’s primary bridge designers and an especially strong advocate of steel, who both harbored doubts about the material, no matter what type of beam or design was involved. Overman is reported to have told representatives of the prestressed concrete industry that he had questions about the longevity of prestressed concrete and was unsure whether it could be maintained over time.33 State officials also expressed a reluctance to invest the staff time and assume the expense of preparing state standards for prestressed concrete bridges, claiming that there was insufficient demand for them. The state’s engineers expressed concerns that expanding the state’s activity in prestressed concrete might raise objections from product manufacturers or contractors. Their reasons for not using prestressed concrete, however, had little to nothing to do with the technical success or failure of the composite slab bridges fabricated and placed by the Marietta division state forces in 1954-55 or the two stringer bridges with continuous, composite decks built by private contractors on state routes in 1958-59.34

So entrenched was the Department’s reluctance to use prestressed concrete that it was not until the Ohio Prestressed Concrete Association (a private sector, trade group established in 1959 and representing nine companies from all across Ohio) paid for preparation of prestressed concrete bridge standards that the state adopted them late in 1960. The bridge standards did not feature continuous deck designs, but they offered both composite and non-composite deck variations. The I-beams ranged in


34 Carroll, “Early Prestressed Concrete Development”; “High Court Reverses Lower: Ohio Turnpike to be Concrete,” Engineering News-Record v. 150 (June 11, 1953), pp. 21-22; Telephone interview of Frederick H. Ray, West Worthington, Ohio, August 21, 2002; Telephone interview of Joseph Kelleher, Worthington, Ohio, July 24, 2002; "Report on Loading Tests of Composite Beams, April 1956" by Robert Carroll, Robert Carroll Papers. Circumstantial evidence suggests that senior state officials had plenty of reasons to simply brush aside the trial effort and not advertise its results. The design didn’t appear to offer any significant cost-savings nor advance engineering knowledge, and it had the distinct possibility of upsetting private interests. The prestressed concrete industry had a stake in not wanting the state going into the business of fabricating beams for itself, and perhaps more importantly Ohio’s powerful steel interests had no reason to encourage the use of an alternative beam material.
depth from 30" to 54" and spans lengths of from 40' to 100'. The hollow box beam plans were for 36" wide by 21" to 42" deep boxes for spans from 35' to 95'. Absent from the standard designs was Carroll’s composite slab.

The Ohio Prestressed Concrete Association was formed in the summer of 1959 “to stimulate and advance the general welfare” of the industry. The creation of state standards for prestressed concrete bridges and building components was among the first orders of business. Under the leadership of association president Tadius “Ted” Gutt of Cleveland’s Rackle company, a “bridge committee” was directed to “develop safe and economical specifications for lineal prestressed concrete products” and obtain their approval and acceptance among private and public officials. The initial budget of $20,000 appropriated for this purpose would eventually prove inadequate. Nonetheless, standard drawings for I-beam and box beam bridges were prepared by Erik Ericksson Engineering on behalf of the association and officially approved for use by the state on November 15, 1960. Since these standard drawings were not approved by the state until late 1960, they were not applied to any of the bridges in the study population.35

<table>
<thead>
<tr>
<th>SFN/County</th>
<th>Feature Carried/Crossed</th>
<th>Summary of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>210135, Delaware</td>
<td>US 37 over Scioto River</td>
<td>The 1959-60, prestressed concrete stringer bridge with a continuous-design composite deck on simply supported I beams represents the Ohio Department of Highway's earliest foray into a prestressed concrete bridge type and design that would influence its decision to adopt the material for use on state highways. While it is not a technologically significant bridge, the US 37 bridge is historically significant as it starts an important and significant shift in state highway department policy (Criterion A).</td>
</tr>
</tbody>
</table>

Table 5: Recommended Eligible, State-Built Prestressed Concrete Bridge

35 “Resolution of the Ohio Prestressed Concrete Association,” September 1, 1959, “Code of Regulations of Ohio Prestressed Concrete Association,” and “Figure Prestressed Concrete in Your Plans,” AIA File No. 4-E-12, all from the Tadius J. Gutt Collection, Phoenix, AZ; Telephone interview of Joseph Kelleher, Worthington, Ohio, July 24, 2002. Both Gutt and Kelleher had experience with early prestressed concrete developments in Pennsylvania that marked the beginnings of the industry in the United States.
Prestressed Concrete Bridges at the County Level

A number of Ohio counties, including Auglaize, Green, Hamilton, and Muskingum, working with consulting engineers, bridge contractors, and beam fabricators who were promoting the material, quickly recognized the advantages of precast, prestressed concrete bridge units. They did not hesitate to use the material, especially when speed of erection was an important consideration. While some of the early prestressed concrete bridges have been lost, enough of the pre-1957 population survives to inform how the material came to be a dominant alternative to steel and reinforced concrete for county-built bridges in Ohio. Largely through the foresight and effort of consulting engineers such as Hanly & Young of Cincinnati, who did most of the bridge work for Hamilton County, and Charles Roberts, the counties were building both standardized and non-standardized designs of prestressed concrete bridges as early as 1952. Individual efforts were aided by a plethora of articles on the subject in the technical publications of the day, BPR’s influential 1952 (revised 1954) Design Criteria for Prestressed Concrete Bridges, and annual national conferences with published proceedings like the first one held at MIT in August 1951. By the late 1950s, Ohio’s counties and the state’s prestressed concrete industry had demonstrated, even to the skeptical Ohio Department of Highways, that prestressed concrete was a viable and important new bridge technology that could not be ignored for reasons of cost, maintenance, efficiency, speed of erection, and availability of material.

The most important prestressed concrete bridge in the state is the 1952 Roseville Bridge in Muskingum County (SFN 6036155, Figure 11). Not only is it Ohio’s first prestressed concrete bridge, but it also demonstrated the advantages of the material to engineers and bridge contractors throughout the region. Construction of the Roseville Bridge was so regionally important that on July 29, 1952, over 400 engineers from Ohio, West Virginia, Pennsylvania, Illinois, Indiana, Michigan “gathered at Roseville, Ohio, to inspect the first prestressed concrete bridge in that state.” It is also reportedly the first example in the country of “pretensioned” units constructed at the site. The prestressed concrete I-shaped beam design was developed as an alternate to a steel stringer bridge by Wander & Mason, bridge contractors from Worthington, Ohio, who are credited with the design, and Charles Roberts, another registered engineer and Ohio pioneer in prestressed

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concrete, who assisted with the design. The county selected the prestressed concrete alternate over a traditional steel stringer design because it could be constructed in half the time (approximately seven months as opposed to 14 months) and its anticipated lower, long-term maintenance costs. Russell Mason stated when the bridge was about 70 percent complete that “... it is apparent that in the future prestressed concrete will be competitive in first cost with other conventional types of bridges.”

The five span, 226'-long Roseville Bridge with 44'-long and 30"-deep beams is a watershed in the application of prestressed concrete for bridges in Ohio as it proved the viability of the material. Other counties, like Auglaize, Champaign, and Hamilton, followed Muskingum County’s lead and almost immediately began erecting prestressed concrete bridges. For example, Hamilton County built three, I-shaped beam bridges designed by Hanly & Young in 1953. Wander & Mason followed their success with the Roseville Bridge by building bridges in other counties, and Charles Roberts, who had worked in Florida for over a year with an unsuccessful bidder on the design for the prestressed concrete approach spans for the 1951-1954 Sunshine Skyway across Tampa Bay, returned to Ohio to join his son William Roberts in an endeavor to manufacture and sell prestressed concrete bridges. The Roberts sold many modified T-shaped beam and adjacent box beam bridges to the counties (see below).

The design that did more than any other to promulgate prestressed concrete bridge technology to the cities and counties was the voided box beam developed by Concrete Products Company of America in Pottstown, Pennsylvania, in 1949-50. They came up with the 17" and 21"-deep precast hollow box beam as a longer and stronger replacement for the reinforced concrete channel beam, a precast unit that was being used with great frequency on secondary roads after World War II. Concrete Products Company was looking for a way to increase the capacity of the channel beam to H20, and they achieved the desired stiffness by enclosing the C-shaped channel beam into a box shape and then applying the new reinforcing system of prestressing with seven-strand wire developed by the John A. Roebling Sons Company. They worked with the Pennsylvania State Highway Department, which placed its first adjacent box beam bridges late in 1950. Concrete Products Company successfully marketed the beams throughout the region, and they were among the sponsors of, and presenters at, the First United States Conference on Prestressed Concrete at MIT in 1951. While other engineers also produced beam designs, it was the voided box beam that came to dominate for span lengths up to 100' during the last half of the 20th century. In Ohio, the historically and technologically significant early examples of the prestressed concrete hollow box beam, such as the 1954 Middleburg Road bridge in Champaign County (SFN 1130412) and the 1956 Middle Pike bridge in Auglaize County (SFN 0630535) date from 1954 through 1956, after which they became increasing common on non-state roads.

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37 “Ohio’s First Prestressed Concrete Bridge,” Concrete, November, 1952, p. 18.
The 1959 Suder Avenue bridge in Toledo (SFN 4860098, Figure 12) is significant as one of the earliest, long, prestressed concrete adjacent box beam bridges. It represents one of the first known instances of 100’ long beams being used, and the bridge ranks as a milestone in the evolution of the important bridge type within the state and the nation. A 1950 Villanova University engineering school graduate named Joseph Kelleher went to work for Concrete Products Company at Pottstown, and he later moved to Pittsburgh where he set up their Neville Island fabricating yard where both 3’ wide and 4’ wide beams were made. In 1958, Mr. Kelleher left Concrete Products Company and moved to Toledo where he designed and set up the fabricating facility for Great Lakes Structural Concrete Products. It was a state-of-the-art facility designed to accommodate construction of the 42” deep and 100’ long beams that would be needed for the upcoming Suder Avenue project. Kelleher worked with Lucas County Engineer Arthur Ozzlin, who was “technically very good,” according to Mr. Kelleher. The Suder Avenue bridge was designed for use by heavy equipment associated with construction of the nearby Interstate highway. The deck was not made composite, just an asphalt wearing surface. This was the first of two or three 100’ box beam bridges that Great Lakes Structural Concrete Products constructed for Lucas County. Another example is Central Avenue in Toledo that is believed to postdate 1960.

One of the alternative designs that did not become standard but resulted in bridges that influenced adoption of the material for bridge construction in the state was a modified T beam marketed by Charles and William Roberts (Figure 13). Starting in 1954, in addition to 17” voided box beams, the Roberts initially marketed a modified T beam design that was developed and manufactured by a firm in White Marsh, Maryland. They went on to purchase more beams because they thought that the 2’-wide beams had the advantage of being lighter than a comparable prestressed concrete box beam with its 3’ width. This facilitated erection of up to 65’ long beams with
then-available equipment, which, at that time, included few heavy cranes. The Maryland firm went bankrupt, so in 1954, the Roberts set up their own casting yard at Crestline where they manufactured the same design T beams as well as standardized adjacent box beams under the name of Prescon. Both types of beams were made in steel forms that William Roberts remembers being made in Plant City, Florida. The Roberts were not able to make a financial success of the Crestline facility, so it was sold to Intrusion Prepakt of Cleveland about 1956, it was then restyled as Concrete Fabricators, Inc. Concrete Fabricators continued to make and sell prestressed beams to the counties, and about 13 examples dating from 1954 until 1960 survive.

The Roberts’s non-standard, modified T beam design is reflective of the early days of prestressed concrete bridges (pre-1957) when many engineers would design their beams believing that theirs was the most efficient and economical for a given span length and load. What the modified T beam bridge accomplished was introducing the material into many counties in Ohio. But as the decade progressed, two standardized designs, the I-shaped beam and the voided box beam, came to dominate in Ohio and the United States, and fabrication of the units was consolidated under the control of large companies as was the case with the American-Marietta Company, which had fabricating yards in most midwestern states. American-Marietta even acquired Concrete Products Company of America. American-Marietta’s Amdek logo is still visible on some beams throughout the state.
<table>
<thead>
<tr>
<th>SFN/County</th>
<th>Feature Carried/Crossed</th>
<th>Summary of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0630535, Auglaize</td>
<td>Middle Pike (DUC-150-16.87) over Dry Run</td>
<td>The 40’-long box beam bridge built by Prescon, Inc. in 1956 for Auglaize County ranks as one of the earliest extant adjacent box beam bridges in the state, and as such it represents the introduction of the important bridge type and design in Ohio (Criterion C).</td>
</tr>
<tr>
<td>1130234, Champaign</td>
<td>Lippincott Road over Mad River</td>
<td>The 1958 adjacent, continuous, box beam bridge built by Concrete Fabricators, Inc., (Charles &amp; William Roberts) is historically significant as an early state example of a prestressed concrete bridge on a federal aid project on a county road. It marks the beginning of local-level participation in what has evolved into an extremely successful and influential federal program. The bridge represents that transition (Criterion A).</td>
</tr>
<tr>
<td>1130412, Champaign</td>
<td>Middleburg Road over Branch of Big Darby Creek</td>
<td>The prestressed concrete, adjacent box beam bridge was built in 1954 for the county by Prescon, and it is one of the oldest extant hollow box beam bridges in Ohio. It is the early applications that are recognized as historically and technologically significant for their pioneering and influential introduction of the technology into the state and on the eventual widespread acceptance of the technology (Criterion C).</td>
</tr>
<tr>
<td>2935716, Greene</td>
<td>Grinnell Road over Yellow Springs Creek</td>
<td>The prestressed concrete, modified tee beam bridge built in 1954 is one of the oldest extant examples in Ohio of a pre-standardized design marketed and manufactured by Charles and William Roberts, pioneers in prestressed concrete bridges in the state. Their influential introduction of the technology led to the widespread acceptance of prestressed concrete as a bridge-building material (Criterion C).</td>
</tr>
<tr>
<td>3132749, Hamilton</td>
<td>CR 365 (B-0087) over Five Mile Creek</td>
<td>The bridge is one of two similar bridges on Five Mile Road designed in 1953 by Hanly &amp; Young Structural Engineers, a Cincinnati firm that did most of the design work for Hamilton County at that time. Hanly was particularly enthusiastic about prestressed concrete and was a pioneer in its use in Ohio. The bridges are among the oldest prestressed concrete bridges in Ohio and chronicle how progressive consulting engineers and county engineers influenced the subsequent domination of the material for locally constructed bridges (Criterion C).</td>
</tr>
<tr>
<td>3132730, Hamilton</td>
<td>CR 365 (B-0071) over Five Mile Creek</td>
<td>Same as SFN 3132749 (above).</td>
</tr>
<tr>
<td>County</td>
<td>Location</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>Lucas</td>
<td>4860098, Suder Avenue over Ottawa River</td>
<td>The 1959 Suder Avenue bridge in Toledo is historically and technologically significant as one of the earliest, truly long, prestressed concrete adjacent box beam bridges in the country. It represents one of the first known instances of a 100' long beams being used, and the bridge ranks as a milestone in the evolution of the extremely important bridge type (Criterion C).</td>
</tr>
<tr>
<td>Muskingum</td>
<td>6036155, CR 32 (Main Street) over Moxahola Creek</td>
<td>The 1952 Roseville Bridge ranks as the most significant prestressed concrete bridge in the state and one of the most important nationally based on its early date of construction and state of completeness. Construction of the bridge was so important that on July 29, 1952, over 400 engineers and technicians engaged in various phases of concrete design gathered at Roseville to inspect the first prestressed concrete bridge in the state. It is reportedly the first pretensioned units constructed at the site. The design was by Ohio prestressed concrete pioneers Charles Roberts and Wander &amp; Mason (Criterion C).</td>
</tr>
<tr>
<td>Summit</td>
<td>7731108, Brady Avenue over Wolf Creek</td>
<td>The prestressed concrete, modified T-shaped stringer bridge built in 1954 is one of the oldest examples in the state of the pre-standardized design marketed and fabricated by Charles and William Roberts, pioneers in prestressed concrete bridges in Ohio. The bridge chronicles the transition from steel and reinforced concrete to the material that would become the only serious rival to steel as a dominant bridge-building material during the second half of the 20th century (Criterion C).</td>
</tr>
</tbody>
</table>

Table 6: Recommended Eligible, County-Built Prestressed Concrete Bridges.
Arch Bridges

Reinforced Concrete Arch Bridges. ODOT’s “Concrete Arch Supplement to the Ohio Historic Bridge Inventory” (1994) develops the historic context for the reinforced concrete arch bridges prior to 1951. As it points out, the first reinforced concrete arch bridge in the state was built in Cincinnati’s Eden Park in 1895. The technology spread throughout the state during the first decades of the 20th century and construction of reinforced concrete arch bridges peaked during the 1920s.

Following World War II, the reinforced concrete arch bridge type fell from popularity in Ohio as well as nationally. The leading factor in decline was one of economics – reinforced concrete arch bridges were labor intensive, requiring extensive falsework and curing time, in a period when labor costs were rising. The arches also used more material in comparison with other reinforced concrete bridge types such as the rigid frame and tee beam of similar span lengths. Furthermore, arch bridges did not lend themselves to standard plans. In fact, they were never a standard of the Ohio Department of Highways except for short-span arch culverts.

By the 1950s, reinforced-concrete arch bridges were usually strictly limited to use in settings where an aesthetic bridge was desired, such as parks and parkways, and even there, rigid frame bridges detailed to appear as arches, were often selected instead. The three 1950s reinforced concrete deck arch bridges in the study population are all in park or park-like settings in Cuyahoga County.

The skewed, 362'-long, three span, ribbed open spandrel arch bridge that carries Monticello Road over Euclid Creek (SFN 1830082, Figure 14) is by far the most interesting and technologically significant of Ohio’s 1950s reinforced concrete arch bridges. With its deck-stiffened arches, the bridge is reduced to its most basic form with no applied ornamentation. The main span, a three-center arch, has a small rise of 18'-8" over its 140' length. The approach spans are segmental with the springing at the interior and crown at the ends. The abutments are well designed with buried buttresses to resist the arch thrust. The plain spandrel walls extend beyond the plane of the ribs to support the cantilevered deck sections. Since the distance between the walls varies, the slopes of the walls differ to create an uncommon visual effect.

Figure 14: The 1954 Monticello Road bridge over Euclid Creek (SFN 1830082) is a rare example of a deck-stiffened open spandrel arch bridge. The bridge was designed by Cleveland’s Osborne Engineering Co. It was undergoing rehabilitation when this photo was taken. Source: Lichtenstein, 2003.
The 1954-55 Monticello Road bridge is a rare and successful American example of the attenuated, deck-stiffened arch bridge design and aesthetic developed by noted Swiss engineer Robert Maillart. Distinguished by the extremely thin arch ribs and spandrel supports, Maillart’s sleek, severe, deck-stiffened arch bridges were not built in great numbers in the United States. The Monticello Road bridge was designed by Osborn Engineering of Cleveland, and the bridge type and design were selected because of the setting in the Euclid Creek Reservation and the insistence of William Stinchcomb of the Metropolitan Park Board. The Monticello Road bridge marks a strong departure from the more commonly used designs for open spandrel arch bridges in the state and midwest region.\(^{38}\)

<table>
<thead>
<tr>
<th>SFN/County</th>
<th>Feature Carried/Crossed</th>
<th>Summary of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1830082, Cuyahoga</td>
<td>Monticello Road over Euclid Creek</td>
<td>Monticello Road bridge, built in 1954-55 and designed by Osborn Engineering Co., reflects the influence of the design and aesthetic developed by noted Swiss engineer Robert Maillart. It marks a strong departure from the commonly used design for open spandrel arch bridges in the state and region. It has high artistic merit (Criterion C).</td>
</tr>
</tbody>
</table>

Table 7: Recommended Eligible Reinforced Concrete Arch Bridge

**Steel Thru Arch Bridges.** The steel thru arch bridges in the 1950s survey population all have a pair of laterally braced arch ribs, either built up or welded box sections, above the deck, which is supported by hangers. The principle of the arch, where the arch ring is in compression and the horizontal thrust of the arch ring has be countered by an equal reaction at the skewback or abutments, is the same regardless if the arch is masonry or metal or if the design is deck or thru. Need for massive abutments was eliminated by using a tied arch. In that design, the horizontal thrust is taken by one or more horizontal beams or ties that extends the length of the arch between or near springing points. The vertical component of the arch thrust is carried by the abutments. The design is not unlike the bowstring arch truss.

The steel arch bridge reached maturity during the last quarter of the 19th century, and it was used for major rail and vehicular crossings during the first quarter of the quarter of the 20th century. But it was used increasingly for smaller bridges during the middle of the century, especially after the development of arc welding in the late 1920s, which meant that the lightness and grace previously reserved for suspension bridges could be

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brought to the steel thru arch because of the ability to more easily fabricate curved and variable depth steel members.  

The most distinguished example of a steel arch bridge in the 1950s study population is the three-hinged, steel thru arch pedestrian bridge that links two sections of Gordon Park in Cleveland, Cuyahoga County (SFN 1808370, Figure 15). The 205'-long main span of the 459'-long pedestrian overpass has ribs composed of angles and plates welded to make a box with battens on the bottom. The bridge was built in 1952 as part of the completion of the east section of the Memorial Shoreway. The Shoreway was started with Works Progress Administration (WPA) participation in the mid 1930s with long sections on both the east and west sides completed prior to World War II. A seven-million-dollar addition connecting the sections and improving the original highway to an eight-lane, limited access through highway was completed in 1953. The 1952 pedestrian bridge was designed by the Ohio Department of Highways and was fabricated by the Mount Vernon Bridge Company. It received an American Institute of Steel Construction (AISC) honorable mention award for 1952, given to steel bridges that displayed both architectural and engineering merit. Technologically it is a relatively early and complete example of a welded arch that was used again for two bridges in Cuyahoga County designed by Osborn Engineering and for a nearly identical 1959 pedestrian bridge in Cincinnati (SFN 3111342).

The two steel thru arch highway bridges in the study population are tied arches with riveted members. The 1957 Division Street bridge at Youngstown in Mahoning County (SFN 5008298) and the 1959 Old Mill Road bridge over the Chagrin River at Gates Mills in Cuyahoga County (SFN 1832271) are later and undistinguished examples of a technology and bridge type that was already well established by the mid 20th century and represented by pre-1951 bridges in the previous ODOT arch bridge inventory.

<table>
<thead>
<tr>
<th>SFN/County</th>
<th>Feature Carried/Crossed</th>
<th>Summary of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFN/County</td>
<td>Feature Carried/Crossed</td>
<td>Summary of Significance</td>
</tr>
</tbody>
</table>

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Historic Highway Bridges in Pennsylvania (Harrisburg: Commonwealth of Pennsylvania), 1986, pp. 91-103.
1808370, Cuyahoga

Gordon Park Pedestrian Bridge over IR 90

The bridge is a relatively early and complete example of a welded arch that was used again for two bridge in Cuyahoga County designed by Osborn Engineering and for a nearly identical 1959 pedestrian bridge at Cincinnati. This is a technologically significant example that applied the welded fabrication method to arch bridges (Criterion C).

<table>
<thead>
<tr>
<th>Table 8: Recommended Eligible Steel Thru Arch Bridge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural Steel Plate Corrugated Arches.</strong> A very common type of drainage structure on highways and railroads throughout Ohio and the nation is the structural steel plate corrugated arch. The arches were introduced in 1931 when Armco Drainage and Metal Products, Inc. of Middletown, Ohio, began producing them in diameters up to about 20’. They were the product of advances associated with the corrugated metal pipe culverts that had become ubiquitous during the 1910s and 1920s. The multi-plate arches were developed because of the practical limitations of manufacturing and shipping large diameter pipes. Most steel plate corrugated arches are either the half-circular (spring lines vertical with the footings) or reentrant (spring lines are above the footings) design, and both are typically placed on concrete footings. The multi-plate arches are built up of corrugated steel plates curved at the factory and shipped in nested, knocked-down form for bolted assembly in the field. The multi-plate arch design proved to be resistant to cracking and disjointing under loads, easy to construct, and durable. It was immediately popular in Ohio and throughout the country, and it is still being used today with little variation in design. None of the identified corrugated metal plate arches of 20’ long or greater (greater lengths are sometimes recorded because of the way skew is measured, not because the openings are that long) from 1951 to 1960 in Ohio were evaluated as significant for their technology or engineering.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Wood Bridges</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NBIS data initially identified four wood bridges dated from 1951 to 1960. Phase 1 research confirmed that three of the four bridges were post-1980 superstructures on older substructures, thus eliminating them from further consideration. The fourth example in Champaign County (SFN 1130978) is a laminated wood girder-floorbeam structure dated 1960 but which appears to be newer or have much in-kind replacement material. The bridge is not considered historically or technologically significant.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Bascule Bridge</strong></th>
</tr>
</thead>
</table>

The Robert Craig Memorial Bridge at Toledo (Lucas County #4805917), a bascule bridge over the Maumee River, was built by the state in 1956 as part of the Toledo-Detroit Expressway, one of several pre-interstate, limited-access, urban expressways in the state. It was taken into the state’s interstate highway system after 1956 and was then designated IR 280. In 2004, it was being bypassed by the construction of a high-level, cable-stay bridge on a new alignment. The new bridge is part of an upgrading of the highway. The project to bypass the bascule bridge had been through environmental review in the mid-1990’s prior to the bridge being 50 years old. In that NEPA document the commitment was made that the 1956 bascule bridge was to remain in place to carry local traffic. Therefore it is being preserved for functional reasons.

The Maumee River bridge is the only bascule bridge built in the state during 1951-1960 period, but there are many that were built prior to 1960. This is a late example of its type. Bascule bridge technology saw its most rapid period of development between 1895 and 1920, and there are at least four earlier highway examples in Ohio: (1) SR 531 over the Ashtabula River (Ashtabula County, 0406635), built in 1925, a Strauss heel-trunnion design (evaluated select); (2) US 6 over the Black River (Lorain County, 4700813), built in 1939, a double-leaf bascule (evaluated select); (3) Cherry Street over the Maumee River (Lucas County, 4860004), built in 1914, a double-leaf bascule (evaluated select); (4) Highway/Pedestrian Walk over Portage River (Ottawa County, 6201628), built in 1933 (evaluated select). The highway with which the bridge is historically associated has been significantly altered from its pre-1956 appearance and, in sections, alignment.
<table>
<thead>
<tr>
<th>SFN/Location</th>
<th>Bridge Type/Design</th>
<th>Yr. Built</th>
</tr>
</thead>
<tbody>
<tr>
<td>0630535, Auglaize County Middle Pike over Dry Run</td>
<td>Prestressed Concrete Box Beam</td>
<td>1956</td>
</tr>
<tr>
<td>1130234, Champaign County Lippincott Road over Mad River</td>
<td>Prestressed Concrete Box Beam</td>
<td>1958</td>
</tr>
<tr>
<td>1130412, Champaign County Middleburg Road over Br. of Big Darby Creek</td>
<td>Prestressed Concrete Box Beam</td>
<td>1954</td>
</tr>
<tr>
<td>1808370, Cuyahoga County Gordon Park Pedestrian Bridge over IR 90</td>
<td>Steel Thru Arch</td>
<td>1952</td>
</tr>
<tr>
<td>1830082, Cuyahoga County Monticello Road over Euclid Creek</td>
<td>Reinforced Concrete, Ribbed Open Spandrel Arch</td>
<td>1954</td>
</tr>
<tr>
<td>2101351, Delaware County US 37 over Scioto River</td>
<td>Prestressed Concrete Stringer</td>
<td>1959-60</td>
</tr>
<tr>
<td>2935716, Greene County Grinnell Road over Yellow Springs Creek</td>
<td>Prestressed Concrete, Modified T Stringer Bridge</td>
<td>1954</td>
</tr>
<tr>
<td>3061043, Guernsey County Campbell Avenue over Wills Creek</td>
<td>Steel, Polygonal Warren Pony Truss</td>
<td>1958</td>
</tr>
<tr>
<td>3132749, Hamilton County CR 365 over Five Mile Creek</td>
<td>Prestressed Concrete Stringer</td>
<td>1953</td>
</tr>
<tr>
<td>3132730, Hamilton County CR 365 over Five Mile Creek</td>
<td>Prestressed Concrete Stringer</td>
<td>1953</td>
</tr>
<tr>
<td>4860098, Lucas County Suder Avenue over Ottawa River</td>
<td>Prestressed Concrete Box Beam</td>
<td>1959</td>
</tr>
<tr>
<td>6036155, Muskingum County CR 32 over Moxahola Creek</td>
<td>Prestressed Concrete Stringer</td>
<td>1952</td>
</tr>
<tr>
<td>7731108, Summit County Brady Avenue over Wolf Creek</td>
<td>Prestressed Concrete, Modified T Stringer Bridge</td>
<td>1954</td>
</tr>
</tbody>
</table>
APPENDIX A

OHIO HISTORIC BRIDGE INVENTORY UPDATE
SURVEY FORMS FOR ELIGIBLE BRIDGES, 1951-1960
Ohio Department of Transportation  
Historic Bridge Inventory - Phase 2  
Pre-1961 Interstate Highway Bridges

<table>
<thead>
<tr>
<th>Bridge #</th>
<th>0630535</th>
<th>County:</th>
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<th>Municipality:</th>
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<td>COUNTY</td>
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<td>Location:</td>
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<td>UTM:</td>
<td></td>
<td></td>
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<tr>
<td>Feature On:</td>
<td>MIDDLE PIKE (DUC-150-16.87)</td>
<td>Design:</td>
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<tr>
<td>Feature Intersected:</td>
<td>DRY RUN</td>
<td>Type:</td>
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<td>Material:</td>
<td>PRESTRESSED CONCRETE</td>
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</tr>
<tr>
<td># Spans:</td>
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<td>Deck Width:</td>
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</tr>
<tr>
<td>Year Built:</td>
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<td>Alteration (Date):</td>
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<td>Source:</td>
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</tr>
<tr>
<td>Standard Design:</td>
<td>(Yes or No)</td>
<td>No</td>
<td></td>
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</tr>
</tbody>
</table>

Physical Description:
The skewed, one span, 40' long and 26' wide, prestressed concrete, adjacent box beam bridge is supported on concrete abutments and is finished with structure mounted beam guide rail railings. The bridge appears to be complete.

Integrity:

Summary of Significance:
The adjacent box beam bridge was placed by the county in 1956. The county has the records for the bridge. County Engineer George A. Shuster was an early proponent for using prestressed concrete, and the county has six examples from the 1950s. Auglaize County was among the earliest counties in the state to build prestressed concrete bridges in any number. This one ranks as one of the earliest extant adjacent box beam bridges in the state, and as such it represents the introduction of the important bridge type and design into the state (criterion C). There were several bids for different types of superstructures for this crossing, but Prescon won the bid. (Prescon, Inc, Prestressed Concrete and Steel Structures, 58 West Tulane Rd., Columbus). The beams were purchased by Prescon from Lamar Pipe and Tile in Grand Rapids, MI, but the Roberts would later manufacture voided box beams at their Crestline facility.

Concrete Products Company of America in Pottstown, PA developed and tested a precast prestressed concrete beam in 1950. Working in conjunction with the Pennsylvania State Highway Department, they came up with the precast hollow box beam that was longer and stronger than the reinforced concrete channel beam. The desired stiffness was achieved by enclosing the previously developed channel beam and then applying the new reinforcing system of prestressing with 7-strand wire developed by the John A. Roebling Sons Company. The Pennsylvania State Highway Department placed its first adjacent box beam bridges late in 1950, and Concrete Products Company successfully marketed the beams throughout the region. While other engineers also produced beam designs, believing that theirs was the most efficient and economical for a given span and load, it was the voided box beam that came to dominate for span lengths up to 100’ during the last half of the 20th century. In Ohio, the historically
and technologically significant examples of the prestressed concrete hollow box beam date from 1954 through 1956.

Father Charles and son William went into business together to sell prestressed concrete bridges to the counties, and they also started their own manufacturing yard at Crestline in 1954-55. Charles, a second-generation Ohio bridge contractor and registered engineer, was enthusiastic about the new material, and he had worked in Florida for over a year with an unsuccessful bidder on the prestressed concrete approach spans for the 1951-1954 Sunshine Skyway across Tampa Bay. They initially sold T beams as well as 17” deep box beams like these that were manufactured by others. The Roberts set up their own casting yard at Crestline where they manufactured the modified T beams as well as standardized adjacent box beams under the name of Prescon. Both types of beams were made in steel forms that William Roberts remembers being made in Plant City, Florida. The Roberts were not able to make a financial success of the Crestline facility, so it was sold to Intrusion Prepakt of Cleveland about 1956, it was then restyled as Concrete Fabricators, Inc. Concrete Fabricators continued to make and sell prestressed concrete beam bridges to the counties. William Roberts remained with Concrete Products, Inc.

Sources: William Roberts Personal Communication with Mary McCahon, Feb. 10, 2004. Mr. Roberts lives in Sun City, FL.

Reviewed By: MEM (2/04)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

Bridge #: 1130234  County: CHAMPAIGN  Municipality: CONCORD TWP

NR Recommendation: Eligible

ODOT District: 7  Owner: COUNTY

Location: .6 MI E OF YEARION RD  UTM:
Feature On: LIPPINCOTT ROAD
Feature Intersected: MAD RIVER

Type: BOX BEAM  Design: ADJACENT

Material: PRESTRESSED CONCRETE
Railing Type: BEAM GUIDE RAILS (CA 1998)

# Spans: 3  Length: 108 ft (32.9 m)  Deck Width: 24 ft (7.4 m)
Year Built: 1958  Alteration (Date):

Source: WM ROBERTS
Standard Design: (Yes or No) No

Physical Description:
The skewed, 3 span, adjacent box beam bridge is supported on concrete abutments and piers with concrete-filled fluted steel piles and deep concrete cap beams. The bridge is finished with structure mounted beam guide rails installed as in kind replacements of the originals ca. 1998. The fascia beams have been repaired.

Integrity:

Summary of Significance:
According to William Roberts, who built the bridge, the 1958 Lippincott Road bridge was the first prestressed concrete bridge on a county road constructed with federal aid. For many years, the federal Bureau of Public Roads participated in the construction of bridges on a 50-50 matching funding basis, but most counties found that they could construct bridges more economically and with less “red tape” by funding their construction themselves. Since there was federal participation in this bridge and its cost exceeded $10,000, by state statute, the state highway department’s bridge bureau had to review the plans. Mr. Roberts remembers that state bridge engineer Henry Overman did not want to do the bridge in prestressed concrete. The county engineer, however, was convinced from his previous experience with prestressed concrete bridges, that it “was the way to go.” Mr. Overman was an advocate of continuous design bridges in order to eliminate joints over bearings, which are a constant source of deterioration. He approved this bridge with the understanding that the beams be made continuous as best they could thus eliminating all joints over the piers. So successful was Mr. Overman’s suggestion that the detail was used repeatedly on successive, multi-span prestressed concrete bridges. The detail continues to be used today, both as initial construction and as a retrofit. The beams for this bridge were fabricated by Concrete Fabricators, Inc. The bridge is historically significant (criterion A) as an early state example of a federal aid project on a county road. It marks the beginning of local level participation in what has evolved into an extremely successful and influential federal program. This bridge represents that transition.

Concrete Products Company of America in Pottstown, PA developed and tested a precast prestressed concrete beam in 1950. Working in conjunction with the Pennsylvania State Highway Department, they came up with the
precast hollow box beam that was longer and stronger than the reinforced concrete channel beam. The desired stiffness was achieved by enclosing the previously developed channel beam and then applying the new reinforcing system of prestressing with 7-strand wire developed by the John A. Roebling Sons Company. The Pennsylvania State Highway Department placed its first adjacent box beam bridges late in 1950, and Concrete Products Company successfully marketed the beams throughout the region. While other engineers also produced beam designs, believing that theirs was the most efficient and economical for a given span and load, it was the voided box beam that came to dominate for span lengths up to 100' during the last half of the 20th century. In Ohio, the historically and technologically significant examples of the prestressed concrete hollow box beam generally date from 1954 through 1956. This slightly later example is significant for its associative significance with the important funding source.

Reviewed By: MEM (2/04)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

Bridge #: 1130412  County: CHAMPAIGN  Municipality: RUSH TWP

NR Recommendation: Eligible

ODOT District: 7  Owner: COUNTY

Location: .5 MI E OF SR 245  UTM:

Feature On: MIDDLEBURG ROAD
Feature Intersected: BRANCH OF BIG DARBY CREEK

Type: BOX BEAM  Design: ADJACENT

Material: PRESTRESSED CONCRETE

Railing Type: BEAM GUIDE RAILS

# Spans: 1  Length: 24 ft (7 m)  Deck Width: 24 ft (7.3 m)

Year Built: 1954  Alteration (Date):  Source: WM ROBERTS

Standard Design: (Yes or No) No

Physical Description:
The 1 span, 24'-long, prestressed concrete box beam bridge is supported on scored concrete abutments with stepped wingwalls. It is finished with structure mounted beam guide rail railings.

Integrity:

Summary of Significance:
The prestressed concrete, adjacent box beam bridge was built in 1954 for the county by Prescon, and it is one of the oldest extant hollow box beam bridges in the state. The beams were purchased from the Indiana Limestone Company. The bridge chronicles the transition from steel and reinforced concrete to the material that would become the only serious rival to steel as a dominant bridge building material during the second half of the 20th century. It was far-sighted county engineers like those in Auglaize, Hamilton, and Champaign counties working with contractors and fabricators like the Roberts who introduced and demonstrated the viability of the prestressed concrete in several efficient, economical, and easily erected bridge types in Ohio, and this led to their widespread use on both primary and secondary roads throughout the state after 1960. It is the early county applications of prestressed concrete bridges that are recognized as historically and technologically significant for their pioneering and influential introduction of the technology into the state and on the eventual widespread acceptance of the technology (criterion C). In Ohio, counties and the prestressed concrete industry were responsible for the transition to the material, and their success forced the Ohio State Highway Department, which was reluctant to use the material on state routes through the 1950s, to adopt standards for prestressed concrete bridges on state highways after 1960.

Father Charles and son William Roberts went into business together to sell prestressed concrete bridges to the counties, and they also started their own manufacturing yard at Crestline in 1954-55. Charles, a second-generation Ohio bridge contractor and registered engineer, was enthusiastic about the new material, and he had worked in Florida for over a year with an unsuccessful bidder on the prestressed concrete approach spans for the 1951-1954 Sunshine Skyway across Tampa Bay. They initially sold modified T beams as well as 17” deep box beams like these that were manufactured by others. The Roberts set up their own casting yard at Crestline where they
manufactured standardized adjacent box beams under the name of Prescon. Both types of beams were made in steel forms that William Roberts remembers being made in Plant City, Florida. The Roberts were not able to make a financial success of the Crestline facility, so it was sold to Intrusion Prepakt of Cleveland about 1957, it was then restyled as Concrete Fabricators, Inc. Concrete Fabricators continued to make and sell prestressed concrete beam bridges to the counties. William Roberts remained with Concrete Products, Inc.

Sources: William Roberts Personal Communication with Mary McCahon, Feb. 10, 2004. Mr. Roberts lives in Sun City, FL.

Reviewed By: MEM (2/04)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

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Physical Description:
The 205'-long main span of the 459'-long pedestrian overpass is a welded, inclined, 3 hinge through arch span. The ribs are composed of angles and plates welded to make a box with battens on the bottom. The pipe section members that carry the flooring system are pin connected at the ribs. The flooring system and approaches are concrete-filled pans held by welded angles. The lateral and sway bracing is also pipe section. The north side approach spans are supported on concrete columns, and the approach on the south is supported by pipe section bents on concrete pads. Save for the installation of a chain link pedestrian fence, the bridge appears to be complete.

Integrity:

Summary of Significance:
The 1952, welded, 3 hinge, steel arch pedestrian bridge that links two sections of Gordon Park was built as part of the completion of the east section of Cleveland's Memorial Shoreway. The Shoreway was started with WPA participation in the mid 1930s, and long sections on both the east and west sides were complete prior to World War II. A $7 million addition connecting the sections and improving the original highway to an eight-lane, limited access through highway was completed in 1953. The 1952 pedestrian bridge was designed by the Ohio Department of Highways and was fabricated by the Mount Vernon Bridge Co. It received an AISC honorable mention-class III award for 1952. Technologically it is a relatively early and complete example of a welded arch (criterion C) that was used again for two bridges in Cuyahoga County designed by Osborn Engineering and for a nearly identical 1959 pedestrian bridge at Cincinnati. This bridge cost $125,000. In the late 1950s, during the period of great highway construction in Cleveland, the Shoreway was joined with the Lakeland Freeway, which was complete to Painesville in 1963, and the two roads were taken into the interstate system and designated IR 90.

With post-World War II improvements in arc welding, engineers increasingly turned to shop-welded beams and other shapes like arches instead of riveted, built-up sections. Welded bridges became increasingly popular in the 1950s, particularly with the availability of high strength, low alloy steel developed specially for welding. The history of welded bridges goes hand-in-hand with the development of electric arc-welding technology. Welding, in its simplest
terms, is the joining of metal parts by bringing them together at high temperature. It had been done for centuries by blacksmiths heating and hammering together metal parts, but its use for connecting structural members did not begin until the early 20th century and the development of arc-welding where an electric current provides the welding heat. The technology saw its earliest structural applications in steel-frame building construction starting in the late 1910s. The Westinghouse Electric Company of Pittsburgh, a leading promoter of electric arc-welding, is usually credited with building the nation’s first weld-connected truss bridge at its Chicopee Falls, Massachusetts, plant in 1927-28. The arc welding industry heavily publicized the technology, particularly through industry associations such as the American Welding Society. By the 1940s, welded connections had become standard curriculum in engineering textbooks. While 1950s welded beam bridges are common, welded arch bridges are not. This is an early and complete example that applies the fabrication method to arch bridges.

William J. Gordon, who died in 1892, left his estate to the city to be a park. It is linked to Rockefeller and Wade parks by a series of bridges, some of which are National Register listed. The freeway through the park was completed in 1953. All three parks suffered from years of vandalism and misuse that practically destroyed them. They were subsequently taken over by the state and designated Lakefront State Park.

Reviewed By: MEM (2/04)

Notes:
Ohio Department of Transportation
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

Bridge #: 1830082  County: CUYAHOGA  Municipality: SOUTH EUCLID
NR Recommendation: Eligible

ODOT District: 12  Owner: COUNTY
Location: 1015’ E GREEN RD  UTM:
Feature On: WILSON MILLS ROAD/MONTICELLO ROAD (CR #19 BRIDGE #199)
Feature Intersected: EUCLID CREEK
Type: OPEN SPANDREL ARCH  Design: RIBBED
Material: REINFORCED CONCRETE
Railing Type: COUNTY STANDARD STEEL

# Spans: 3  Length: 362 ft (110.3 m)  Deck Width: 70 ft (21.3 m)
Year Built: 1954-55  Alteration (Date): 2003  Source: COUNTY BRIDGE CARD
Standard Design: (Yes or No) No

Physical Description:
The skewed, 362'-long, three span, ribbed open spandrel arch bridge has span lengths of 108', 140', and 108'. Very much in the attenuated artistic and design style of noted Swiss engineer Robert Maillart and his deck-stiffened arches, the bridge is reduced to its most basic with no applied ornamentation. The main span, a three-center arch, has a small rise of 18'-8" over its 140' length. The approach spans are segmental with the springing at the interior and crown at the ends. The abutments are well designed with buried buttresses to resist the arch thrust. The plain spandrel walls extend beyond the plane of the ribs to support the cantilevered deck sections. Since the distance between the walls varies, the slopes of the walls differ to create an uncommon visual effect. The bridge is finished with plain metal railings.

Integrity:

Summary of Significance:
The 1954-55 ribbed open spandrel arch bridge is a rare and successful American example of the attenuated, deck-stiffened arch bridge design and aesthetic developed by noted Swiss engineer Robert Maillart. Noted for its extremely thin arch ribs and spandrel supports, Maillart's severe designs reduced the open spandrel arch to its most basic where the steel is literally just covered in concrete. Maillart's sleek, deck-stiffened arch bridges were not built in great numbers. Carl Condit, in his seminal American Building Art Nineteenth Century attributes American's need for capacity to carry significantly heavier loads than the Europeans as a prime reason for the scarcity of the sophisticated design in this country. The Monticello Road bridge was designed by Osborn Engineering of Cleveland, and the bridge type and design were selected because of the setting in the Euclid Creek Reservation and the insistence of William Stinchcomb of the Metropolitan Park Board. The Monticello Road bridge marks a strong departure from the commonly used design for open spandrel arch bridges in the state and region. It has high artistic merit (criterion C) and technological influence of Robert Maillart, one of the most important bridge and influential designers of the 20th century. Research by William Vermes and Dario Gasparini suggests that Ralph Scott with Osborn Engineering was responsible for the conceptual design of the bridge. Scott joined the firm after World War II, and he became president of the company in 1974. The county's plans for the bridge are filed as Drwg. No. B-104.
Bridge #: 1830082  County: CUYAHOGA  Municipality: SOUTH EUCLID

NR Recommendation: Eligible

Reviewed By: MEM (2/04)

Notes:
Ohio Department of Transportation
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

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| No |

Physical Description:
The skewed, 4-span, 309' long bridge is composed of simple, prestressed concrete I beams with a continuous, composite concrete deck. There are no expansion joints in the deck. It is finished with 1 rail high steel channel railings and is supported on concrete abutments and plain piers.

Integrity:

Summary of Significance:
The prestressed concrete I beam bridge placed in 1960 is one of two nearly identical bridges designed and built by the Ohio State Highway Department as their trial effort long-span, prestressed concrete bridges in 1958-60. The earlier of the two, placed in 1958-59 on US 35 in Ross County (SFN #7102585), was demolished in 2003. Both were designed with a continuous design, composite-deck on simply supported I beams. While the counties and private industry had been constructing prestressed concrete I beam bridges in ever-increasing numbers since 1952, the state's bridge bureau under the leadership of D. Henry Overman was reluctant to use prestressed concrete for bridges on state routes. Save for about half a dozen, short, experimental, maintenance forces-manufactured, composite slab bridges with prestressed concrete "joists" (a mid-1940s design built in England and copied by bureau engineer Robert Carroll) placed on very low volume roads in District 10 in 1954-58, the state would not use the burgeoning bridge material, despite repeated attempts on the part of the industry to convince Mr. Overman otherwise. Perceiving that the continuous steel stringer, reinforced concrete slab, and other standardized bridge types had already proven their worth, the department's chief engineers and officials through most of the 1950s had little interest in investing significant manpower or expense into the development of the new technology. But unlike the 1954-55 composite slab bridges that had absolutely no influence on the advancement of prestressed concrete technology, the 1959-60 Delaware County I beam bridge represents the department's earliest foray into a prestressed concrete bridge type and design that would influence its decision to adopt the material for use on state highways. While it is not a technologically significant bridge, the SR 37 bridge is historically significant under criterion A as it starts an important and significant shift in state highway department policy. In November, 1960, the state did adopt standards for prestressed concrete bridges, which the state continues to build in great numbers today.
Since the 1930s, Henry Overman had been a strong advocate for the elimination of joints over piers. He was particularly partial to continuous reinforced concrete slab and I beam bridges with the approach spans being 8/10ths of the main span and butt welds connecting the beams at the piers. So it is not surprising that the limited research related to prestressed concrete that the department undertook involved making prestressed concrete beams continuous and thus eliminate joints over piers (simply supported beams have joints at the piers), even if continuity was in concept only. The bridge the state designed under the direction of Walter Jestsings has traditional, simply supported, prestressed concrete I beams with a continuous deck, which achieved Mr. Overman's goal of no joints over the piers. It was pretensioned with deflected strands and no end blocks and was built during the winter of 1959-60 by Wander & Mason of Worthington. In the absence of state standards, AASHO-PCI Type V beams were used, and they were manufactured by Great Lakes Structural Concrete Products of Toledo. The bridge appears to be complete.

Reviewed By: MEM (2/04)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

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Physical Description:
The 1 span, 41’ long and 24’ wide, prestressed concrete bridge is composed of the modified T beams with integral diaphragms that were used by the Roberts. Transverse stressing is applied through the diaphragms by use of tie rods, and the attachments are expressed on the fascia beams. The present structure mounted beam guide rail railings are in kind replacements of the original treatment. The concrete abutments and wingwalls are scored, and the date is cast into the wingwall ends.

Integrity:

Summary of Significance:
The 1 span, 41'-long and 24' wide, prestressed concrete tee beam bridge built in 1954 is one of the oldest extant examples in the state of a pre-standardized design marketed and manufactured by Charles and his son William Roberts, pioneers in prestressed concrete bridges in Ohio. The bridge chronicles the transition from steel and reinforced concrete to the material that would come the only serious rival to steel as a dominate bridge building material during the second half of the 20th century. It was far-sighted county engineers like those in Greene, Champaign, and Lucas counties working with fabricators like the Roberts who would introduce and demonstrate the viability of prestressed concrete in several efficient, economical, and easily erected bridge types in Ohio, and this led to their widespread use on both primary and secondary roads throughout the state after 1960. It is the early county applications of prestressed concrete bridges that are recognized as historically and technologically significant for their pioneering and influential introduction of the technology into the state and on the eventual widespread acceptance of the technology (criterion C). In Ohio, counties and the prestressed concrete industry were responsible for acceptance of the material, and their success forced the Ohio State Highway Department, which was reluctant to use the material on state routes through the 1950s, to adopt standards for prestressed concrete bridges on state highways after 1960.

Father Charles and son William went into business together to sell prestressed concrete bridges to the counties, and they also started their own manufacturing yard. They initially sold T-shaped beams as well as 17” deep box beams
manufactured by others. The beam design was developed and manufactured by a firm in White Marsh, MD. The Roberts purchased the beams from them in 1954. They went on to purchase more beams because they thought that the 2'-wide beams had the advantage of being lighter than a comparable prestressed concrete box beam span with its 3' wide beams. This facilitated erection of up to 65' long beams with then-available equipment, which included few heavy cranes. The Maryland firm was not successful, and it went bankrupt. In 1955 the Roberts set up their own casting yard at Crestline where they manufactured the same design T beams as well as standardized adjacent box beams under the name of Prescon. Both were made in steel forms that William Roberts remembers being made in Plant City, Florida. The Crestline facility was sold to Intrusion Prepakt of Cleveland, who restyled it as Concrete Fabricators, Inc., and it continued to manufacture and sell prestressed concrete beam bridges to the counties until failing in 1957. Prescon/Concrete Fabricators was the only supplier of this particular design of beam in the state, and about 13 examples dating from 1954 until 1960 remain. The non-standard beam design is reflective of the early days of prestressed concrete bridges when many engineers would design their beams believing that theirs was the most efficient and economical for a given span length and load. According to an article by Fred R. Lemke, County Engineer, in the August, 1956 issue Public Works magazine, Green County built its first prestressed concrete beam bridge in 1953. They liked the beams because of their speed of erection.

Sources: William Roberts Personal Communication with Mary McCahon, Feb. 10, 2004. Mr. Roberts lives in Sun City, FL.

Reviewed By: MEM (2/04)

Notes:
The 1958 welded pony truss bridge is historically significant as the longest bridge fabricated by the Ohio Bridge Corporation, a prolific and notable instate fabricator of stringer and pony truss bridges for Ohio’s counties. The firm is most noted for its all-welded pony truss bridges that continue to be built today based on a design developed by founder Herman Rogovin in 1946. This is the only one ever fabricated with this built-up upper chord detail. It was done to make the member stronger, which was required given the length of the span, and it stands out from the large population of Ohio Bridge Corporation bridges built in the 1950s in the state. The bridge has apparently not been altered.

Ohio Bridge Corporation was started in 1936 as the American Culvert Company at Cambridge by Herman Rogovin, who grew up in Cambridge and attended Case School of Applied Science where he received his BS in mechanical engineering in 1936. American Culvert fabricated and marketed corrugated pipe culverts to the counties and municipalities. The name of the bridge fabrication part of the business was changed to Ohio Bridge Corporation in 1952. While working at the B-29 bomber plant in Cleveland during World War II, Mr. Rogovin formulated ideas about an all-welded pony truss bridge design with rolled section members and welded shop connections that could be erected without expensive false work. He began producing that design in 1946 with the first one being placed at Millersburg (Holmes County). Dardelet bolts, a button-head bolt with a serrated center section were used for field connections. They automatically set themselves when driven in with a sledge and are locked with a nut. The bolts were used to connect sections of the truss lines into a unit and to attach the floorbeams. The pony truss bridge...
Initially conceived by Mr. Rogovin is the one that the company continues to fabricate. Rogovin hired Sid Rockoff of Varo Engineers in Columbus to prepare the calculations and member specifications for standard truss designs in 10-foot increments between 50' to 120' in length. Standard plans were prepared for H12, H15, and H20 loading so the counties and municipalities could purchase the appropriate capacity.

Development of weld-connected truss bridges goes hand-in-hand with the development of electric arc-welding. The Westinghouse Electric Co. of Pittsburgh was a leading promoter of the technology and is widely credited with fabricating the nation’s first weld-connected truss bridge in 1927-28. The arc-welding industry heavily publicized the technology, and its application to bridges spread rapidly during the 1930s. Pre-World War II examples are not rare. Ohio’s 1951-1960 examples, including this one, are a continuation of a design that was well established in the state during the 1940s.

Reviewed By: MEM (9/03)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

Bridge #: 3132749  County: HAMILTON  Municipality: ANDERSON TWP
NR Recommendation: Eligible

ODOT District: 8  Owner: COUNTY

Location: FIVE MILE ROAD  UTM:
Feature On: CR 365 (FIVE MILE ROAD) (B-0087)
Feature Intersected: FIVE MILE CREEK

Type: STRINGER  Design:
Material: PRESTRESSED CONCRETE

Railing Type: BEAM GUIDE RAILS

# Spans: 1  Length: 50 ft (15.2 m)  Deck Width: ft (9.1 m)
Year Built: 1953  Alteration (Date): 2001  Source: PLANS/WM ROBERTS

Standard Design: (Yes or No) No

Physical Description:
The skewed, 50 long, one span bridge is composed of 4, prestressed concrete I beams supported on concrete abutments. The bridge was stressed transversely through the concrete diaphragms, and the fascia anchors are protected by concrete "mortar covers." The bridge was rehabilitated in 2001, and a new RFP deck with cantilevered sections and new beam guide rail railings with backing were installed over the original beams. The original reinforced concrete deck had integral curbs and was finished with structure mounted beam guide railings.

Integrity:

Summary of Significance:
The bridge is one of three similar prestressed concrete I beam bridges on Five Mile Road (referred to as Bridges Nos. 7, 8, & 20) designed in 1953 as one contract by Hanly and Young Structural Engineers, a Cincinnati firm that did most of the bridge design work for Hamilton County at that time. Mr. Hanly was particularly enthusiastic about prestressed concrete and was a pioneer in its use in Ohio. Bridge No. 20 was removed in 2000, but the remaining two are historically and technologically significant within the state context because they are early examples of an important and influential bridge type and design. The surviving bridges chronicle how prestressed concrete was introduced into usage in Ohio and how progressive consulting engineers and county engineers influenced the subsequent domination of the material for state and locally constructed bridges. Prestressed concrete bridges went on to dominate bridge design during the last third of the 20th century, and in Ohio, it was the counties, not the state highway department, that affected the important transition to the new material that proved to be a viable alternative to steel and reinforced concrete. The Five Mile Road bridges join the 1952 CR 32 (6036155) over Moxahola Creek bridge in Muskingum County, the first prestressed concrete bridge in Ohio, as the most significant prestressed concrete bridges in the state.

Prestressed concrete first appeared in bridge applications in Europe during the early 20th century, but it was slow to spread to the United States finding its first application in prestressed-concrete water tanks before World War II. Philadelphia's 1949-51 Walnut Lane bridge inaugurated the modern prestressed concrete bridge era with 160'-long,
cast in place, I-shaped beams that were then post-tensioned. Contemporaneous with the Walnut Lane bridge, several state highway departments, including Pennsylvania, Tennessee and Florida, were developing standard designs for both pretensioned, prestressed concrete I- and T-shaped beams and box beams for use on their highways. In 1950, Concrete Products of America of Pottstown, PA developed the now-common, voided box beam that became a Pennsylvania Department of Highways standard design shortly thereafter. Other engineers and fabricators produced beam designs, believing that theirs was the most efficient and economical for a given span and load. These efforts were encouraged by the federal Bureau of Public Roads, which believed that prestressed concrete could play an important role in standardized bridge construction during the last half of the 20th century. From the pioneering work of Concrete Products of America in 1950 and others like Charles Roberts, P.E. and Hanly & Young from Cincinnati or contractors like Wander and Mason of Worthington and Foley of Cincinnati, prestressed concrete has been an increasingly important and dominant bridge material.

Typical of the state’s early prestressed concrete bridges, the design was developed as an alternate superstructure design for traditional steel stringer bridges with composite decks. The reason for Hamilton County’s selection of the alternate is not known, but the project plans were revised July 30, 1953 “to conform to the alternate design with 4 continuous beams per span.” Mr. William Roberts, son of Charles Roberts and a salesman with several fabricators including Prescon, Concrete Fabricators, Inc., and Martin Marietta, remembers that the beams were fabricated by Foley, a very large construction firm in Cincinnati, as part of their contract with the county to build the bridges. Foley also fabricated the beams and bridge at Norwood (3164470). That bridge is dated 1957, but the firm did not continue to construct small, prestressed concrete bridges once work on interstate highways commenced.

Reviewed By: MEM (10/03)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

Bridge #: 3132730  County: HAMILTON  Municipality: ANDERSON TWP
NR Recommendation: Eligible

ODOT District: 8  Owner: COUNTY

Location: FIVE MILE ROAD  UTM:
Feature On: CR 365 (FIVE MILE ROAD) (B-0071)
Feature Intersected: FIVE MILE CREEK
Type: STRINGER  Design:
Material: PRESTRESSED CONCRETE
Railing Type: BEAM GUIDE RAILS

# Spans: 1  Length: 46 ft (14 m)  Deck Width: 30 ft (9.1 m)
Year Built: 1953  Alteration (Date):
Source: PLANS/WM ROBERTS

Standard Design: (Yes or No) No

Physical Description:
The 46'-long, one span bridge is composed of 4, prestressed concrete I beams supported on concrete abutments. The bridge was stressed transversely through the concrete diaphragms, and the fascia anchors are protected by concrete "mortar covers." The bridge was rehabilitated in 2001, and a new RFP deck with cantilevered sections and new beam guide rail railings with backing were installed over the original beams. The original reinforced concrete deck had integral curbs and was finished with structure mounted beam guide railings.

Integrity:

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cast in place, I-shaped beams that were then post-tensioned. Contemporaneous with the Walnut Lane bridge, several state highway departments, including Pennsylvania, Tennessee and Florida, were developing standard designs for both pretensioned, prestressed concrete I- and T-shaped beams and box beams for use on their highways. In 1950, Concrete Products of America of Pottstown, PA developed the now-common, voided box beam that became a Pennsylvania Department of Highways standard design shortly thereafter. Other engineers and fabricators produced beam designs, believing that theirs was the most efficient and economical for a given span and load. These efforts were encouraged by the federal Bureau of Public Roads, which believed that prestressed concrete could play an important role in standardized bridge construction during the last half of the 20th century. From the pioneering work of Concrete Products of America in 1950 and others like Charles Roberts, P.E. and Hanly & Young from Cincinnati or contractors like Wander and Mason of Worthington and Foley of Cincinnati, prestressed concrete has been an increasingly important and dominant bridge material.

Typical of the state’s early prestressed concrete bridges, the design was developed as an alternate superstructure design for traditional steel stringer bridges with composite decks. The reason for Hamilton County’s selection of the alternate is not known, but the project plans were revised July 30, 1953 “to conform to the alternate design with 4 continuous beams per span.” Mr. William Roberts, son of Charles Roberts and a salesman with several fabricators including Prescon, Concrete Fabricators, Inc., and Martin Marietta, remembers that the beams were fabricated by Foley, a very large construction firm in Cincinnati, as part of their contract with the county to build the bridges. Foley also fabricated the beams and bridge at Norwood (3164470). That bridge is dated 1957, but the firm did not continue to construct small, prestressed concrete bridges once work on interstate highways commenced.

Reviewed By: MEM (2/04)

Notes:
The 1959 Suder Avenue bridge in Toledo is historically and technologically significant as one of the earliest, truly long, prestressed concrete adjacent box beam bridges in the country. The prestressed concrete box beam was developed by Concrete Products Company of American of Pottstown, PA in 1950. Working in conjunction with the Pennsylvania State Highway Department, the company came up with the precast hollow box beam that was longer and stronger than the reinforced concrete channel beam. The desired stiffness was achieved by enclosing the previously developed channel beam and then applying the new reinforcing system of prestressing with 7-strand wire developed by the John A. Roebling Sons Company. The earliest beams were in the 38' to 60' length range. The Pennsylvania State Highway Department placed its first adjacent box beam bridges late in 1950, and Concrete Products Company (purchased by American-Marietta) successfully marketed the beams throughout the region. The Suder Avenue bridge represents one of the first known instances of a 100' long beams being used, and the bridge ranks as a milestone in the evolution of the extremely important bridge type. The voided box beam that came to dominate for span lengths up to 100' during the last half of the 20th century. The Suder Avenue bridge was designed for Lucas County by Joseph Kelleher, P.E. of Great Lakes Structural Concrete Products of Toledo. The original plans remain with the county.

A 1950 Villanova engineering school graduate named Joseph Kelleher went to work for Concrete Products Company at Pottstown, and he later moved to Pittsburgh where he set up their Neville Island fabricating yard where both 3’ wide and 4’ wide beams were made. In 1958, Mr. Kelleher left Concrete Products Company and moved to Toledo
where he designed and set up the fabricating facility for Great Lakes Structural Concrete Products. It was a state-of-the-art facility, and it was designed to accommodate construction of the 42” deep and 100’ long beams that would be needed for the upcoming Suder Avenue project. Kelleher worked with Lucas County Engineer Arthur Ozzlin, who was “technically very good,” according to Mr. Kelleher. The Suder Avenue bridge was designed for use by heavy equipment associated with construction of the nearby interstate highway. In order to maintain traffic, the 4-lane wide box beam bridge was constructed around the old truss bridge by placing the outside beams beside it, moving traffic to the those lanes, and then removing the truss and placing the inside most box beams. The deck was not made composite, just an asphalt wearing surface. This was the first of two or three 100’ box beam bridges that Great Lakes Structural Concrete Products constructed for Lucas County. Another example is Central Avenue in Toledo. They also built shorter box beam bridges throughout the region.


Reviewed By: MEM (6/03)

Notes:
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

Bridge #: 6036155  County: MUSKINGUM  Municipality: CLAY TWP
NR Recommendation: Eligible

ODOT District: 5  Owner: COUNTY
Location: N END MAIN ST TOWARD RANSBOTTOM/IRONSP  UTM:
Feature On: CR 32 (MAIN STREET)
Feature Intersected: MOXAHOLA CREEK
Type: STRINGER  Design:
Material: PRESTRESSED CONCRETE
Railing Type: 2 RAIL HIGH STEEL CHANNEL RAILINGS/CONCRETE ENDS

# Spans: 5  Length: 226 ft (0 m)  Deck Width: 24 ft (0 m)
Year Built: 1952  Alteration (Date):
Source: PLANS/WM ROBERTS
Standard Design: (Yes or No) No

Physical Description:
The 226' long, 5-span, prestressed concrete beam bridge with a composite concrete deck is built on a 45-degree skew. The abutments and piers are concrete. Each simply supported span is 44' long and is composed of 9, 30''-deep beams with 28'' wide top flanges. The beams are placed 3' centers, and the 8'' space between the top flanges accommodated installation of the transverse tie bars through the flanges. Seven-wire strand was used for the prestressing, and each beam has 32 strands. The bridge was prestressed transversely through two intermediate diaphragms in each span in order to ensure good transverse distribution of live loads. All diaphragms are parallel to the skewed abutments and piers. The structure mounted railings are composed of 2 rails of angles attached to rolled I section posts. There are concrete end posts. The curbs have open drain panels set into them. According to the designers, the beams are understressed to ensure flexibility under overloads and eliminate brittleness. The bridge appears to be complete.

Integrity:

Summary of Significance:
The 1952 Roseville Bridge ranks as the most significant prestressed concrete bridges in the state and one of the most important nationally based on its early date of construction and state of completeness (criterion C). Construction of the Roseville bridge was so regionally important that on July 29, 1952, "over 400 technicians engaged in various phases of concrete design [engineers came from Ohio, West Virginia, Pennsylvania, Illinois, Indiana, Michigan] and construction gathered at Roseville, Ohio, to inspect the first prestressed concrete bridge in that state" (ACI Journal, Vol. 49 October, 1952, pp. 155-156). Its is reportedly the first "pretensioned" units constructed at the site. Wander and Mason of Worthington were the contractors, and Russell Mason, an Ohio-registered, professional engineer is credited with the design, although Charles Roberts, another registered engineer and Ohio pioneer in prestressed concrete, was also have been involved. Roberts had learned about prestressed concrete in Florida, and he was working on bridges in Zanesville at the same time Russell Mason, who had previously worked for Charles Roberts, was developing the prestressed concrete alternate for this bridge. The CR 32 bridge was built for Muskingum County as part of its 2.5 million dollar bond to replace obsolete bridges. The
county selected the prestressed concrete alternate over a traditional steel stringer bridge because it could be constructed in half the time (approximately 7 months as opposed to 14 months) and its perceived lower, long-term maintenance costs. Russell Mason stated when the bridge was about 70% complete that "... it is apparent that in the future prestressed concrete will be competitive in first cost with other conventional types of bridges." The bridge is a watershed in the adoption of prestressed concrete bridges in the state as it proved the viability of the material, and other counties like Hamilton, Montgomery, and Auglaize almost immediately began erecting their own prestressed unit bridges. The material steadily gained popularity throughout the 1950s so that in the 1960s its position as a dominant material for bridges was established.

Reviewed By: MEM (2/04)

Notes:
Ohio Department of Transportation
Historic Bridge Inventory - Phase 2
Pre-1961 Interstate Highway Bridges

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<th>County: SUMMIT</th>
<th>Municipality: BARBERTON</th>
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<tr>
<td>ODOT District: 4</td>
<td>Owner: COUNTY</td>
<td></td>
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<tr>
<td>Location: 1400 FT E OF CLARK MILL RD</td>
<td>UTM:</td>
<td></td>
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<td>Feature On: BRADY AVENUE</td>
<td>Feature Intersected: WOLF CREEK</td>
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<tr>
<td>Type: STRINGER</td>
<td>Design: MODIFIED T</td>
<td></td>
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<tr>
<td>Material: PRESTRESSED CONCRETE</td>
<td>Railing Type: CHANNEL RAILINGS WITH TUBULAR POSTS AND BAR FILL</td>
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<tr>
<td># Spans: 1</td>
<td>Length: 72 ft (22 m)</td>
<td>Deck Width: 30 ft (9.1 m)</td>
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<tr>
<td>Year Built: 1954</td>
<td>Alteration (Date):</td>
<td>Source: COUNTY BRIDGE CARD</td>
</tr>
<tr>
<td>Standard Design: (Yes or No)</td>
<td></td>
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</tr>
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</table>

Physical Description:
The 1 span, 72' long, prestressed concrete stringer bridge is composed of the modified T beams with integral diaphragms that were used by the Roberts. It is composed of 2' by 2' beams and is supported on scored concrete abutments. Transverse stressing is applied through the diaphragms by use of stressing strands, and the diaphragms are filled with grout. The metal railings with tubular posts are mounted to the safety walk/curbs. The bridge appears to be complete.

Integrity:

Summary of Significance:
The prestressed concrete, modified T-shaped stringer bridge built in 1954 is one of the oldest extant examples in the state of the pre-standardization design marketed and manufactured by Charles and his son William Roberts, pioneers in prestressed concrete bridges in Ohio. The bridge chronicles the transition from steel and reinforced concrete to the material that would become the only serious rival to steel as a dominant bridge building material during the second half of the 20th century. It was far-sighted county engineers like those in Summit, Hamilton, and Lucas counties working with fabricators like the Roberts who would introduce and demonstrate the viability of prestressed concrete in several efficient, economical, and easily erected bridge types in Ohio. This led to its widespread use on both primary and secondary roads throughout the state after 1960. It is the early county prestressed concrete bridges that are recognized as historically and technologically significant for their pioneering and influential introduction of the technology into the state and on the eventual widespread acceptance of the technology (criterion C). In Ohio, counties and the prestressed concrete industry were responsible for the transition to the material, and their success forced the Ohio State Highway Department, which was reluctant to use it on state routes through the 1950s, to adopt standards for prestressed concrete bridges on state highways after 1960.

Father Charles and son William went into business together to sell prestressed concrete bridges to the counties, and they also started their own manufacturing yard. They initially sold T-shaped beams as well as 17” deep box beams manufactured by others. The beam design was developed and manufactured by a firm in White Marsh, MD. The
Roberts purchased the beams from them in 1954. They went on to purchased more beams because they thought that the 2'-wide beams had the advantage of being lighter than a comparable prestressed concrete box beam span with its 3' wide beams. This facilitated erection of up to 65' long beams with then-available equipment, which included few heavy cranes. The Maryland firm was not successful, and it went bankrupt. In 1955 the Roberts set up their own casting yard at Crestline where they manufactured the same design T beams as well as standardized adjacent box beams under the name of Prescon. Both were made in steel forms that William Roberts remembers being made in Plant City, Florida. The Crestline facility was sold to Intrusion Prepakt of Cleveland, who restyled it as Concrete Fabricators, Inc., and it continued to manufacture and sell prestressed concrete beam bridges to the counties. Prescon/Concrete Fabricators was the only supplier of this particular design of beam in the state, and about 13 examples dating from 1954 until 1960 remain. The non-standard beam design is reflective of the early days of prestressed concrete bridges when many engineers would design their beams believing that theirs was the most efficient and economical for a given span length and load.

Sources: William Roberts Personal Communication with Mary McCahon, Feb. 10, 2004. Mr. Roberts lives in Sun City, FL.

Reviewed By: MEM (2/04)

Notes:
APPENDIX B

CRITERIA FOR DETERMINING SIGNIFICANCE AND
THRESHOLDS OF INTEGRITY FOR NON-EXCLUDED BRIDGES
CRITERIA FOR DETERMINING SIGNIFICANCE AND THRESHOLDS OF INTEGRITY FOR NON-EXCLUDED BRIDGES

The eligibility of each 1951-1960, non-excluded bridge was individually assessed using the standards for significance and integrity as enumerated in the National Register of Historic Places criteria for evaluation (30 CFR 60.4). Under the criteria, to qualify for the National Register a bridge must have both significance and integrity. Significance means that a resource must represent a significant part of the history, architecture, archeology, engineering, or culture of an area. Significance is evaluated within historic contexts, which are studies which place an event, occurrence, property, or site within a larger framework, providing it meaning. Lichtenstein Consulting Engineers prepared historic contexts to assist with understanding what aspects of associative and technological history are significant. The bridge technology context defines what features make each bridge type significant for its technology and engineering, and which features are ubiquitous and thus not significant. It also defines what are rare, uncommon, and common details.

Significance

In order to be eligible for the National Register, a bridge must first be shown to be significant under one or more of the National Register criteria for evaluation. The criteria for evaluation are broadly defined, and there are numerous areas of significance associated with the criteria that relate to bridges, such as transportation, community planning and development, commerce, engineering, and landscape architecture. But the criteria are also discriminating, and careful application of the criteria within historic contexts can be used to distinguish the subtle yet often crucial distinctions of significance among large numbers of similar resources with a common history, separating those that are significant from those that are not.

The National Register of Historic Places Criteria for Evaluation are

The quality of significance in American history, architecture, archeology, engineering and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or

B. that are associated with the lives of person significant in our past; or

C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. that have yielded or may be likely to yield information important in prehistory or history.

Two “criteria considerations” also can apply to the evaluation of bridges:

Criteria considerations: Ordinarily ... structures that have been moved from their original locations ... and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

b. a building or structure removed from its original location but which is significant primarily for architectural value or which is the surviving structure most importantly associated with a historic person or event; or

g. a property achieving significance within the past 50 years if it is of exceptional importance.

APPLYING THE CRITERIA FOR EVALUATION

The following explain how the individual criterion will be applied to evaluate Ohio’s 1951-1960, non-excluded bridge population.

**Criterion A** addresses a bridge’s association with an event or pattern of events that made an important contribution to the historical and physical development of a locality or a region. This could range from bridges associated with significant landscapes to bridges built as part of a significant county-wide improvement campaign or an important urban expressway or interregional highway.

All bridges have a history. They were built by a county, the state, or a quasi-private authority like the Ohio Turnpike Commission, and they are related to larger historic contexts, such as development of improved county roads or development of limited access highways. Criterion A can be used to draw distinctions between bridges with common history, like the many state-built bridges that have been placed to keep a crossing in service, from those associated with locally significant events like a bridge built as part of an element in a significant landscape or a county effort to upgrade its bridge inventory after World War II. Furthermore, emphasizing association with important events, Criterion A differentiates between history that is common to nearly every bridge, like railroads having an impact on the subsequent development of the areas through which they passed or 1950s dualized state highways facilitating suburbanization, and distinguishable events that made a significant contribution to historical development on the national, state or local level. Thus, bridges with no links to significant events will be evaluated as not meeting Criterion A. A bridge type built in the 1950s as part of historically significant improvement campaign may be considered potentially significant. For bridges to be historic in association with other contexts, like post-World War II suburbanization, tourism, or other postwar contexts, the association
needs to be direct.

**Criterion B** addresses historic association with great persons from the past. This criterion generally has not been commonly applied to bridges, as the works of noted engineers and builders are usually better represented under Criterion C. For a bridge to be significant under Criterion B, the connection with the person significant in our past needs to be direct. A prominent engineer or fabricator would need to have been directly and influentially involved in the design and construction of the bridge to meet this criteria.

**Criterion C**, the most broadly applicable criterion, addresses individual bridges that meet at least one of the following characteristics: they embody distinctive characteristics of a type, period, or method of construction; they are the work of a master; they possess high artistic value; or they contribute to an historic district. The criterion affords recognition of the evolution of bridge types and bridge building technology over time, as well as the importance of the engineer/engineering firm who designed a bridge and the fabricator/contractor who erected it. Architectonic and aesthetic bridges, bridges with unusual construction details or rare surviving examples of a type that was significant in the development of a bridge technology, and the distinguished work of noted engineers, engineering firms, the state highway commission, or bridge companies can be eligible under Criterion C.

Criterion C applies to common bridge types, such as welded pony truss and prestressed concrete box beam bridges that are ubiquitous throughout the state. Common types will be evaluated to identify which examples are technologically significant. Priority will be placed on identifying examples that mark the introduction of the technology or bridge design, like the earliest state- and county-built prestressed concrete bridges, or that illustrate engineering advances within a long-lived technology like metal truss bridges. This generally means that significant examples from large populations of similar bridges are the earlier, longer, and/or more complicated bridges.

Evaluation of bridge types and designs that predate 1951, like welded and riveted truss bridge bridges and open spandrel arch bridges, will be based on the entire statewide population; not just the 1951-1960 population. Since bridge types and designs are considered technologically significant when they are initially introduced, evaluation of technological significance will be based on information and findings from the previous surveys and will place the currently studied population of bridges within its broader context. A welded pony truss bridge built in the 1950s that is a continuation of the basic design and fabrication techniques introduced and popularized in the 1930s and 1940s will not be considered to meet Criterion C unless it represents an engineering advance within this long-lived technology.

Because of the role of the Bridge Bureau of the Ohio Department of Highways and some companies like the Ohio Bridge Corporation and the Concrete Fabricators Inc. in construction of the state’s roads and bridges, the historical and technological significance of standardized bridge designs will be an important consideration. The
historic contexts will establish when and under what historical circumstances standardized bridge designs and details were introduced, the frequency at which a standardized design was built, and the technological significance of the specific examples. The contexts coupled with the survey database provide a means of acknowledging on a statewide basis the oldest extant examples of a type, design or detail in an effort to set the engineering history in the state context. These examples are generally regarded as more significant than later examples because they represent a shift in technology or construction techniques.

Under Criterion C, bridges that are documented as to designer or fabricator will be evaluated as more significant than those that are undocumented. Such information establishes the historical, and frequently, the technological significance of the span.

Unique, rare, or infrequent surviving types and unusual designs of a particular bridge technology are also evaluated as having engineering significance under Criterion C. Bridge types like thru truss and thru arch bridges are generally evaluated as significant because they represent an increasingly rare bridge type important in the development of bridge technology in this country. Likewise, unusual construction details, like early application of high strength bolts, are evaluated as significant because they reflect the era of experimentation or transition. The unique, rare, or infrequent criterion will be evaluated on a statewide basis.

Criterion D is generally interpreted to refer to archeological resources, but it can also apply to structures and objects that contain important information if the structure or object is the principal source of important information. This could apply to an unusual and/or technologically significant bridge for which no plans or other documentation survives.

Criteria Consideration B addresses properties that have been removed from their original or historically significant location. Ordinarily structures that have been moved from their original locations shall not be considered eligible for the National Register. If, however, it is significant primarily for architectural value or which is the surviving structure most importantly associated with a historic person or event it can be considered to meet the criteria. Although National Register Bulletin 15 specifies only architectural significance, it does make provisions for “portable resources.” Some bridge types, especially metal pony truss bridges, have historically been relocated. Technologically significant bridges will be evaluated as meeting the criteria even if they have relocated. Bridges that are significant in association with a historic road will be evaluated as not meeting the criteria if they have been relocated.

Criteria Consideration G states that properties that have achieved their significance within the last fifty years do not meet the criteria for evaluation unless they are of “exceptional importance.” Exceptional importance is defined to be those less-than-50-year-old properties that have “the extraordinary importance of an event or to an entire category of resources so fragile that survivors of any age are unusual.” Fifty years is a general estimate of the time needed to develop historical perspective and to evaluate
significance. It is explained in National Register Bulletin 22, *Guidelines for Evaluating and Nominating Properties That Have Achieved Significance with the Last Fifty Years* (revised 1998) that “it rarely is possible to evaluate historic impact, role, or relative value immediately after an event occurs or a building is constructed. The passage of time is necessary in order to apply the adjective “historic” and to ensure adequate perspective.”

Criteria Consideration G is applicable to this studied population of 1951-1960 bridges because the overwhelming majority of them will not be 50 years old at the time of the evaluation. Most of the bridges to be evaluated individually, however, are examples of standardized designs that were developed and popularized in previous decades. Therefore, their technological and historical contexts are 50 years old or older. Bridges that are examples of types and designs that predate 1951 will be evaluated in full consideration of the entire statewide population. A welded or riveted pony truss bridge that is less than 50 years old in 2003 will be assessed on its merits within its population rather than recommended as not eligible because it is not yet 50 years old.

Prestressed concrete was introduced as a bridge building material during this period, and early examples of what would go on to be extremely important and common bridge types and designs will be evaluated as meeting the National Register criteria consideration G. Survivors from the earliest days of prestressed concrete bridges in Ohio are sufficiently rare to be considered “fragile.” Criteria consideration G will only be applicable to the earliest examples; not all prestressed concrete bridges from the 1950s.

**Integrity**

In addition to significance, in order for a bridge to be eligible for the National Register it must also have integrity. A synonym for the state of completeness or preservation, integrity refers to a resource’s retention of original fabric and/or historic appearance. It does not refer to its state of repair or its structural or functional adequacy.

The National Register criteria recognize seven aspects or qualities that define when a resource has integrity: location, design, setting, materials, workmanship, feeling and association. To retain integrity a property will always possess several and usually most of these qualities. A bridge can have historical significance, but if it does not possess the aspects of integrity, it will be evaluated as not eligible.

To arrive at an accurate assessment of integrity, alterations will be studied to determine if they (1) changed the design, appearance, or how a bridge functions, or (2) compromised the technological and/or historical significance of the structure. These issues figure greatly in the assessment of the eligibility of each bridge, especially when they are well represented standard bridge types/designs.

Alterations that are considered drastic enough to affect eligibility of 1951-1960 bridges include widening on both sides so that the original structure is not discernible in the elevation view or material is added in a manner that is different from the original
treatment. A higher degree of alteration is acceptable for rare bridges like very early prestressed concrete box beams or open spandrel arch bridges. When a resource type or detail becomes so infrequent or rare that losing one or two examples will mean that it is no longer represented in the bridge population, then the integrity question is secondary to recognizing the worthiness of preserving a disappearing bridge type or design.

Some modifications common to a particular bridge type or design will not be considered as alterations that detract from the potential significance of a span because the changes (1) were necessary to address inherent weaknesses in the original design, (2) were such minor changes that they did not affect the overall appearance or design of the span, (3) were sensitive alterations done in a manner that did not detract from the original design, or (4) are reversible alterations that do not involve the removal of original fabric.

These common modifications include the replacement of stringers and decks or wearing surfaces on truss bridges and the replacement of beam guide rail railings with similar ones that reflect current design. Limited in-kind replacement and adding members and sections for strengthening does not adversely affect the technological and historical significance of a bridge as long as the new material respects the original material used and is done in the same manner as the original construction.

Relocation of a bridge is not considered a significant alteration unless the bridge was important in association with its original setting/context. It is common for metal truss bridges in particular to be moved.

Alterations that can adversely affect common and not rare bridge types/designs are

**Prestressed Concrete I Beam (Stringer) and Box Beam Bridges**

- Removal/replacement of original railings other than beam guide rail railings.
- Non-inkind replacement of beams.
- Strand popping.

**Arch Bridges**

- Widening to both sides and loss of original railings, regardless of original date of construction.
Truss Bridges

- Change to the original method of connecting members.
- Encasement of flooring system or bearings in concrete.
- So much deterioration and section loss that a high percentage of original fabric has been lost.
- Additional material/members that are different from the original, like channel added to WF section.
APPENDIX C

CRITERIA FOR DETERMINING SIGNIFICANCE AND THRESHOLDS OF INTEGRITY FOR PRE-1961 INTERSTATE HIGHWAY BRIDGES IN OHIO
CRITERIA FOR DETERMINING SIGNIFICANCE AND THRESHOLDS OF INTEGRITY FOR PRE-1961 INTERSTATE HIGHWAY BRIDGES IN OHIO

The eligibility of each pre-1961 Interstate bridge was assessed using the standards for significance and integrity as enumerated in the National Register of Historic Places criteria for evaluation (30 CFR 60.4). Under the criteria, to qualify for the National Register a bridge must have both significance and integrity. Significance means that a resource must represent a significant part of the history, architecture, archaeology, engineering, or culture of an area. Significance can be established individually or within historic districts and/or contexts, which are studies which place an event, property, or site within a larger framework, providing it meaning. Lichtenstein Consulting Engineers prepared a specific historic context to assist with understanding what aspects of associative and technological history related to Interstate highways in Ohio are significant.

Significance

In order to be eligible for the National Register, a bridge must first be shown to be significant under one or more of the National Register criteria for evaluation. The criteria for evaluation are broadly defined, and there are numerous areas of significance associated with the criteria that relate to bridges, such as transportation, community planning and development, commerce, or engineering. But the criteria are also discriminating, and careful application of the criteria within historic contexts can be used to distinguish the subtle yet often crucial distinctions of significance among large numbers of similar resources with a common history, separating those that are significant from those that are not.

Historic contexts work in concert with the criteria for evaluation to determine if a property has significance under the National Register. The criteria for evaluation are:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

a. That are associated with events that have made a significant contribution to the broad patterns of our history; or

b. That are associated with the lives of persons significant in our past; or

c. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
d. That have yielded, or may be likely to yield, information important to prehistory of history.

One “criteria consideration” also can apply to the evaluation of pre-1961 Interstate highway bridges:

Criteria considerations: Ordinarily ... properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:

  g. a property achieving significance within the past 50 years if it is of exceptional importance.

As a general rule, properties that have achieved significance within the past 50 years are not eligible for National Register listing because the National Register is intrinsically a compilation of the Nation’s historic resources that are worthy of preservation. (National Register Bulletin No. 22).

APPLYING THE CRITERIA FOR EVALUATION

The following explains how the individual National Register criterion will be applied to evaluate Ohio’s pre-1961 Interstate highway bridges, both individually and as part of historic districts. National Register guidelines require that significance be evaluated against the National Register criteria for determining significance within historic contexts. The historic transportation and technology contexts for Ohio’s more than 680 pre-1961 Interstate bridges will be used to determine significance. There is nothing contextually significant about the 1960 end date of the bridge inventory study since the bridges do not reflect a specific period in the Interstate system’s development. They are the same bridge types that were used over a more than 40 year history of staged construction between 1950 and 1992. There are very few features of any individual bridge on the entire system that distinguish it from the hundreds of alike bridges built between 1950 and 1992.

Bridges may be evaluated as individual structures. No significant contextual or technological differences exist among the hundreds of standardized Interstate bridges of non-excluded types. A few bridges, such as truss and arch bridges, may have individual significance, but those are covered under the Criteria for Determining Significance and Integrity for Non-Excluded Bridges.

Bridges may also be evaluated as part of a historic district. “A district possesses a significant concentration, linkage or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development.” The historic contexts support the conclusion that potential historic significance of the pre-1961 Interstate bridges appears to be derived from and dependent on historical association.
with Ohio’s Interstate system. The population will thus be evaluated both individually and as contributing resources to a potential historic district(s). Interstate highways clearly meet the National Register definitions of historic districts.

“A district can comprise both features that lack individual distinction and individually distinctive features that serve as focal points. It may even be considered eligible if all of the components lack individual distinction, provided that the grouping achieves significance as a whole within its historic district. In either case, the majority of the components that add to the district’s historic character, even if they are individually undistinguished, must possess integrity, as must the district as a whole.... ”

A district must be a definable geographic area that can be distinguished from surrounding properties by changes such as density, scale, type, age, style of sites, buildings, structures, and objects, or by documented differences in patterns of historic development or associations. ....”

(National Register Bulletin No. 15, How To Apply The National Register Criteria For Evaluation, page 5.)

**Criterion A** addresses a bridge’s association with an event or pattern of events that made an important contribution to the historical and physical development of a locality or a region. Criterion A differentiates between history that is common to nearly every bridge and distinguishable events that made a significant contribution to historical development on the national, state or local level. Thus, bridges with no links to significant events will be evaluated as not meeting Criterion A. A bridge built in the 1950s as part of historically significant improvement campaign may be considered potentially significant.

To meet Criterion A, the system and its bridges must be directly associated with an important event or have made a significant contribution to the broad patterns of our history.

**Criterion B** addresses historic association with great persons from the past. Generally, this criterion has not been commonly applied to bridges, as the works of noted engineers and builders are usually better represented under Criteria A or C.

To meet Criterion B, Ohio’s Interstate system and/or bridges must be directly identifiable with specific individuals whose explicit contributions to history can be documented. In general, Ohio’s Interstate system and the standardized bridges were the product of hundreds of individuals working for the Ohio Department of Highways, the federal Bureau of Public Roads, city planning organizations, and private contractors.

**Criterion C**, the most broadly applicable criterion, addresses individual bridges that meet at least one of the following characteristics: they embody distinctive characteristics of a type, period, or method of construction; they are the work of a master; they possess high artistic value; or they contribute to an historic district.
To meet Criterion C, Ohio’s Interstate system and its bridges would need to embody a distinctive characteristic of a type, period, and method of construction or represent a significant and distinguishable entity whose components may lack individual distinction. The distinguishable entity in this case is the Interstate system, made up of components, including bridges, that may lack individual distinction, but taken together define a significant and distinguishable transportation system built from 1950 to 1992.

**Criterion D** is generally interpreted to refer to archeological resources, but it can also apply to structures and objects that contain important information if the structure or object is the **principal** source of important information. This could apply to an unusual and/or technologically significant bridge for which no plans or other documentation survives. Ohio’s pre-1961 Interstate bridges would only meet Criterion D if they were resources likely to yield information that can only be answered by direct physical evidence. The Interstate bridges and the associated system are well documented through existing drawings, plans, books, and other documents maintained by ODOT.

**Criteria Consideration G** states that properties that have achieved their significance within the last fifty years do not meet the criteria for evaluation unless they are of “exceptional importance” and preservation worthiness. Exceptional importance is defined to be those less-than-50-year-old properties that have “the extraordinary importance of an event or to an entire category of resources so fragile that survivors of any age are unusual.” Fifty years is a general estimate of the time needed to develop historical perspective to evaluate significance and to assess preservation worthiness.

Criteria Consideration G is applicable to this studied population of pre-1961 interstate bridges because the overwhelming majority of them will not be 50 years old at the time of the evaluation. The state’s comprehensive Interstate system was developed as 549 different construction sections dating between 1950 and 1992. The Interstate program will not be fifty years old until 2006. By July 1961, the Ohio Department of Highways had 522 miles of Interstate open to traffic, or only about one-third of the system. Ohio had opened a majority of its mileage by 1968 but completion of all of the sections of the the two-digit number routes was not until 1978. If one considers the three-digit urban routes, the date would be pushed back even further; the last section of the original three-digit urban routes to be opened completely to traffic was IR 275 in Hamilton County in 1992.

Pre-1961 Interstate bridges will be evaluated as contributing resources to a historic district that will be evaluated applying Criteria Consideration G. The contexts demonstrate that Ohio’s comprehensive Interstate highway system, which is physically less than 50 years old, is of exceptional significance. There is scholarly consensus that design and construction of the nation’s Interstate highway system will be considered the most important public work of the mid to late 20th century.

National Register Bulletin No. 22, *Guidelines for Evaluating and Nominating Properties That Have Achieved Significance with the Last Fifty Years*, (revised 1998) states:
“As a general rule, properties that have achieved significance within the last fifty years are not eligible for the National Register listing because the National Register is intrinsically a compilation of the Nation’s historic resources that are worthy of preservation. The National Register does not include properties important solely for their contemporary impact and visibility, and it rarely is possible to evaluate historic impact, role, or relative value immediately after an event occurs or a building is constructed. The passage of time is necessary in order to apply the adjective “historic” and to ensure adequate perspective. .... In nominating properties to the National Register, we should be settled in our belief that they will possess enduring value for their historical associations, appearance, or information potential.”

What is less possible than significance to determine using the contexts and applying the National Register criteria for evaluation is whether the resource is worthy of preservation and whether the system will have ‘enduring’ value for its appearance. As a physical entity, the entire system might not be worthy of preservation if preservation is understood to be the retention of as much of its original fabric as possible because the resource is determined to be “historic.” This important consideration is handled to an extent within the fifty year guideline by the provisions for “fragile or short-lived.” It is stated that “some resources acquire historical qualities before the passage of fifty years because they either were not built to last that long or, by their nature, are subject to circumstances that destroy their integrity before fifty years have elapsed.” Such resources are often considered as old, in the sense of superceded by an newer, better, faster replacement, before they are fifty years old. The Interstate system is not generally viewed as “old” under this definition, nor is it short-lived, nor are its materials inherently fragile by their nature, although some materials, such as pavements, are subject to heavy usage and frequent replacement. It seems likely that some older components of the system that are rarely found unaltered could be viewed as having preservation worthiness but bridges do not appear to be among the rare unaltered components of the system.

The worthy of preservation consideration will be used as part of the application of Criteria Consideration G.

Integrity

In addition to significance, in order for a bridge or district to be eligible for the National Register it must also have integrity. A synonym for the state of completeness or preservation, integrity refers to a resource’s retention of original fabric and/or historic appearance. It does not refer to its state of repair or its structural or functional adequacy.

The National Register criteria recognize seven aspects or qualities of integrity: location, design, setting, materials, workmanship, feeling and association. To retain integrity a property will always possess several and usually most of these qualities. A bridge can have historical significance, but if it does not possess the aspects of integrity, it will be
evaluated as not eligible. While it is not necessary for a property to retain all of its historic features or characteristics, it must have its “essential features,” which are defined as “those features that define both why a property is significant and when it was significant.” Evaluating integrity as it applies to the pre-1961 Interstate bridges is complicated because the large system has sections that have significant alterations like additional lanes and new access ramps while others survive as built.

Because the significance of the pre-1961 interstate highway bridges appear to be best understood within the context of application of a national program, the aspects of integrity will be applied on a systemwide basis rather than section by section when considering the bridges under Criterion A. Given their historic context, the bridges cannot be fairly assessed for either significance or integrity without being considered within the overarching context of Ohio’s complete, comprehensive interstate network developed between 1950 and 1992.

To arrive at an accurate assessment of integrity, alterations to the bridges and the district/context to which they are related will be studied to determine if they (1) changed the design, appearance, or how a bridge or district/context functions, or (2) compromised the technological and/or historical significance of the resource.

The National Register normally treats the aspects of integrity differently for different criteria. Under Criterion A for a property associated with an important event or historical pattern, such as the patterns associated with the Interstate system, to be eligible, the property ideally should retain some features of all seven aspects of integrity. Under Criterion C emphasize shifts to retention of design and materials.

Location. The Interstate system and its pre-1961 bridges retain integrity of location. They are in the places they were constructed. How important is location to the significance of the Interstates? In general, the Interstate route locations were selected based on traffic data that showed that they were already important cross-state transportation routes served by US-numbered highways. The major exception to route locations based on previously existing routes were the urban loop roads.

Design. Design is defined as “the combination of elements that create the form, plan, space, structure, and style of a property.” Highways that have lost the ability to convey their original design have lost their integrity. Adding lanes, improving alignment, changing median treatments, widening or improving shoulders, and adding or lengthening ramps are significant alterations. Design is a very important aspect of integrity as applied to the Interstate system.

Ohio’s Interstate system maintains its key gross design features - limited access, grade separation, medians. The system is still based on balanced design to specific design speeds, although modern-day preferred design speeds are slightly higher. The standard travel-lane width is still 12’. The shoulders of the original system have been upgraded over most sections, including replacement of the original bituminous surface treatments with more permanent surfaces and the addition of safety features, such as
rumble strips. The original capacity of the system has been greatly increased by the addition of lanes, especially in and around urban areas. It is estimated that approximately 1,300 lane miles have been added to the system and that over twenty percent of the original Interstate route mileage has been widened. Alterations to the medians are extensive with the addition of median barriers and the taking of original wide grass medians for additional lanes or wider shoulders.

Bridges continue to play an important role in the system as grade separations and at interchanges. The more than 680 pre-1961 bridges still in-use on system indicate that rehabilitation of existing bridges has typically been the preferred approach, not bridge replacement. Widened bridges are found on sections of Interstate that have been widened for additional lanes and at interchanges where capacity of the intersecting road has been increased. Approximately twenty percent of the pre-1961 bridges in the inventory have been widened.

Setting. The setting is the physical environment of the property. It is uncertain how relevant setting is to conveying the significance of the Interstate system. As a geographically large feature, there have been significant changes in the larger setting, commensurate with the changes that have occurred in Ohio’s landscape since the various sections of Interstate opened. In fact, it might very well be observed that the greatest changes have occurred in proximity to Interstates because of the system’s impact on development. The setting could also be defined to include the relationship of the Interstate to intersecting roads. The setting within the right-of-way has remained undeveloped except to the degree that it has been converted to more lanes.

Materials. Materials are defined as “the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property.” Both the roadway itself and its component bridges have had loss of original fabric from constant usage and upgrading to meet current safety and capacity standards. Bridge inventory data indicates that the most common alteration to bridges has been railing replacement. About fifty percent of the bridges have lost their original railings, and most have also had their decks replaced or reconditioned. Additionally, the materials are not combined in a way that is noteworthy as all were used on all classification of roads since the early decades of the 20th century. In kind replacement of materials will not be considered as an alteration that lessens integrity.

Workmanship. The aspect of workmanship is generally considered the physical evidence of the crafts of a particular artisan, culture or people. It does appear to be an important aspect when evaluating the Interstate system.

Feeling. Feeling is a property’s expression of the aesthetic or historic sense of a particular period of time. It results from the presence of physical features that, taken together, convey the property’s historic character. This is an important aspect of integrity when evaluating Interstate highways. It will be applied to both the physical elements and associative significance of the system.
Association. Association is the direct link between the important historic event or person and a historic property. The Interstate system maintains it historic associations with the program that funded and built it. It remains a system with the primary purpose of conveying motor vehicles on high-speed highways. This seems very much an aspect of the Interstate system that is intact, but National Register guidelines specifically state that association and feeling alone do not adequately convey significance.
APPENDIX D

PROGRAMMATIC AGREEMENT
AMONG
THE FEDERAL HIGHWAY ADMINISTRATION, OHIO DIVISION
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
OHIO DEPARTMENT OF TRANSPORTATION
OHIO STATE HISTORIC PRESERVATION OFFICER
REGARDING
FEDERALLY FUNDED OR APPROVED HIGHWAY BRIDGE PROJECTS
PROGRAMMATIC AGREEMENT
AMONG
THE FEDERAL HIGHWAY ADMINISTRATION, OHIO DIVISION
THE ADVISORY COUNCIL ON HISTORIC PRESERVATION
OHIO DEPARTMENT OF TRANSPORTATION
OHIO STATE HISTORIC PRESERVATION OFFICER
REGARDING
FEDERALLY FUNDED OR APPROVED HIGHWAY BRIDGE PROJECTS
AGREEMENT NUMBER - 10978

WHEREAS, the Federal Highway Administration (FHWA) has determined that assisting the Ohio Department of Transportation (ODOT) with replacement or rehabilitation of bridges (the Projects) may have an adverse effect on bridges listed or determined eligible for listing in the National Register of Historic Places and has therefore consulted with the Advisory Council on Historic Preservation (the Council) and the Ohio State Historic Preservation Officer (OSHPO), pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. 4701) and implementing regulations (36 CFR Part 800); and

WHEREAS, on July 23, 1993, the Federal Highway Administration (FHWA), the Advisory Council on Historic Preservation (ACHP), the Ohio Historic Preservation Officer (OHPO), and the Ohio Department of Transportation (ODOT), executed a Programmatic Agreement for Administration of federally funded or approved highway projects in accordance with 36 CFR Sec. 800.14; and

WHEREAS, Stipulation C-III of the original agreement and Stipulation E-III as amended, require that when the numbers in any Reserve Pool category reach 50% of the original total in that category, the remaining bridges in that category will be reevaluated and elevated to the Reserve Pool to compensate for losses and to reestablish the original number Reserve Pool structures in individual categories; and
WHEREAS, the subsequent annual reviews of the Agreement determined that Stipulation E-III cannot be satisfied because insufficient numbers of qualified bridges remain in certain categories to reestablish the Reserve Pool; and

WHEREAS, the signatories to this agreement desire to expedite the necessary historic preservation review for transportation enhancement activities beneficial to historic preservation and thereby encourage the use of transportation enhancement funds for historic preservation purposes; and

WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that as used in this Programmatic Agreement the term “first historic bridge inventory” refers to the bridge inventory completed by ODOT in 1982 and published in 1983 as the Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan; and

WHEREAS, FHWA, OSHPO, and ODOT agree to accept the results of the “first historic bridge inventory” regarding Baltimore through trusses; bascules; bowstring arch pony and through trusses; camelback pony and through trusses; cantilevered deck through trusses; double intersection Pratt through trusses; double intersection Warren pony, deck and through trusses; Fink through truss; king post; lattice trusses; lenticular pony and through trusses; Parker pony, deck and through trusses; Pegram through trusses; Pennsylvania through trusses; Pratt double deck truss; Pratt pony, deck, and through trusses; steel arches; suspension bridges, swing bridges; truss leg bedstands; vertical lifts; Warren pony and through trusses; Warren polygonal chord pony and through trusses; and stone arch bridges; and

WHEREAS, FHWA, OSHPO, and ODOT agree that metal and stone bridges identified as “Selected” in the first historic bridge inventory, are eligible for the National Register of Historic Places. Undertakings, as defined in Stipulation I, involving Selected bridges, are subject to the 106 Consultation Process; and
WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that as used in this Programmatic Agreement, the term “second historic bridge inventory” refers to the inventory completed and published as the Second Ohio Historic Bridge Inventory, Evaluation, and Preservation Plan in 1990; and

WHEREAS, FHWA, OSHPO, and ODOT agree to accept results of the second historic bridge inventory, concerning metal truss bridges, continuous steel deck girders and beams, concrete arches, cantilevered deck and steel arches; and

WHEREAS, FHWA, OSHPO, and ODOT agree that bridges identified as “selected” in the “second historic bridge inventory” are eligible for the National Register of Historic Places. “Undertakings”, as defined in Stipulation A-I, involving these bridges are subject to the 106 Consultation Process; and

WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that as used in this Programmatic Agreement, the term “Concrete Arch Inventory: refers to the survey completed and accepted by the Advisory Committee on February 12, 1993; and

WHEREAS, FHWA, OSHPO, and ODOT agree to accept the February 1993 results of the concrete arch inventory for closed concrete filled, hollow and ribbed arches and open concrete ribbed and slab arches. FHWA, OSHPO, and ODOT agree that these results supercede any previous designations of Selected or Reserve Pool in the concrete arch categories built prior to 1941; and

WHEREAS, FHWA, OSHPO, and ODOT agree that concrete arch bridges identified as “selected” in the concrete arch inventory are eligible for the National Register of Historic Places. “Undertakings”, as defined in Stipulation I, involving these bridges, are subject to the 106 Consultation Process; and
WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that the goal of these inventories is to identify and preserve bridges on or eligible for listing on the National Register; and

WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that as used in this Programmatic Agreement, the term “historic bridge” refers to bridges included in or eligible for inclusion on the National Register of Historic Places; considered a contributing element within a listed or eligible historic district; or identified as Selected bridges in Ohio’s historic bridge inventories. Historic bridges are subject to the 106 Consultation Process; and

WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that as used in this Programmatic Agreement, the term “Reserve Pool” bridge refers to bridges included in the historic bridge inventories that will be assessed for National Register eligibility when they are programmed for rehabilitation or replacement. If the “Reserve Pool” bridge is identified as eligible for the National Register of Historic Places, it will be subjected to the 106 Consultation Process. If the Reserve Pool bridge is identified as not eligible for the National Register of Historic Places the 106 Consultation Process has been completed for that bridge; and

WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that all bridges included in the historic bridge inventories and not identified as Selected or Reserve Pool structures, or located within a historic district are determined to be not eligible for the National Register of Historic Places; and

WHEREAS, FHWA, the Council, OSHPO, and ODOT agree that all slab, beam, box beam, girder and frame bridges, or culverts made of concrete, steel, or aluminum are determined to be not eligible for the National Register of Historic Places; and

WHEREAS, FHWA and OSHPO have determined that all continuous steel beam and continuous steel girder deck bridges constructed after the issuance of standardized plans in 1939 are not eligible for the National Register of Historic Places; and
WHEREAS, FHWA, the Council, OSHPO, and ODOT agree this Programmatic Agreement shall remain in effect until the completion and acceptance by all parties of the historic bridge inventory update scheduled for year 23002 or January 1, 2003. Renewal of the Programmatic Agreement will be by mutual consent of all parties.

NOW, THEREFORE, the FHWA, the Council, OSHPO, and ODOT (the parties to this agreement) agree that Highway Bridge Projects shall be administered in accordance with the above provisions and the following stipulations as amended to satisfy FHWA’s Section 106 responsibility for all individual undertakings of the highway bridge projects.

STIPULATIONS

Section A- Definitions

A-I As used in this Programmatic Agreement, the term “undertaking” refers to federal actions potentially affecting bridges. “Undertaking” includes replacement, restoration, or repair or bridges; removal and replacement of structural parapets on historic bridges; and attachment of guardrails across historic bridges.

A-II “Undertakings: involving historic bridges will be subject to the 106 Consultation Process.

A-III “Undertakings” affecting bridges not eligible for the National Register of Historic Places will not be subject to the 106 Consultation Process, if the undertaking, in compliance with 36 CFR Part 800, will have no effect upon other known cultural resources.

A-IV Routine maintenance, road repair, deck replacement, resurfacing, and attachment of approach guardrails to an existing historic structure are not considered “undertakings” as defined in Stipulation A-I, and are not subject to the 106 Consultation Process.

Section B- General

B-I The next update is scheduled for the year 2002 or January 1, 2003, when at such time FHWA, OSHPO, and ODOT agree to update the historic bridge inventory every ten years. During
the evaluation schedule for the year 2002, bridges built between the years 1951 and 1960 will be added to the evaluation; and the bridge styles previously identified as not eligible for the National Register will be reevaluated.

B-II In the event of an emergency involving a historic bridge, ODOT and FHWA will undertake only those repairs or other immediate actions necessary to maintain public safety and remedy the emergency situation; once the immediate emergency is remedied, ODOT will consult with the OSHPO in accordance with Stipulation A-I regarding any further necessary, permanent repair work.

B-III When an owner of an historic bridge notifies ODOT of its intent to replace the bridge using local government funds and no federal approvals required, ODOT will immediately notify the OSHPO and will encourage the owner to consider one or all of the following: rehabilitation, reuse, or relocation. IF the bridge is removed ODOT will notify the OSHPO and will encourage documentation.

B-IV When an owner of a historic bridge notifies ODOT of its intent to rehabilitate the bridge using local government funds, ODOT and the OSHPO will, upon the owner’s request, meet with the owner and provide expert advice on a rehabilitation which would retain the historic integrity of the structure.

B-V ODOT will encourage county engineers to salvage usable elements of non-historic structures for use on historic structures.

B-VI ODOT will notify the OSHPO when the National Register, Selected, or Reserve Pool bridge is lost through a natural disaster, an accident, or through demolition by a local government. When a Selected bridge is lost, ODOT will recommend a Reserve Pool structure, in the same category, as a replacement.
B-VII  When significant new information is found for a bridge not listed on the National Register or identified as Selected, it will be reevaluated for National Register eligibility by ODOT and the OSHPO.

B-VIII  The OSHPO will notify ODOT of nomination (historic districts, thematic, individual) that include bridges.

B-IX   FHWA, OSHPO, and ODOT will present up to three annual awards to city, town, village, and county engineers who have initiated and completed the most outstanding projects involving the preservation, rehabilitation, and reuse of historic bridges. The recipients of the awards will be selected jointly by representatives FHWA, OSHPO and ODOT.

B-X   The OSHPO and ODOT will maintain an updated file of parks, political subdivisions, agencies, museums, and individuals interested in obtaining a historic bridge for non-vehicular or limited use. If economically and structurally feasible to move the bridge to a new location, the OSHPO and ODOT will assist by identifying the potential funding sources to aid in the relocation.

B-XI  When the total number of bridges in any category previously identified as historic by the Agreement (excluding those categories where ten or fewer bridges were originally identified) reaches 10 or below, ODOT, in consultation with OSHPO, will develop a Preservation Plan for the category. The Preservation Plan will include a strategy for encouraging and assisting the owners in preserving their bridges. ODOT, in consultation with OHPO, will develop recommendations for preservation for at least three of the bridges in each category. The strategy could include, but is not limited to, rehabilitation, reuse such as pedestrian structures at the same location, moving to a new location for reuse. Technical assistance, and identification of any potential funding, The ODOT District Director or local project sponsor will be provided a copy of the Preservation Plan and encouraged to implement the preservation strategies included in the Plan. If OSHPO and ODOT agree that preservation is not reasonable or feasible, the requirements of this provision may be considered satisfied, and FHWA will so advise the ACHP in its annual report.
If after such food faith efforts to develop a Preservation Plan for any particular historic bridge category have been made, FHWA determines that ODOT and OHPO cannot agree on a Plan, provisions for dispute resolution described in Stipulations F-I and II, as amended below, shall be implemented.

Section C- Rainbow Arch Bridges

C-I As used this Programmatic Agreement, the term “rainbow arch” refers to reinforced concrete structures that essentially duplicate 19th century bowstrings metal trusses with main arches, diagonal braces, and verticals, compromising the “bow and the horizontal lower chord in tension comprising the “string”. These bridges are subject to the 106 Consultation Process.

C-II FHWA, OSPHO, and ODOT agree that when any of the existing rainbow arch bridges is programmed for replacement, ODOT will encourage rehabilitation. If rehabilitation is not feasible and prudent, ODOT will recommend bypassing the bridge and reusing it for pedestrian and/or bicycle traffic.

C-III FHWA, OSHPO, and ODOT agree that if it is deemed not prudent and feasible to rehabilitate or bypass a rainbow arch, ODOT will recommend a new rainbow arch. The new rainbow arch will not necessarily constitute a replica, but will be built using the plan developed by ODOT for rainbow arches. This plan utilizes original highway department standard plans, to meet current design standards. This standard shall be considered only if there are no other available alternatives. FHWA, OSHPO, and ODOT agree that no more than three rainbow arches will be replaced in such a manner, with one in northern Ohio, one in central Ohio, and one in southern Ohio.

Section D- Determination of Effect

D-I For all proposed “undertakings” involving historic bridges, ODOT, in consultation with the OSHPO, will follow procedures in 36 CFR Section 800.4 and 800.5 to determine the effect of the undertaking on the historic bridge. FHWA and ODOT will seek the concurrence of the OSHPO with the finding and transmitting of sufficient descriptive information (such as maps, photographs, preliminary engineering studies) to enable the OSHPO to evaluate the effect of the undertaking,
the OSHPO will notify ODOT of their concurrence or disagreement with ODOT’s assessment of the effect of the undertaking.

D-II When FHWA, OSHPO, and ODOT agree to a finding of “no Historic Properties Affected” or “no Adverse Effect”, the project may proceed.

D-III OSHPO and ODOT will mutually determine the level of documentation necessary for proposed rehabilitation or replacement projects for Reserve Pool bridges that are identified as eligible for the National Register.

D-IV When FHWA, OSHPO, and ODOT agree to a finding of an “Adverse Effect”, pursuant to 36 CFR Section 800.5 for a historic bridge, FHWA and ODOT will attempt to minimize, and mitigate the adverse effect. FHWA and ODOT will evaluate as appropriate, alternatives such as one-way traffic, minor rehabilitation, and major structural upgrade of the existing bridge as mitigation measures. If these alternatives are found to be not feasible and prudent, then relocation and marketing of the historic bridge will be considered prior to demolition, with recordation of the bridge.

D-V In the case of an “Adverse Effect”, for a historic bridge, FHWA and ODOT will comply with 36 CFR Section 800.6. FHWA and ODOT agree to provide a Memorandum of Agreement accompanied by the documentation specified in Section 800.11(e) and afford the Council an opportunity to comment as required by 36 CFR Part 800.6(a)(1).

D-VI When FHWA, OSHPO, and ODOT cannot agree on the potential effects of an “undertaking” or mitigation measures, FHWA will request comments for the Council in the ordinary process, pursuant to 36 CFR Part 800.

D-VII FHWA and ODOT will ensure the preparation of Level II Historic American Engineering (HAER) recordation when a bridge listed in or eligible for listing in the National Register of Historic Places is threatened with demolition or substantial alteration by projects with FHWA assistance.
One archival copy of the HAER documentation will be made available to the OSHPO and one archival copy to the designated American History Research Center.

Section E- Monitoring

E-I FHWA, OSHPO, and ODOT will meet on an annual basis for a process review which will include an assessment of this Programmatic Agreement.

E-II ODOT will provide annually to the OSHPO a listing of bridge project undertakings which, in accordance with Stipulation A-III, are not subject to the 106 Consultation Process.

E-III OSHPO and ODOT will meet on an annual basis to review the status of the National Register, Selected, and Reserve Pool structure. To assist in this review ODOT will provide the OSHPO, annually, a status report of the National Register, Selected, and Reserve Pool structures. During the annual review when the numbers of any Reserve Pool category reaches 50% of the original total of Reserve Pool structures in that category, the remaining bridges in that category will be re-evaluated. Based upon re-evaluation, ODOT will recommend to the OSHPO those bridges to be reclassified as Reserve Pool structures. A sufficient number of structures will be elevated to the Reserve Pool category to compensate for losses and re-establish the original number of Reserve Pool structures in individual categories. ODOT will notify FHWA and the OSHPO when the original number of Reserve Pool structures in individual categories cannot be reestablished because of a lack of bridges in that category. Upon such notification, the provisions of Section B-XI of this agreement must be followed.

Section F- Dispute Resolution

F-I Any party to this agreement may institute a 60 day negotiation to resolve any mutually identified problems with any particular stipulation. In the event that all parties are unable to develop a mutually agreeable resolution, the Stipulation in question will be nullified, and FHWA and ODOT will comply with the applicable procedures of 36 CFR Part 800.3 through 800.6 regarding undertakings. Should any of the parties object to products of the stipulations of this agreement, FHWA shall consult with the objecting party to resolve the objection. If the FHWA determines that the objection cannot be resolved, the FHWA shall request further comments of
the Council pursuant to 36 CFR Section 800.7(a)(1). Any Council comment provided in response to such a request will be taken into account by the FHWA in accordance with 36 CFR Section 800.7(c)(4) with reference only to the subject of the dispute; the agency’s responsibility to carry out all actions under the PA that are not the subjects of dispute will remain unchanged.

F-II FHWA, the Council, OSHPO, and ODOT agree that at any time during implementation of the measures stipulated in this Agreement, should an objection to any such measure or its manner of implementation be raised by a member of the public, FHWA and OSHPO shall take the objection into account and consult as needed with the objecting party. The Council, in accordance with 36 CFR Section 800.7(c), shall participate in consultation to resolve such an objection when it receives a request from the public or when FHWA requests Council participation.

Section G- Amendments

G-I FHWA, the Council, OSHPO, and ODOT agree that the next update is scheduled for the year 2002, when at such time FHWA, OSHPO, and ODOT agree to update the historic bridge inventory every ten years. During the evaluation scheduled for the year 2002 or January 1, 2003, bridges built between the years of 1951 and 1960 will be added to the evaluation; and the bridge styles previously identified as not eligible for the National Register will be reevaluated.

G-II FHWA, the Council, OSHPO, and ODOT agree that the Programmatic Agreement shall remain in effect until the completion and acceptance by all parties of the historic bridge inventory update scheduled for the year 2002 or January 1, 2003. Renewal of this Programmatic Agreement will be any mutual consent of all parties.

G-III FHWA, the Council, OSHPO, and ODOT agree if any of the signatories to this agreement determine that the terms cannot be met or believe a change is necessary, that signatory shall immediately request the consulting parties to consider an amendment or addendum to the agreement. Such an agreement or addendum shall be executed in the same manner as the original agreement.
This agreement will be null and void if its terms are not carried out within five years from the date of its execution, unless the signatories agree in writing to an extension for carrying out its terms.

Execution and implementation of the terms of this Programmatic Agreement evidences that FHWA has satisfied its Section 106 responsibilities for individual undertakings affecting historic bridges under the federally approved or funded Highway Bridge Projects.

**ADVISORY COUNCIL ON HISTORIC PRESERVATION**

By: John M. Fowler Date: 4/3/02

Executive Director

**FEDERAL HIGHWAY ADMINISTRATION**

By: Leonard E. Brown Date: 1/8/2002

Division Administrator

**OHIO STATE HISTORIC PRESERVATION OFFICE**

By: Mark Epstein Date: 3/11/02

Department Head, Resource Protection and Review

**OHIO DEPARTMENT OF TRANSPORTATION**

By: Gordon Proctor Date 12/10/01

Director