

Grand Rapids, Michigan US-131 S-Curve Replacement: Collaborative Design, Construction Closure of Central Urban Access

EXECUTIVE SUMMARY

In January 1998, the Michigan Department of Transportation (MDOT) discovered that a pier supporting a heavily traveled urban bridge had suddenly settled several inches with a resulting dip in the road surface. The bridge was part of the “S-Curve,” a raised portion of US-131 that runs through downtown Grand Rapids, Michigan and traverses the Grand River. Faced with the discovery of this serious structural damage to a major bridge located in the downtown of Michigan’s second largest city, MDOT had to decide whether the bridge could remain open. After completing emergency repairs to fill the bedrock voids that caused the pier to sink, MDOT determined that the S-Curve could safely continue in service, but that planning for a more permanent solution must commence immediately.

Given both the need to correct the structural damage as quickly as possible and the availability of project funding, MDOT initially proposed to rehabilitate and reconstruct the damaged bridge. However, members of the Grand Valley Metro Council, the local Metropolitan Planning Organization (MPO), were not receptive to these plans. The Council saw an opportunity to meet the region’s future transportation needs and requested a new proposal from MDOT. The mayor of Grand Rapids and other city leadership also opposed the “as is” replacement alternative.

Although it understood the MPO’s and city’s concerns, MDOT had not planned or budgeted for any capacity improvements to the S-curve. Prior to the January 1998 incident, MDOT had scheduled the S-Curve for continued rehabilitation and maintenance over a multiple-year period. After the incident, the replacement proposal submitted to the MPO was priced at approximately \$40 million, and additional funds for capacity enhancements were not available.

Fortunately, MDOT had just received an infusion of new federal and state transportation dollars, providing MDOT with the short term financial flexibility to consider and propose alternatives other than just S-Curve replacement. MDOT returned to the MPO and proposed to replace and improve the entire 1.2-mile S-Curve with more lanes, wider shoulders, and longer merging lanes. Nevertheless, many planning and implementation issues remained to be resolved before this proposal was feasible.

Safety concerns raised by a deteriorating S-Curve coupled with the S-Curve’s status as the main north/south transportation corridor required that construction be completed as quickly as possible. This gave rise to an overarching project concern about potentially lengthy planning and construction schedules. The mayor of Grand Rapids shared this scheduling concern because of the potential adverse economic impacts to downtown commercial and business interests from years of traffic congestion. As a result, the mayor, city officials, and MDOT met frequently and formed a powerful team to push for a seldom-used solution: full closure of an important urban transportation link.

MDOT released its plans to fully close the S-Curve and simultaneously demolish the entire structure, while building a new one within one season. This aggressive approach met with

strong business and public opposition. Business interests believed that a total S-Curve closure would be tantamount to a downtown closure. The public feared that massive traffic congestion would result within the affected region.

In response to these concerns, MDOT took an extensive and transparent approach, meeting with local media, the chamber of commerce, community and neighborhood organizations, and affected businesses to explain its plans, listen to concerns, and propose solutions to the problems raised. All communications with the local media were coordinated through a single MDOT spokesperson. MDOT also hired a public relations firm to prepare and disseminate clear information on construction plans, detour planning, and alternative commuting arrangements to and from downtown.

MDOT not only identified detour routes early but also set aside funding to keep the designated routes in the best condition possible to accept the additional traffic loading. In response to concerns raised by downtown employers and their commuting employees, MDOT teamed with the local transit authority, the Interurban Transit Partnership, to establish a free bus system that included free, secured parking areas, frequent rush hour service, a dedicated bus lane, and the pledge of a guaranteed ride home. MDOT funded \$1.2 million for this alternative transit program.

Through the combination of MDOT's extensive public outreach efforts and its specific and effective responses to the transportation and commuting problems that were raised, MDOT gradually persuaded the business community and the public that a full closure was feasible and in the best overall interests of the city and region. MDOT effectively implemented their plan with contributions from:

- The city, an adjacent university, downtown businesses, and other organizations that contributed to aesthetic designs for the S-Curve structure;
- The local public transportation agency, which created a shuttle bus service to bring people into downtown;
- The State Historic Preservation Office, which assisted in negotiations to remove an historic building that would be demolished; and
- The State Archaeologist and staff from Grand Valley State University, who assisted in archaeological work on the S-Curve construction site.

MDOT accommodated plans to fit the existing alignment in order to avoid more extensive environmental impact analysis requirements and other planning processes that would require years to complete. On October 26, 2000, 33 months after the discovery of the sunken pier, both north and southbound lanes of the new S-Curve were open to traffic. On November 15, 2000, MDOT's project staff and other key players received a National Quality Initiative Bronze Award for partnering.

BACKGROUND

The S-Curve is a section of US-131 that carries traffic north and south through downtown Grand Rapids, Michigan. It spans 1.2 miles and includes three interchanges and six bridges, one of which crosses the Grand River. Grand Rapids is the second largest city in Michigan and US-131 is the most heavily traveled corridor in the Grand Rapids metro area. Before the

replacement project, the S-Curve contained six lanes and serviced an average daily traffic load of approximately 110,000 vehicles.

The state constructed US-131 between 1959 and 1961 to promote commerce and provide a freeway connection between Kalamazoo, Grand Rapids, and Northern Michigan. The highway formed an S-curve in downtown Grand Rapids because, although city leaders wanted a roadway that brought travelers close to downtown, local businesses refused to relinquish sufficient property for the right-of-way.

The result was a series of bridges that curved around downtown buildings.



Figure 1. S-Curve in Grand Rapids, Michigan

The original S-Curve had 11-foot lanes with no shoulders for disabled vehicles, short ramps, and five steel-beam structures that required continuous maintenance. In the 1960s and 1970s, the state erected guardrails, barriers, and glare screens between opposing traffic lanes and painted solid lines between lanes to prevent lane shifting. However, there were still problems associated with the highway:

- The sharp curve of the roadway resulted in higher than average accident levels;
- Short on-ramps made merging difficult, and the low speed limit caused constant bottlenecks during peak commuting times;
- From the community's perspective, the poor design of the structure, with its closed-off bridge supports, divided the downtown area; and
- The aging S-Curve had increasingly become an eyesore in a downtown area otherwise experiencing extensive revitalization in the form of the Van Andel Arena, the Van Andel Museum, the Amway Grand Hotel, DeVos Place, and the Grand Center Convention Center.

Project Drivers

Since 1961, MDOT's long-term strategy for the S-curve was to rehabilitate and maintain the structure. For example, the roadway surface was reconstructed in the 1970s and ongoing maintenance was performed as needed. In 1989, a Structural Inspection Engineer noted a possible settlement of pier 5 on the bridge portion over Grand River. In 1996, MDOT initiated a Maintenance Alternatives Study and also began monitoring points along the S-Curve for lateral movement and settlement. MDOT made repairs to the structures to address identified problem areas.

During a monthly inspection of a bridge pier, engineering staff discovered a settlement of more than seven inches and lateral movement of three inches from the previous month. MDOT's immediate investigation found that the bridge piers rested on gypsum in the bedrock under the S-Curve. The gypsum was dissolving over time and leaving cavities, one of which was reported to be "the size of a Volkswagen." As a temporary measure, MDOT injected grouting in the

cavities, installed mini piles at two piers, straightened rocker bearings, and patched the deck. An engineering evaluation indicated the need to replace the entire bridge over the Grand River. MDOT concluded that, in the interim, the emergency repairs were sufficient to allow the S-curve to remain open to traffic, but a permanent fix as soon as possible was essential for public safety. The need for a rapid response, therefore, was the paramount driver.

Two key institutional drivers molded the ultimate scope of the project: the area's Metropolitan Planning Organization (MPO) and the mayor of Grand Rapids. Although they both recognized the need to move quickly, they also saw an opportunity to address the historical problems associated with the S-Curve's initial design. The MPO wanted to see design enhancements that would accommodate future traffic projections. The mayor and other city officials wanted a new structure with a more aesthetically pleasing design that was more fully integrated into the cityscape and economic development plans. The integration would allow for improved local street circulation and accommodate numerous ongoing and planned urban revitalization projects in the neighborhoods adjacent to the S-Curve.

Grand Valley State University (GVSU) has been a major partner in the city's downtown redevelopment efforts. The university already had buildings located on either side of the S-Curve and was in the midst of a major campus expansion. Over the long term, the appearance of the new S-Curve, specifically the location and design of the bridges' supporting structures, would directly impact the appearance of this expanding, modern, and well-designed campus. Construction plans and impacts were also relevant to the university in the short term. Student safety was potentially at risk because students would virtually have to pass through a portion of the work zone in order to move between campus buildings. Early in the planning process for the new S-Curve, GVSU made these concerns known to MDOT and expressed the university's desire to work closely with MDOT on their resolution.

City officials and members of the Grand Rapids Area Chamber of Commerce shared concerns about the potential adverse impacts from construction activities. Business owners feared that the re-construction project would cause extensive periods of major traffic congestion in the downtown area. As a result, they predicted that employees would face major delays in commuting to and from their downtown work sites and that shoppers would bring their business elsewhere. Minimizing these potential problems for downtown businesses and commuters became another important driver.

Initial Concept and Planning

MDOT's 1998 plans to repair the affected bridge over the Grand River "as is" and perform preventative maintenance on other piers that might sink would have cost \$40 million. Straightening the S-curve would have required realignment, several costly land acquisitions, and a lengthy environmental study. Given these anticipated difficulties, budget constraints and likely local opposition to a new alignment, MDOT deemed infeasible the option of straightening the S-Curve.

Early objections from local government officials and the MPO changed these initial plans to a project that evolved into a compromise between straightening the S-Curve and repairing just the sunken bridge. The MPO made clear the need to improve the facility to meet future traffic needs, while city leadership not only supported the MPO's position but insisted on additional design enhancements plus an accelerated construction schedule. The result was a well designed project within the same environmental footprint as the existing alignment but widened

to allow more lanes and shoulders to meet the MPO's future traffic projections. Total project costs were \$145 million.

Project Overview

The reconstruction and enhancements for the S-Curve addressed vertical and horizontal alignment deficiencies. Vertically, MDOT stabilized the foundations at the river bridge, constructed drilled shafts below the gypsum deposits, mechanically stabilized earth abutments and added retaining walls.

The horizontal enhancements included an additional continuous merge/weave lane in both directions in order to improve traffic flow between interchanges and to accommodate projected traffic growth and larger radius curves on the bridges. These changes allowed the design speed to be increased within the curve from previous limits of 45 miles per hour.

MDOT also widened the outside shoulders along most sections of the corridor and added inside shoulders, providing space for disabled vehicles and alleviating congestion caused by roadside incidents. The shoulders also accommodate maintenance activities for the S-Curve.

Interchange modifications were made for the purposes of enhancing local street circulation and consolidating access points to and from the US-131 freeway in the downtown area. A resulting "split diamond" interchange improves safety during ramp merging by reducing conflict points on US-131 in the S-Curve area. The interchange improvements also provide a more direct link to the Van Andel Arena and adjacent new developments.

Figure 2. Landscaped Park Adjacent to S-Curve



Intelligent Transportation Systems were included and cameras were placed strategically to allow for the continuous monitoring of traffic. MDOT also decided to employ the latest technology in anti-icing systems. Small disks embedded in the deck release a chemical across the lanes for the purpose of preventing ice and snow from accumulating.

Under the S-Curve, and with the help of city and other local partners, two city streets were connected. Excess state-owned property was converted to much needed downtown parking. A new walkway to accommodate

pedestrian traffic was added along with other sidewalk and landscaping improvements. Additionally, one of the distinctive arches of the new S-Curve serves as a major bus stop for the nearby Grand Valley State University campus.

MAJOR PROJECT ISSUES

The major project issues affecting the S-Curve were:

- **Structural safety.** MDOT had to build a new facility that eliminated risks posed by structural deterioration and foundation settlement. Upon the discovery of the sunken bridge, MDOT's first issue was whether the existing S-curve could remain open. After completion of emergency repairs and analyses on the structure, MDOT determined that it was safe to keep the bridge open while planning for reconstruction.
- **Available Budget.** Because the long term plan for the S-Curve was premised on making essential repairs, funding was accordingly limited to that purpose. This funding issue drove the Agency to initially propose the alternative of repairing the sinking bridge. Funding was not available for the variety of enhancements that the MPO, the mayor, the owners of affected neighboring properties, and the public were seeking.
- **Timeframe.** Closely associated with the safety issue, was the amount of time it would take to put a safer structure in place. This time period needed to be shortened as much as possible. Planning and construction phases had to be reviewed for all opportunities to save valuable time.
- **Full Closure.** Because the construction phase could make up the largest segment of the project schedule, MDOT planners weighed whether full closure of the S-Curve was preferable to the more traditional construction approach of phased construction, i.e., allowing traffic limited lane access while other lanes are closed to construction. MDOT had experienced some success in totally closing freeways near Detroit. The agency believed that residents and commuters would prefer this solution with its shorter construction period over the limited access approach that extended congestion due to construction over several seasons. MDOT planners recognized that it would be difficult to make the case for the full closure of a heavily traveled urban thoroughfare; it would raise major questions about the adequacy of detours and other steps to minimize congestion.
- **North and South Access.** Drivers from north and south of Grand Rapids relied on the US 131 freeway access both to get through the city and to get to the downtown. The S-Curve was at the center of the city and its reconstruction would clearly affect this well-traveled route. Regional travelers and shippers expressed concern that closure of the S-curve would severely delay north and south access. Local businesses and commuters feared downtown gridlock. The TV and news media strongly echoed and reported on these concerns.
- **Aesthetics.** As talk of a reconstruction project surfaced, it highlighted the fact that the old S-Curve had been poorly planned and, with age, had become an eyesore. City officials and community leaders did not want to see a repeat of this poor planning. They pushed for an aesthetically pleasing centerpiece to the city, as well as a design that improved street circulation patterns below the bridges.
- **Grand Valley State University.** With the existing freeway dividing the university's campuses, tunnels and underpasses provided access for students and faculty. GVSU wanted the final designs for the S-curve to facilitate access throughout the campus and complement its aggressive plans for expanding campus facilities. GVSU also wanted to address student safety during construction by including safe pedestrian routes that connected campuses but skirted work sites.
- **Historical and Cultural Resources.** The initial S-Curve structure wove closely around the Star Building, the first all concrete building in Grand Rapids and an important contributor to

the development of the city as a center of commerce. The Star Building was considered eligible for listing on the National Register of Historic Places, but its demolition would be required in order to make room for the locally popular alternative of widening the S-Curve. MDOT recognized that a Section 4(f) Evaluation would have to accompany the consideration of this alternative and would complicate its efforts to meet an expedited project development schedule. Archaeological resources also emerged as an issue to be addressed. Native American settlements preceded the city's existence, along the Grand River. Historical evidence shows that early European settlers used Indian burial mounds as fill. The Grand River Bands of Ottawa Indians believed that artifacts and possibly human burial remains existed under a portion of the S-Curve project on the north side of the Grand River and under an area called Parking Lot B. This parking lot was the proposed site for the construction of two new bridge piers.

INSTITUTIONAL FRAMEWORK FOR DECISION MAKING

MDOT was the lead decision-making agency for the project while many other entities played major roles in the project's successful planning, design, and implementation stages. MDOT kept FHWA informed of the resolution status of all major issues and steps in the project development process. FHWA, in return, remained fully involved and responsive and consistently supported MDOT's major recommendations.

The area's MPO, the Grand Valley Metropolitan Council, was determined to affect the project's ultimate design parameters by acting as a facilitator for transportation decision making. The MPO could also reject or accept a project proposal for inclusion in the metro area's Long Range Transportation Plan and Transportation Improvement Program and consequently, the project's eligibility for federal funding. In that role, the Council worked constructively with MDOT in seeking a compromise design that accommodated future traffic projections while meeting other community needs.

Also from a regional perspective, the cooperation and active participation of the metro area's transit authority was essential to addressing the overriding concerns about pending downtown gridlock. That authority is now called the Interurban Transit Partnership but at the time of the project development was called the Grand Rapids Area Transportation Authority.

The Kent County Road Commission is charged with the day-to-day maintenance responsibilities along the S-Curve. MDOT had long-standing contract arrangements with the Commission and intended to seek their help in performing a variety of on-site tasks throughout the project's construction.

Because of the project's downtown location, the City of Grand Rapids was fully engaged in the project from start to finish. When the MDOT project engineer was first informed of the sinking pier in 1998, he immediately included city officials such as the mayor and assistant city manager in the initial response. Besides voicing needs as the project developed, the city played a key role in planning, financing, coordinating, and completing work on a variety of affected utilities. The Public Museum of Grand Rapids owned the Star Building, the demolition of which required relocation of nearly one million historic artifacts stored within.

The Grand Rapids Area Chamber of Commerce and the Grand Rapids/Kent County Convention and Visitors Bureau actively and effectively represented the business community's interests. In

particular, the Chamber of Commerce worked closely with MDOT in bringing together major opinion leaders on the S-Curve Impact Council.

Planning construction activities along a navigable and important recreational river also requires the participation of federal and state permitting agencies. The US Army Corps of Engineers and the Michigan Department of Environmental Quality were consequently important players in completing the planning process. These agencies focused their project reviews on potential impacts to the floodplain, adjacent wetlands, fish spawning periods, and the river's recreational use.

Additionally, cultural resource impacts necessitated the involvement of the State Historic Preservation Officer and the State Archaeologist. The Grand River Bands of Ottawa Indians were deeply concerned about the presence of ancestral artifacts and participated in the planning and conduct of the archaeological investigation and salvage procedures.

TRANSPORTATION DECISION-MAKING PROCESS / KEY DECISIONS

Project Scope

After the discovery of the sinking bridge pier in January 1998, MDOT discussed the S-Curve's condition with the FHWA Michigan Division. Based primarily on the immediate availability of funds, MDOT prepared plans to repair and replace the damaged bridge and so informed the MPO and the city. The MPO rejected this proposal because it failed to address the region's forecasted transportation needs. In mid-1998, the MPO requested that the project expand to include enhancements to the entire 1.2-miles of the S-Curve. The mayor strongly endorsed this recommendation.

These actions forced MDOT to consider other project alternatives; however, available funding and time remained important constraints. Fortunately, funding relief arrived as a result of a increase in the state's gas tax and the receipt of additional federal funds through TEA-21.

With funding in place, MDOT engaged the MPO and city staff in discussions on possible S-Curve enhancements. MDOT agreed to address safety, structural, and functional issues by expanding improvements to four lanes in each direction, increasing merging lanes, allowing for shoulders, easing the severity of the curve to increase design speed, and setting foundations for the bridges below the gypsum that caused the 1998 settlement. MDOT approved the proposal, but the city had further requests. Though consensus was evolving around a new scope, the FHWA standard environmental review processes still needed to be streamlined if MDOT was to achieve its first priority, to put a safer structure in place as soon as possible.

Environmental Process

A resulting key decision was whether an environmental impact statement (EIS) would be required for the project. MDOT, after consulting with FHWA, decided to initiate the preparation of an environmental assessment (EA), a document that formally examines the need to prepare an EIS. When the need for an EIS is clear, which is often the case for major highway construction projects, an EIS is simply initiated, without a prior EA. In the case of the S-Curve, MDOT believed they could limit the potential environmental impacts of the bridge replacement to the extent that an EA would produce a Finding of No Significant Impact (FONSI), making an EIS unnecessary. Additionally, an EA process could be concluded in several months, whereas an EIS process could take MDOT approximately seven years to complete. With plans to

immediately replace the structure, time was of the essence. However, in not proceeding directly to an EIS, MDOT risked that the EA might conclude that significant impacts were possible. In that case, an EIS would be required, with the resulting time having been wasted on the preparation of the EA rather than saved and directly applied to preparation of an EIS.

MDOT's Project Planning Division led creation of the EA, working in close cooperation with other divisions such as Design, Construction and Technology, and Traffic and Safety as well as the Grand Region and FHWA. MDOT formed an interdisciplinary team, also known as a study group, and charged the group with the completion of the EA as its highest priority.

The EA addressed three alternatives:

- The no action alternative proposed no improvements; rather it only involved routine maintenance. FHWA and MDOT did not recommend this alternative because routine maintenance would not correct deteriorating conditions and eventually would lead to the permanent closure of the structure;
- A second alternative, major relocation of the S-Curve, would straighten out the curves and increase the design speed to 60 mph. This alternative was rejected on the basis of costs, the lengthy time to complete engineering and environmental studies to include an EIS, and many business and residential displacements; and
- The third and preferred alternative, comprised of enhancements to the S-Curve described in this case study, had the distinct advantage of being feasible within the footprint of the existing structure. This advantage was critical to supporting the eventual Finding of No Significant Impact (FONSI).

MDOT initiated the EA process was in late 1998, and FHWA signed the FONSI in September 1999. The completion of the FONSI represented MDOT's commitment to the EA's preferred alternative. This decision constrained the new S-curve's design to basically the same environmental footprint but with important requested enhancements.

Throughout the completion of the EA, the study team worked extremely well together, sharing information and coordinating analyses and resulting project decisions. The team members managed to maintain the completion of the EA as their first priority. As specific environmental concerns or potential adverse impacts were identified, they communicated with all affected parties, invited input, listened, openly and objectively considered suggestions, reached decisions quickly, and fulfilled commitments to outside parties.

The study team also worked closely with its external partners. MDOT met weekly with key agencies and affected interests and organizations to go over planning status, listen to concerns and recommended solutions, respond, and explain next steps. Similar to the MDOT team members, the partners' representatives were senior staff from their agencies and organizations who could fully represent interests of and expedite decisions from their organizations.

As indicated below, a variety of environmental, social, cultural, and economic concerns surfaced as the project development process moved forward. MDOT used the EA process as the primary vehicle for addressing these concerns and mitigating potential adverse impacts.

Communication and Outreach Strategy

Coincident with the start of the EA process, MDOT and the City of Grand Rapids unveiled the preferred S-Curve improvement plans in October 1998. The local reaction was loud and strongly opposed to full closure of the S-Curve, which was proposed in order to shorten the construction period. The business community believed that full closure would shut off access to downtown, and commuters feared detours would fail to provide adequate north/south routes. Television and press media reported extensively on this opposition.

The extent of the opposition to full closure took MDOT by surprise, and led to the agency's decision to place more emphasis and resources on effectively communicating both the need for and the advantages of a full closure. The MDOT team made two important decisions in this regard:

- First, MDOT designated its region communications representative as its primary public contact for the project; and
- Second, the agency concurred in that representative's recommendation to hire a public relations firm to assist MDOT in addressing the expanding local controversy, an unusual course of action that involved an expenditure of approximately \$500,000.

These decisions reaped immediate benefits. MDOT's communications representative conducted numerous media interviews and spoke before any and all interested community organizations, the Chamber of Commerce, and a variety of other business interests. Easily readable pamphlets and flyers were broadly circulated and emphasized not only the need for a full closure but comprehensive plans for adequate detours as well as commuter assistance programs. Several billboards erected before and during construction reminded commuters that downtown Grand Rapids was "open for business."

The communications representative coordinated closely with MDOT's project engineers to assure that all information provided to the public was accurate, especially the need for full closure and the planned traffic mitigation strategies. This central point of coordination on a highly controversial project ensured MDOT's delivery of a consistent message and relieved engineering staff of the continuing need to keep the media informed. The communications representative provided a consistent media "face" for MDOT and, most importantly, a credible message by matching his external statements to the media and the public with MDOT's internal planning and project commitments.

Through its extensive outreach efforts, MDOT sought to clarify to the public and business community that full closure not only served as the fastest means for resolving a potentially unsafe structural condition but also provided the best approach to incorporating the locally desired design enhancements. For example, MDOT was able to effectively demonstrate that phased lane construction would negate the ability to add new lanes. In terms of structural safety, MDOT explained its data, studies, and findings in a transparent manner. This included conducting bridge tours for the media. Simultaneously, MDOT emphasized that its emergency repairs were sufficient to keep the S-Curve open to traffic.

The mayor of Grand Rapids was a strong proponent of full closure and used his office to fully endorse the MDOT plan. The combination of this support and MDOT's well coordinated outreach efforts gradually convinced a large segment of the business community and the public of the plan's merits. The adverse media reaction shifted; local TV stations frequently

interviewed the MDOT representative, began featuring project status spots on their news programs, and posted project status information on their websites. MDOT officials appeared on live TV spots to answer questions on the project. After project construction began and because the construction site contained physical barriers that blocked a view of the work, the MDOT communications staff invited media into the site to allow reports of the project's progress. Ultimately, the West Michigan Association of Public Relations Professionals named the lead MDOT spokesperson for the project Communicator of the Year.

As project development proceeded, MDOT continued to foster relationships with downtown business owners and highlighted successful business stories. In one case, MDOT worked with a downtown restaurant in order to keep its parking lot open during construction. In turn, the restaurant owner became a local champion of the project.

MDOT also dedicated a website and a toll-free number for the project. Both conveyed information on project status and traffic and mass transit advice.

Detour Planning and Commuter Assistance

A credible program to minimize downtown traffic congestion was an essential ingredient and a significant challenge in gaining local support for the full closure alternative. MDOT and city staff successfully addressed this challenge by working together to identify detours and develop plans for downtown access. Along with planning detour routes, MDOT delayed other area construction projects that could further disrupt traffic.

The original route for US 131 ran through downtown Grand Rapids on a city-owned street called Division Avenue. MDOT chose this roadway as the main downtown north/south detour route. In order to prepare the street for increased traffic, MDOT helped pay for improvements, repaving the road, timing signals to improve traffic flow; and adding several left turn lanes.

A separate city by-pass detour for regional travelers and trucks traveled west off US131 before the S-Curve and connected to Interstate 196. I-196 intersects US 131 just north of the S-Curve, where travelers could rejoin US 131.

MDOT, city, and Interurban Transit Partnership (formerly the Grand Rapids Area Transit Authority) staff widely distributed detour maps and guidance. Similar information was available on the dedicated website as well as the toll free telephone line. As a result, travelers and commuters used the detour routes effectively and consistently avoided serious traffic delays.

Figure 3. Detour map distributed to public



As construction proceeded, commuters also found additional alternative routes within the local grid system.

In order to address the business community's fear that the project would cut off consumer and employee access to downtown businesses, MDOT directed a portion of the project's budget to the establishment of an express bus service. The metro region's Interurban Transit Partnership coordinated the planning and implementation of the service, which consisted of a free bus shuttle from two points south of and one point north of the city.

To prepare for the bus service, Interurban Transit Partnership staff conducted extensive research on where commuters lived within the metro area. This research included surveys of downtown parkers, a license plate survey on the S-Curve, and employer-distributed questionnaires. This research allowed the Interurban Transit Partnership to plan bus routes according to the greatest need. The Interurban Transit Partnership also visited numerous downtown businesses during the four months prior to construction in order to describe detours and the bus program and hand out maps of both.

The Interurban Transit Partnership designed the service was to include free and secured parking areas, comfortable buses, frequent service, and a pledge of a guaranteed ride home in order to draw commuters to the buses. At peak traffic times, the buses picked up passengers every five minutes. The city partnered with the Interurban Transit Partnership and dedicated an express detour lane for exclusive bus use. MDOT paid for \$1.2 million of this alternative transit program.

The bus system was so successful that its only point of controversy arose when project construction was completed and the system was taken out of service. The detailed planning for this alternative transit system coupled with the extensive and early outreach to commuters was a significant factor in persuading the community that MDOT's full closure approach was the best solution.

The bus system was so successful that its only point of controversy arose when project construction was completed and the system was taken out of service.

Aesthetics

The S-Curve is a major aspect of the Grand Rapids landscape; the existing S-Curve had a detrimental impact as an eyesore and physical barrier, and the new S-curve would directly affect the city's and university's development. MDOT learned the bulk of community-based needs from the city, the university, and community groups, particularly the Chamber of Commerce.

Figure 4. Design Concept for Bridge



To specifically address aesthetics, MDOT hired a subcontractor, who built a model of the future S-curve to serve as an illustration in meetings with community representatives. The city and university commented extensively on the aesthetic designs. The university also hired a contractor to draw up designs, and submitted those to MDOT's subcontractor. The subcontractor incorporated some of those ideas, including a decorative feature on the bridge that indicated where the river began and ended.

To specifically address aesthetics, MDOT hired a subcontractor, who built a model of the future S-curve to serve as an illustration in meetings with community representatives and on which the city and university commented extensively. The university also hired a contractor to draw up designs, and submitted those to MDOT's subcontractor.

MDOT's designs included bridge supports as arches, and the arch theme was continued throughout the walls and other sections of the structure. Decorative lighting was added along the S-curve, and underpasses were given more than ordinary lighting. Working with Grand Rapids staff and area utility companies, MDOT moved certain electric lines underground, allowing the removal of large transmission towers.

The city of Grand Rapids built on MDOT's direct aesthetic work on the bridge by performing work adjacent to the bridge that complemented the overall aesthetics. The city developed a park and non-motorized path adjacent to the S-curve and installed landscaping along the US 131 ramps.

Possible Construction Delays

As MDOT advanced its full closure alternative, a frequent question from stakeholders, especially the mayor's office, was how MDOT would avoid indefinite construction delays, a common problem on such large-scale construction projects. MDOT responded in two ways:

- First, because special steel beams needed to be ordered months in advance, MDOT consulted with FHWA and gained approval to request bids on the steel contract ahead of and separate from the primary contract; and
- Second, in November 1999, when bids were requested for the primary contract, MDOT used an approach called A + B bidding. Under this method, the bidders must provide the dollar amount as well as the number of days in their bids. MDOT also offered one of the largest incentive/disincentive programs in its history. For every day that the freeway was opened ahead of the construction schedule, the contractor was promised \$50,000. For every day late, there was a \$50,000 penalty. Bonuses were capped at \$3 million but there was no cap on the penalties.

Figure 5. Aesthetic Detail Along S-Curve



MDOT's bid documents required that the project be completed in no more than 18 months. The winning bidder offered an 11-month schedule plus took advantage of the incentives. The

northbound lanes were opened 16 days ahead of schedule and the southbound lanes opened 35 days early.

Archaeology

The need for extensive tribal consultations and archaeological investigations arose late in the S-Curve's project development schedule. In early October 1999, representatives from the Grand River Bands of Ottawa Indians learned about plans for the S-Curve's replacement and became concerned about potential adverse impacts to tribal artifacts, and possibly ancestral remains, known to be located under the Parking Lot B portion of the project site. The representatives had not been previously contacted by the MDOT team. After a local newspaper report the tribe's concerns, MDOT quickly contacted Tribal representatives and requested a meeting.

The Grand River Bands of Ottawa Indians are not a federally recognized tribe for purposes of the Native American Graves Protection and Repatriation Act. Still, MDOT consulted with their own Tribal Affairs Coordinator, FHWA representatives, the State Archaeologist, the State Historic Preservation Officer, a GVSU professor of anthropology, and tribal members expeditiously reached a comprehensive agreement by November 1999 on how to conduct the archaeological investigations.

MDOT led the efforts in forming the agreement with the Grand River Bands of Ottawa Indians. The agency noted that it remained fully involved in the implementation process, as opposed to delegating these responsibilities to its cultural resources consultant, in order to maintain the important inter-governmental relationship between MDOT and the tribe. Tribal members, in turn, had strong local ties and did not want to impede the progress in replacing the S-curve. Rather, they wanted to cooperate with MDOT in ensuring that their ancestors were protected and their settlements properly studied. The agreement:

- Specified that all found objects would be analyzed by MDOT's archaeological consultant, curated by the Michigan Historical Center, and then repatriated to the tribe upon request;
- Allowed tribal members to visit the archaeological site, monitor excavations, conduct guided tours for tribal students, and perform site ritual/ceremonial needs in the event human remains were uncovered; and
- Assured that no invasive techniques were to be employed in the analysis of any human remains and all human remains and associated funerary objects were to be returned to the tribe for reburial and repatriation, if requested.

Archaeological investigations commenced immediately after the agreement was reached. Site investigations that normally would take six months were completed in nine weeks and for \$800,000. Despite adverse weather conditions, investigations were completed just prior to the project's scheduled date for the start of construction in January 2000.

During the nine-week investigation, tribal members visited the site and brought Tribal students for tours and discussions with the archaeologists. The archaeological consultant hired a tribal member to assist in the project, and the GVSU Anthropology Department provided additional expertise. The excavations produced artifacts dating back 2,000 years, including pottery pieces, stone tools, remains of plants and animals that served as food for the site's inhabitants, and items from trade with 18th century Europeans.

All parties involved in the archaeological investigation and salvage phases believe that the initial agreement was successfully implemented. After MDOT completed construction of the piers for the S-Curve, the site of the dig returned to its former use as a parking lot for GVSU. However, the university worked with the tribe to create a small park with monuments in a corner of the parking lot overlooking the river. The monuments describe the early Ottawa settlements that existed in the area.

Star Building

Issues surrounding the historic Star Building developed late in the environmental review. MDOT recognized late in its planning process that the Star Building was actually owned by the City of Grand Rapids. Consequently, the city was entitled to functional replacement of the building under FHWA regulations (23 CFR 712). Built in 1927, the building was the first all-concrete commercial building in Grand Rapids. It also housed nearly one million historic artifacts belonging to the Public Museum of Grand Rapids. The building stood directly adjacent to the existing S-Curve and would need to be demolished to allow the new, wider S-Curve.

Of the several issues that stemmed from the need to demolish the Star Building, its historic significance turned out to be the easiest for MDOT to address. Working with city staff, MDOT learned that there was no strong interest at any level of government or within the local preservation community to preserve the structure. In August of 1999, FHWA, the SHPO, MDOT, the Advisory Council on Historic Preservation, and the Public Museum of Grand Rapids signed a Memorandum of Agreement that allowed for the demolition of the building, subject to pre-demolition recordation, as determined appropriate by the SHPO. MDOT and FHWA compensated the city for the value of the building and provided financial support to retain facilities to store the artifacts.

Grand Valley State University

A campus for Grand Valley State University sits under and adjacent to the S-Curve on the west bank of the Grand River. Thus, the S-Curve affects campus motor and pedestrian movement, as well as the campus' aesthetic feel. In the period leading up to the S-Curve project, the university experienced rapid growth, including several building projects, including academic facilities, a housing project, road work, and parking lots, in the vicinity of the S-curve.

Because of the university's existing and planned facilities' proximity to the S-Curve, the university became involved in the project in order to protect campus operations. MDOT initially discussed parking mitigation strategies with the university, as the project would require closure of a university lot existing under the existing bridges. That initial contact led to other areas of collaboration and assistance.

The university's contracting rules allowed it to contract faster than city or state agencies. Because a great deal of infrastructure was on university property,

Figure 6. Parking Available under Bridge



the university performed certain preparatory work, such as relocating underground pipes and sewage lines.

The university worked with MDOT in designing the S-Curve, and hired a consultant to sketch designs. The bridges' design would greatly impact the aesthetics of the university and had the potential to "wall-off" the campuses on opposing sides of the S-Curve. MDOT used the university's consultant's sketches to choose a final design that included arches to open up the area beneath the S-Curve, a large bus-stop area beneath a bridge, and well-lit underpasses. One segment included an arch that complemented a larger passageway of the university.

School was in session during periods of construction, so the university worked with MDOT, the city, and the construction contractor on protecting students in the work area. Students and staff would need to pass through the site to reach classes, and would pass under the finished S-Curve. The parties addressed construction site safety, movement from one side of the construction site to the other (the university's campuses traversed the site), fences, and snow storage. The university sent a message to students every Friday to give weekly notice of construction issues.

LESSONS LEARNED

Success Factors and Key Innovations

Those working on the project and stakeholders affected by the project noted timing and sensitivity to the surrounding community as the key success factors in the S-curve project. The newly designed S-Curve was fully replaced and open in October 2000, less than two years after MDOT found the piers to be vulnerable and sinking in January 1998. In that time, the project addressed structural risks to the bridges, eased the curvature of the roadway to improve traffic safety, created new safety features such as longer merge lanes and shoulders, and designed a new bridge that aesthetically enhanced the looks of both downtown Grand Rapids and the Grand Valley State University. The communications effort was another key success factor for the project.

Meeting a Demanding Schedule

Time was of the essence given the bridge's structural deterioration. MDOT therefore planned for the maximum improvements that could be completed in the least amount of planning time, that is, those that could be covered in an Environmental Assessment rather than an Environmental Impact Statement that would take years to complete. The environmental team members maintained the completion of the EA as their first priority, communicated effectively with all affected parties, and reached decisions quickly.

MDOT set an aggressive construction schedule and met interim and final milestones. Because the deteriorating bridge needed to be replaced expeditiously, MDOT committed the resources necessary to make the "full closure" construction approach work.

Input and Project Assistance from City, University, and Business Community

An expedited schedule often diminishes a transportation agency's time and inclination to adjust project plans according to community input. Some transportation agencies have cited the emergency nature of a project to bypass earnest community input. In the S-Curve project, though, MDOT significantly modified project plans and design in response to stakeholder input.

The project scope went from repair of a single bridge to full modification and replacement with a design sensitive to the surrounding urban environment.

The plans to replace the entire structure, include modifications, and add aesthetic features initiated from outside of MDOT. The agency involved city, business, community, university and tribal representatives in order to minimize construction impacts while maximizing the economic benefits to the City of Grand Rapids.

The local transit authority planned extensively for the bridge closure, with cooperation and partial funding from MDOT, and introduced new services to accommodate the increased need for transit during construction. Transit authority staff visited businesses to explain the detour planning.

Land use and economic development concerns were very important to the city and the affected local university. Both wanted the new bridge to foster and not dampen economic revitalization. MDOT effectively addressed these concerns in a collaborative design process. MDOT approached the city and neighboring university prior to bridge design, allowed them to suggest design components, and accommodated many of these suggestions.

Stakeholders in the project were also primary team members. The MDOT right-of-way for US 131 touched on city, university, and private property; the highway traveled adjacent to utility lines; and key detour routes used city roads. The project relied directly on coordinated efforts from the city, the university, the Kent County Road Commission, and utility companies to prepare infrastructure within the right-of-way. MDOT, the city, and the construction contractor worked together to develop a schedule that balanced timing and noise concerns.

Stakeholders noted that they felt a sense of ownership in the project and that their various views were manifested in the final product. Project team members noted that an important factor in this success was that different staff and agencies met the various needs of the project, largely according to appropriate areas of expertise.

Public Relations

MDOT communications staff believed that communication for a transportation project required effectively disseminating information to travelers, maintaining control of communication, keeping the community aware of decisions made in planning the project, inviting appropriate stakeholders to meetings, and listening to concerns. MDOT also maintained credibility when the project proceeded in the manner that the MDOT representative described to the public.

Early on, MDOT shared and explained the structural findings on the deteriorating bridge with key players

Figure 7. Billboard Posted after Construction Completed



and media in order to mitigate any potential local panic over bridge safety. As the project continued, MDOT shared all major planning components and documents. The agency also held numerous meetings with the public, affected businesses, and institutions. MDOT developed a model of the bridge for public viewing and shared initial sketches and plans for review and comment by the most affected entities. MDOT designated a single point of contact for the project and hired a public relations firm to assist with outreach efforts.

The MDOT representative noted that successful communication requires money, and public relations are not traditionally an important aspect of project budgeting. Because of the value added to the project via communications, MDOT has used similar tactics emphasizing communications in subsequent projects.

MDOT officials appeared on live TV spots to answer questions on the project. An aspect of success in the communications strategy was media buy-in. Because the construction site contained physical barriers to a view of the work, the MDOT communications staff invited media into the site in order to allow reports of the project's progress.

Archaeology Work with Grand River Band of Ottawa Indians

Success with the archaeological efforts derived from the formal agreement reached by the Grand River Band of Ottawa Indians and state agencies, and from the successful work of contractors performing the archaeology. Given concerns over the presence of burial mounds, MDOT worked closely with the tribe in the planning and implementation of the archaeological excavations. Tribal representatives were allowed to view the excavations, received reports on what was being discovered, and were allowed to bring schoolchildren to the site to learn about the excavation process as well as tribal history. Another key factor contributing to success was the contractor's hiring of a tribal member to work on the dig.

Although the archaeological work on the ancient Ottawa site beneath the S-curve ended successfully, those involved in the work noted that the effort was not a guaranteed success. Archaeological mitigation is time and cost intensive. The project plans did not anticipate the dig, and so the archaeological effort had to be performed before the contractor arrived at the spot. Moreover, the dig was performed in winter, in frozen ground.

MDOT did not identify the Grand River Band of Ottawa Indians before or during the Environmental Assessment process. MDOT staff noted that the fault for this failure lies partly with the agency's reliance on standard business communications via letters.

Success Was Not Guaranteed

As MDOT prepared its very aggressive planning and construction schedules, the agency realized that it would need the extensive cooperation of a variety of state, regional, and local entities in order to have any chance of meeting these schedules. MDOT determined that the best way for it to gain this cooperation was through establishing effective partnerships with these entities. The partners assembled in weekly meetings and MDOT provided thorough and accurate project status reports. MDOT solicited partners' assistance on various issues and input on how to move forward, then evaluated and frequently followed the input. When MDOT did not follow partner input, the agency explained and supported its reasons for not doing so. As a result, FHWA, MDOT, other state agencies, the Grand River Bands of Ottawa Indians, the MPO, the city, the university, the regional transit authority, and various business interests collaborated successfully under time pressure. The mayor of Grand Rapids was a strong

supporter and used his office to promote the MDOT plan. The MDOT environmental study team was particularly effective and worked well together and with all outside parties. This collaborative effort enabled planned agenda items to be met, and when unexpected issues arose, facilitated resolution in record time. For example, both the replacement of the Star Building and the archaeological investigations were completed very expeditiously. The collaboration that occurred dissolved initial adversarial relationships and became the glue that held the partnership together.