MDOT RC-1618B

# Michigan Department of Transportation Bridge Slide Showcase

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Department of Civil & Construction Engineering
College of Engineering and Applied Sciences
**Western Michigan University**


Research

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<tr><td colspan="3">16. Abstract<br>In October 2010, the Federal Highway Administration (FHWA) launched the Every Day Counts (EDC) program to identify and promote innovation in three focus areas: (1) Shortening Project Delivery, (2) Enhancing Safety of the Roadways, and (3) Protecting the Environment. FHWA is partnering with the state departments of transportation to deliver projects with innovative technologies in order to promote their widespread use. The EDC program has been a great stimulus for the Michigan Department of Transportation (MDOT) to perform highway construction Better, Faster, Cheaper, Safer, and Smarter; such is the purpose of Accelerated Bridge Construction (ABC). MDOT is implementing several ABC initiatives throughout the state. This report provides a summary of the FHWA-sponsored MDOT bridge slide showcase that encompassed two ABC slide-in projects in Michigan: US-131 NB and SB bridges over 3 Mile Road in Morley; and the M-50 bridge over I-96 in Lowell. The showcase included presentations from FHWA, MDOT, designers, and contractors, along with a question and answers session at a conference hall in Grand Rapids-Michigan. In addition, the showcase included field visits to the slide projects. This report documents the presentations and discussions of participants with the MDOT panel, designers, and contractors at the showcase.</td></tr>
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# Michigan Department of Transportation
# Bridge Slide Showcase

## Report

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## ACKNOWLEDGEMENTS

This workshop was funded by the Federal Highway Administration (FHWA) and Michigan Department of Transportation (MDOT). The authors would like to acknowledge the support and effort of Mr. Roger L. Safford and his team members for coordinating the event on behalf of MDOT. The authors also wish to acknowledge the support of Mr. David Juntunen, MDOT Bridge Development Engineer; and Mr. Michael Townley, MDOT Research Project Administration Manager, for initiating and Mr. Corey Rogers for managing this activity. The authors and MDOT would like to thank the following individuals for participating and supporting information exchange in the showcase:

- Russell L. Jorgenson, P.E., Michigan Division Administrator, Federal Highway Administration
- Benjamin Beerman, P.E., Senior Structural Engineer, Federal Highway Administration
- Bruce L. Campbell, P.E., Senior Project Manager, Parsons Inc.
- Mike Szumigala, C.A. Hull, Inc.
- Andrew O'Connor, C. A. Hull, Inc.
- Derrick L. Arens, Anlaan Corporation
- Matthew Boben, Mammoet USA South, Inc.
- Representatives from Alabama Department of Transportation
- Representatives from Nebraska Department of Roads
- Representatives from Tennessee Department of Transportation
- Representatives from Texas Department of Transportation

| SI* (MODERN METRIC) CONVERSION FACTORS | | | | |
|---|---|---|---|---|
| **APPROXIMATE CONVERSIONS TO SI UNITS** | | | | |
| **Symbol** | **When You Know** | **Multiply By** | **To Find** | **Symbol** |
| | | **LENGTH** | | |
| in | inches | 25.4 | millimeters | mm |
| ft | feet | 0.305 | meters | m |
| yd | yards | 0.914 | meters | m |
| mi | miles | 1.61 | kilometers | km |
| | | **AREA** | | |
| $in^2$ | square inches | 645.2 | square millimeters | $mm^2$ |
| $ft^2$ | square feet | 0.093 | square meters | $m^2$ |
| $yd^2$ | square yard | 0.836 | square meters | $m^2$ |
| ac | acres | 0.405 | hectares | ha |
| $mi^2$ | square miles | 2.59 | square kilometers | $km^2$ |
| | | **VOLUME** | | |
| fl oz | fluid ounces | 29.57 | milliliters | mL |
| gal | gallons | 3.785 | liters | L |
| $ft^3$ | cubic feet | 0.028 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.765 | cubic meters | $m^3$ |
| | | NOTE: volumes greater than 1000 L shall be shown in $m^3$ | | |
| | | **MASS** | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.454 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams (or "metric ton") | Mg (or "t") |
| | | **TEMPERATURE (exact degrees)** | | |
| °F | Fahrenheit | 5 (F-32)/9 or (F-32)/1.8 | Celsius | °C |
| | | **ILLUMINATION** | | |
| fc | foot-candles | 10.76 | lux | lx |
| fl | foot-Lamberts | 3.426 | candela/$m^2$ | cd/$m^2$ |
| | | **FORCE and PRESSURE or STRESS** | | |
| lbf | poundforce | 4.45 | newtons | N |
| lbf/$in^2$ | poundforce per square inch | 6.89 | kilopascals | kPa |
| **APPROXIMATE CONVERSIONS FROM SI UNITS** | | | | |
| **Symbol** | **When You Know** | **Multiply By** | **To Find** | **Symbol** |
| | | **LENGTH** | | |
| mm | millimeters | 0.039 | inches | in |
| m | meters | 3.28 | feet | ft |
| m | meters | 1.09 | yards | yd |
| km | kilometers | 0.621 | miles | mi |
| | | **AREA** | | |
| $mm^2$ | square millimeters | 0.0016 | square inches | $in^2$ |
| $m^2$ | square meters | 10.764 | square feet | $ft^2$ |
| $m^2$ | square meters | 1.195 | square yards | $yd^2$ |
| ha | hectares | 2.47 | acres | ac |
| $km^2$ | square kilometers | 0.386 | square miles | $mi^2$ |
| | | **VOLUME** | | |
| mL | milliliters | 0.034 | fluid ounces | fl oz |
| L | liters | 0.264 | gallons | gal |
| $m^3$ | cubic meters | 35.314 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.307 | cubic yards | $yd^3$ |
| | | **MASS** | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.202 | pounds | lb |
| Mg (or "t") | megagrams (or "metric ton") | 1.103 | short tons (2000 lb) | T |
| | | **TEMPERATURE (exact degrees)** | | |
| °C | Celsius | 1.8C+32 | Fahrenheit | °F |
| | | **ILLUMINATION** | | |
| lx | lux | 0.0929 | foot-candles | fc |
| cd/$m^2$ | candela/$m^2$ | 0.2919 | foot-Lamberts | fl |
| | | **FORCE and PRESSURE or STRESS** | | |
| N | newtons | 0.225 | poundforce | lbf |
| kPa | kilopascals | 0.145 | poundforce per square inch | lbf/$in^2$ |

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| ABC | Accelerated Bridge Construction |
| ABC Window | The time duration for which the highway traffic is closed for implementing an accelerated bridge construction technology |
| ABC-UTC | Accelerated Bridge Construction-University Transportation Center |
| ACEC of MI | American Council of Engineering Companies of Michigan |
| ACS | Adaptive Signal Control |
| ADT | Average Daily Traffic |
| Anlaan Corporation | Prime contractor performing the M-50 over I-96 lateral bridge slide project |
| APWA of MI | American Public Works Association, Michigan Chapter |
| CFRP Elements | Carbon Fiber Reinforced Polymer Elements |
| C.A. Hull, Inc. | Prime contractor performing the US-131 over 3 Mile Road lateral bridge slide project |
| CMGC | Construction Manager/General Contractor |
| CRAM | County Road Association of Michigan |
| DOT | Department of Transportation |
| e-Construction | Electronic Construction that involves documentation and approving of construction projects electronically |
| e-NEPA | Electronic Submittal of Environmental Impact Statements to the US Environmental Protection Agency |
| e-Signing | Electronic Signing that involves approving of construction projects electronically |
| EB | East Bound Highway |
| EDC | Every Day Counts |
| EPA | US Environmental Protection Agency |
| FHWA | Federal Highway Administration |
| FIU | Florida International University |
| GPS | Global Positioning System |
| GRS | Geosynthetic Reinforced Soil |
| GRS-IBS | Geosynthetic Reinforced Soil Integrated Bridge System |
| HMA | Hot-Mix-Asphalt |
| HP | Steel H-Piles |
| I-xx | Interstate Highway-xx |
| Keeper Bars (or) Stopper Rods | Small steel rods used on railing girder to prevent the sliding pads from moving forward with the superstructure during the sliding operation |
| LOS | Level of Service |
| LRFD | Load & Resistance Factor Design |
| LTAP/TTAP | Local and Tribal Technical Assistance Program |
| M-xx | Michigan Highway-xx |
| Mammoet USA South, Inc. | Slide operation subcontractor for the M-50 over I-96 lateral bridge slide project |
| MDOT | Michigan Department of Transportation |
| MITA | Michigan Infrastructure and Transportation Association |
| MOT | Maintenance of Traffic |
| MPOs | Metropolitan Planning Organizations |

| | |
|---|---|
| MSE Walls | Mechanically Stabilized Earth retaining walls |
| NB | North Bound Highway |
| NCHRP | National Cooperative Highway Research Program |
| PBElement | Prefabricated Bridge Element |
| PBES | Prefabricated Bridge Elements and Systems |
| PTFE sliding pads | Polytetrafluoroethylene (or) Teflon coated on neoprene bearing pads that are used for sliding operation |
| Q&A | Question and Answers |
| Railing Girder | Steel W beam section on which the sliding girder slides via PTFE sliding pads |
| RFQ | Request for Qualifications |
| SB | South Bound Highway |
| SCOBS | Subcommittee on Bridges and Structures |
| SHRP2 | Strategic Highway Research Program 2 |
| SIBC | Slide-In Bridge Construction |
| Slide-In | Lateral Bridge Slide |
| Sliding Girder | Steel W beam section that supports the superstructure and includes stainless steel shoes for sliding on the PTFE sliding pads |
| SPMT | Self-Propelled Modular Transporter |
| STIC | State Transportation Innovation Councils |
| Ton | Short ton = 2000 lbs (907 kg) |
| TRB | Transportation Research Board |
| TSC | Transportation Service Center |
| UHPC | Ultra High Performance Concrete |
| WB | West Bound Highway |
| WMU | Western Michigan University |
| WT section | Steel WT section |
| 3D Modeling | 3 Dimensional Modeling |
| $xx M | xx Million Dollars |

# 1 INTRODUCTION

## 1.1 OVERVIEW

In October 2010, the Federal Highway Administration (FHWA) launched the Every Day Counts (EDC) program in order to identify and promote innovation in three focus areas: (1) Shortening Project Delivery, (2) Enhancing Safety of the Roadways, and (3) Protecting the Environment. The EDC program has been a great stimulus for the Michigan Department of Transportation (MDOT) to perform highway construction Better, Faster, Cheaper, Safer, and Smarter; such is the purpose of Accelerated Bridge Construction (ABC). MDOT is implementing several ABC initiatives throughout the state. MDOT continually evaluates the innovations that each region implemented for the purpose of positively impacting the customers.

On August 14, 2014 at the Ramada Plaza in Grand Rapids, Michigan, FHWA and MDOT convened a 1-day event to showcase two ongoing lateral bridge slide projects. The two projects were on US-131 over 3 Mile Road in Morley and on M-50 over I-96 in Lowell. The M-50 over I-96 project consisted of sliding a two span superstructure onto a new substructure; while the US-131 over 3 Mile Road project was to slide two single span superstructure, carrying US-131 North Bound (NB) and South Bound (SB) traffic, onto existing substructures. The event presentations were delivered by FHWA, MDOT, designers, and contractors. The event included a question and answers (Q&A) session and visits to each project site. The showcase was arranged for information exchange among the DOTs and industry, and to collect the owner, designer, and contractors' perspectives on the lateral bridge slide technology. At the time of the showcase, one slide operation, the US-131 NB bridge over 3 Mile Road, was completed. The US-131 SB bridge over 3 Mile Road and the M-50 bridge over I-96 were under construction.

### 1.1.1 Showcase Purpose

The objectives of the showcase were as follows:

- Share the owner, designer, and the contractors' experiences of the two lateral bridge slide projects with DOTs, industry, and academia.

- Compile lessons learned from the lateral bridge slide implementations and circulate them throughout the department for immediate implementation.
- Identify challenges and develop solutions for future implementations.
- Address participants' concerns and provide bridge slide implementation recommendations.

### 1.1.2 Showcase Outline

Roger L. Safford, Grand Region Engineer, was the host and moderator of the Bridge Slide Showcase convened at the Ramada Plaza in Grand Rapids, Michigan. Mr. Safford welcomed the showcase presenters, introduced the purpose of the showcase, and encouraged participants to get involved and ask questions. He then introduced Russell L. Jorgenson, FHWA Michigan Division Administrator; followed by Gregory C. Johnson, MDOT, Chief Operations Officer. Mr. Jorgenson, on behalf of the FHWA Michigan Division, welcomed all the participants to the slide showcase. He then highlighted the EDC program and showed a video developed by the FHWA public outreach group. Next, Mr. Johnson, on behalf of MDOT, welcomed the participants, provided an overview of MDOT's vision, and described the significance of ABC for achieving MDOT's strategic goals.

Following welcoming talks, Benjamin Beerman, Senior Structural Engineer at the FHWA Resource Center, provided a national perspective for ABC and slide-in bridge construction. The presentation included an overview of the Every Day Counts (EDC) initiative, lateral bridge slide deployment efforts undertaken during last two years, and related activities undertaken by the AASHTO Subcommittee on Bridges and Structures (SCOBS) and the Transportation Research Board (TRB).

This was followed by short presentations from (1) Matthew J. Chynoweth, MDOT Bridge Field Services Engineer; (2) Charles W. Stein, MDOT Innovative Contracting Unit Project Manager; (3) Thomas J. Tellier, MDOT Grand Region TSC Construction Engineer; and (4) Kevin McReynolds, MDOT Grand Region TSC, Construction Engineer. Mr. Chynoweth described MDOT's ABC policy and ongoing related work. Mr. Stein provided details of the contract procurement process of the two slide projects:

US-131 over 3 Mile Road and M-50 over I-96. Mr. Tellier provided details of the M-50 over I-96 project including the up-to-date progress, construction process, challenges, and future plans. Mr. McReynolds provided similar details about the US-131 over 3 Mile Road project. Following the MDOT panel presentations, Bruce L. Campbell, the lead senior project manager from Michigan office of Parsons, Inc., presented the lateral slide considerations, lateral slide design issues and temporary substructure details for both the US-131 over 3 Mile Road and the M-50 over I-96 bridge projects. Parsons, Inc. was the designer of the temporary substructures of both projects.

After Mr. Campbell's presentation, Andrew O'Connor from C. A. Hull, Inc., general contractor (GC) of the US-131 over 3 Mile Road project, described details of constructability and cost aspects of the project. Mr. O'Connor discussed the challenges and lessons learned during the completed lateral slide implementation at the US-131 NB Bridge over 3 Mile Road. He also described planned future considerations of the project. This was followed by Derrick L. Arens, from Anlaan Corporation (the GC), and Matthew Boben from Mammoet USA South, Inc. (the specialty contractor); they jointly provided details of the M-50 over I-96 bridge project and planned slide operations. At the time of the showcase, M-50 over I-96 bridge was still on the temporary supports but was carrying traffic.

At the conclusion of the showcase presentations, the participants visited the project sites in Morley, MI and Lowell, MI. At both sites, showcase participants were accompanied by the contractor representatives. This field visit provided an opportunity to get information on specific project details from the construction engineers at the sites. Following the site visits, the participants convened back at the conference hall for a question and answer session. At that time, participants had the opportunity to ask questions of an MDOT panel and the designer. Following the question and answer session, Mr. Safford concluded the workshop and acknowledged the sponsors and the organizers.

## 1.2 DESCRIPTION OF SLIDE PROJECTS

### 1.2.1 US-131 over 3 Mile Road

The US-131 over 3 Mile Road project consisted of two bridge replacements. The project site is located at about 40 miles North of Grand Rapids in Mecosta County, Michigan. The old side-by-side box beam superstructures of NB and SB bridges on US-131 were severely deteriorated, especially the beams underneath the truck lane; this prompted MDOT to shift the US-131 traffic to the left curb lanes. According to 2014 data, US-131 carries 20,400 ADT with 9% commercial traffic; whereas the 3 Mile Road is a low ADT local route. Thus, this site was selected for slide-in ABC technology implementation for the first project in Michigan. The significant feature of this project location is the surrounding Amish community. MDOT needed to put forth an extra effort toward public awareness with the community before the start of the project.

The project scope included superstructure replacement, widening of NB and SB US-131 structures, and 3 Mile Road improvements. The old NB and SB structures were single span with 86 ft in length and 42 ft in clear width (45 ft 10.5 in. out-to-out). The new NB and SB structures are also single spans with 86 ft in length and 53 ft 8 in. in clear width (56 ft 11 in. out-to-out). Existing abutments were widened for the new superstructures to accommodate the wider new superstructures. The existing footings were also widened to support the eccentric load generated during the sliding activity.

The Construction Manager/General Contractor (CMGC) procurement method was utilized on this project. The prime contractor was C.A. Hull, Inc., and the designers were MDOT Bridge Design Division and Parsons, Inc. MDOT designed the replacement structure while Parsons, Inc. designed the temporary structures and the sliding system. The ABC window included a 5-day detour for each bridge replacement. The contract allowed for a 5-day closure and detour of US-131 traffic with a NB restriction of no closures from Friday 12 PM to 11:59 PM, and a SB restriction of no closures from Sunday 12 PM to 11:59 PM. The detour route for US-131 NB and SB was approximately 10 miles via Jefferson Road to Northland Drive to 8 Mile Road. With 3

Mile Road being a low ADT local route, it was shut down for the entire project duration and used as the staging area.

The temporary NB and SB substructures were built outside of the existing alignment of the NB and SB bridges. The new superstructures for both bridges were built adjacent to old structures on the temporary substructures as shown in Figure 1–1. The new superstructure box beams were supported on wooden blocks placed on the sliding girder. Finally, the old superstructures were demolished, and the new superstructures were slid laterally onto the existing widened abutment walls.

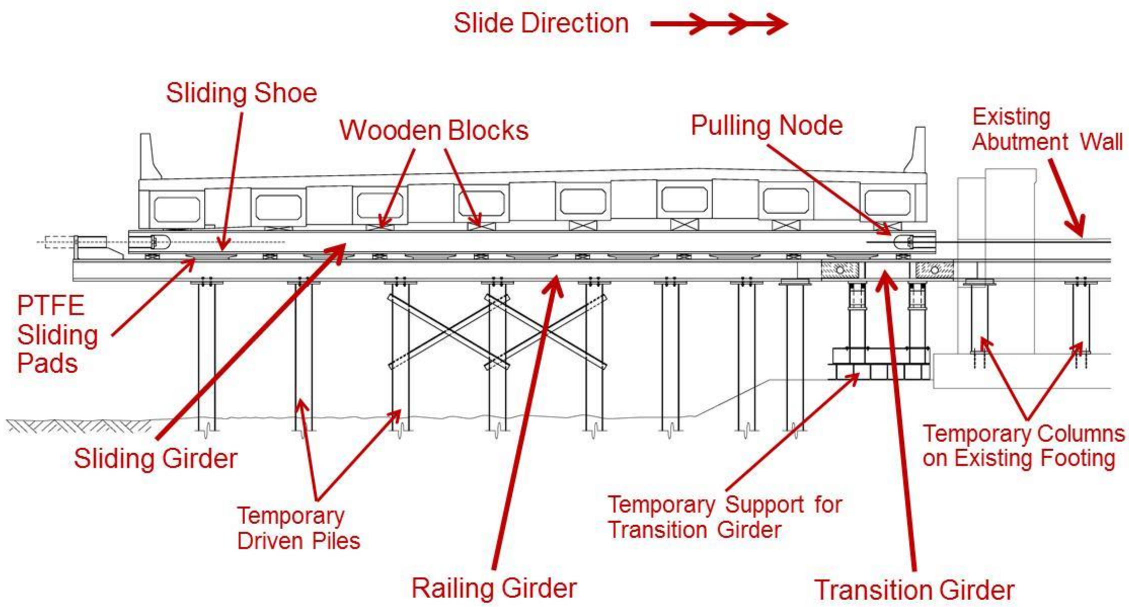


**Figure 1–1 Section through the deck of the new superstructure on temporary structure**

The temporary substructures included driven piles, railing girders, and sliding girders. The temporary structure plans included details of 14×73 HP supporting piles, railing girders, sliding girders, and transition girders. The temporary substructure piles were specified to be, at a minimum, 10 ft away from the existing foundation. This was to address the settlement concerns of the adjacent spread footing foundation under pile driving activity.

In the new superstructure, the permanent bearings were located at 1.17 ft from the girder ends. The sliding girder was located inside of the span, 2.8 ft from girder end. This allowed placing the temporary structure supports on the existing abutment footing

(Figure 1–2). As shown in Figure 1–2, the existing spread footing was widened to control the abutment rotation under eccentric load from the temporary columns. Also, a few feet of the backfill was removed to reduce the lateral pressure on the abutment.

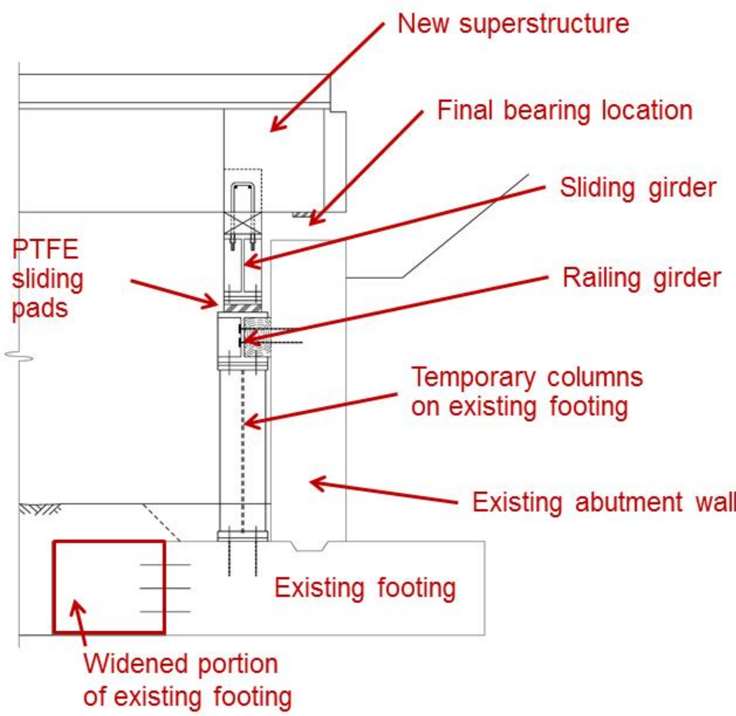


**Figure 1–2 Section through an existing abutment with sliding accessories**

The new NB superstructure weight was about 1.6 million pounds and was slid 65 ft laterally. The sliding activity lasted 28 hrs during August 10 – 13, 2014. Once the superstructure was laterally slid into place, additional activity during this time period included casting of grout bearing pads and installing permanent bearings. For removing the wooden blocks and placing on the bearings, the superstructure was jacked up 7/16$^{th}$ in. with 7 synchronized jacks (100 T capacity each) placed at the pockets casted in the backwall (Figure 1–3 and Figure 1–4). Each end of the superstructure was jacked successively.

**Figure 1–3  Synchronized jacks at the backwall pockets**

**Figure 1–4  Jack with 100 T capacity at the backwall pocket**

Moreover, manual jacks were placed under the fascia girders to help release the wooden blocks (Figure 1–5 and Figure 1–6) because the fascia girders were not getting sufficient lift from the synchronized jacks.

**Figure 1–5 Manual jack under the fascia girder**

**Figure 1–6 Manual jack at fascia girder and pump**

### 1.2.2 M-50 over I-96

The M-50 (Alden Nash Highway) over I-96 project site is located 10 miles East of Grand Rapids in Lowell, Kent County, Michigan. According to 2012 statistics, I-96 carries 44,600 Average Daily Traffic (ADT) with 11% commercial traffic while M-50 carries 11,100 ADT with 6% commercial traffic. The interchange is also the access to the nearby very busy Car Pool lot. The project scope consisted of full structure replacement with increased spans, widening and minor ramp improvements at the intersection.

The Construction Manager/ General Contractor (CMGC) procurement method was utilized on this project. Anlaan Corporation was the prime contractor. The bridge designer was the MDOT Bridge Design Division. The temporary substructure and the sliding system were designed by Parsons, Inc. Mammoet USA South, Inc. was the slide-in subcontractor. The ABC window included two weekend shutdowns of M-50 and single lane closures on I-96: the first weekend closure was for demolition of the old structure, and the second weekend closure was for sliding the new superstructure. The benefit expected from the slide-in implementation was the reduction in user delay costs.

The old 227 ft long, 37 ft 5 in. wide bridge included 4 spans. The reasons for the implementation of slide-in technology were due to reducing user delays. During the peak hour periods, M-50 traffic was facing backups due to inadequate number of lanes, and creating backups on I-96 EB ramp to M-50. Also, I-96 is a heavily travelled interstate that required minimum disruption during bridge replacement. The new bridge (i.e., replacement bridge) was designed as 71 ft 3 in. wide and 198 ft long with 2 spans. The new superstructure was designed with wide shoulders and two left turn lanes to facilitate the traffic movement to 96 EB and WB ramps. The bridge structure was designed as a jointless sliding deck with independent backwalls. At the final location, the approach slab will be cast-in-place and tied to the independent backwall with the other end supported on the sleeper slab. A closure pour will connect the approach slab with the deck. The contractor (Anlaan Corporation) incorporated mechanical splices to connect the approach slab rebars to the new deck (Figure 1–7, Figure 1–8, and Figure 1–9). This was an innovation to expedite completing the post-slide approach work.

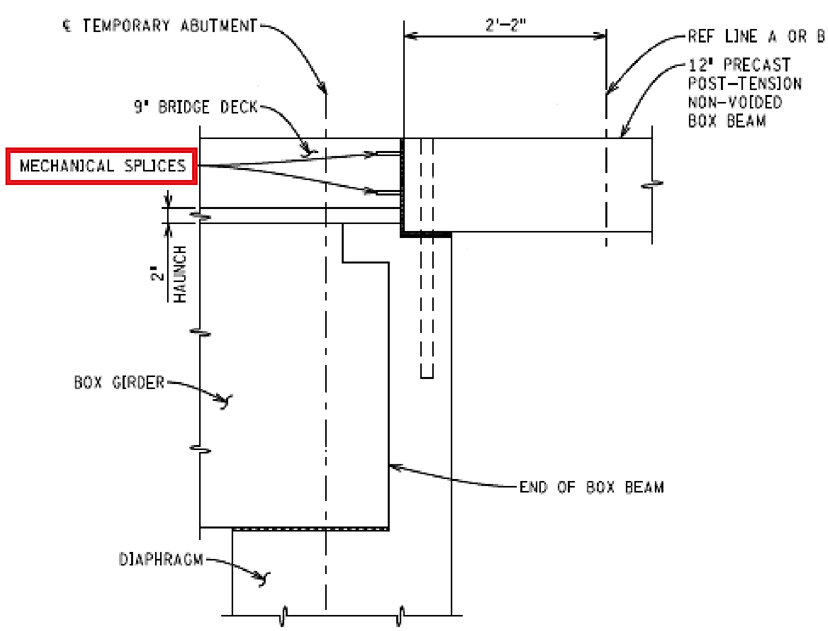


**Figure 1–7 Section through the abutment with superstructure at temporary location**

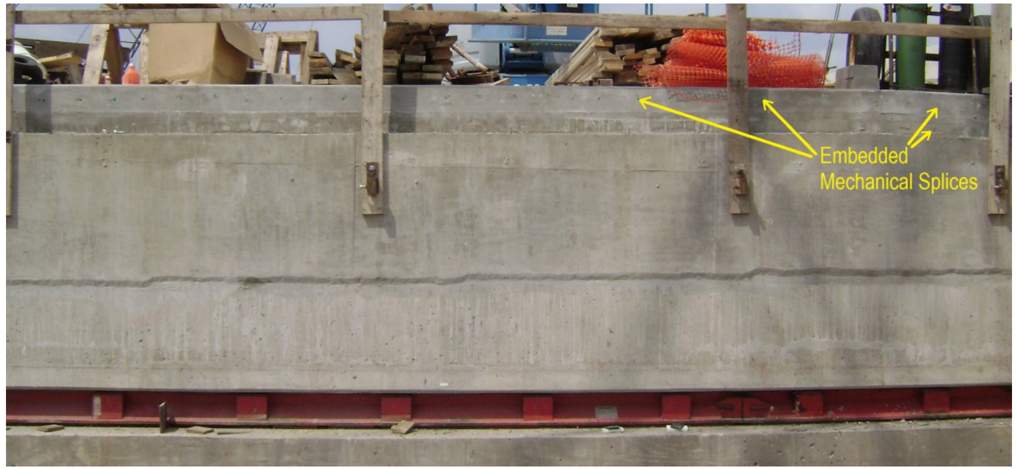


**Figure 1–8  New superstructure at temporary location (front view of the end diaphragm and deck)**

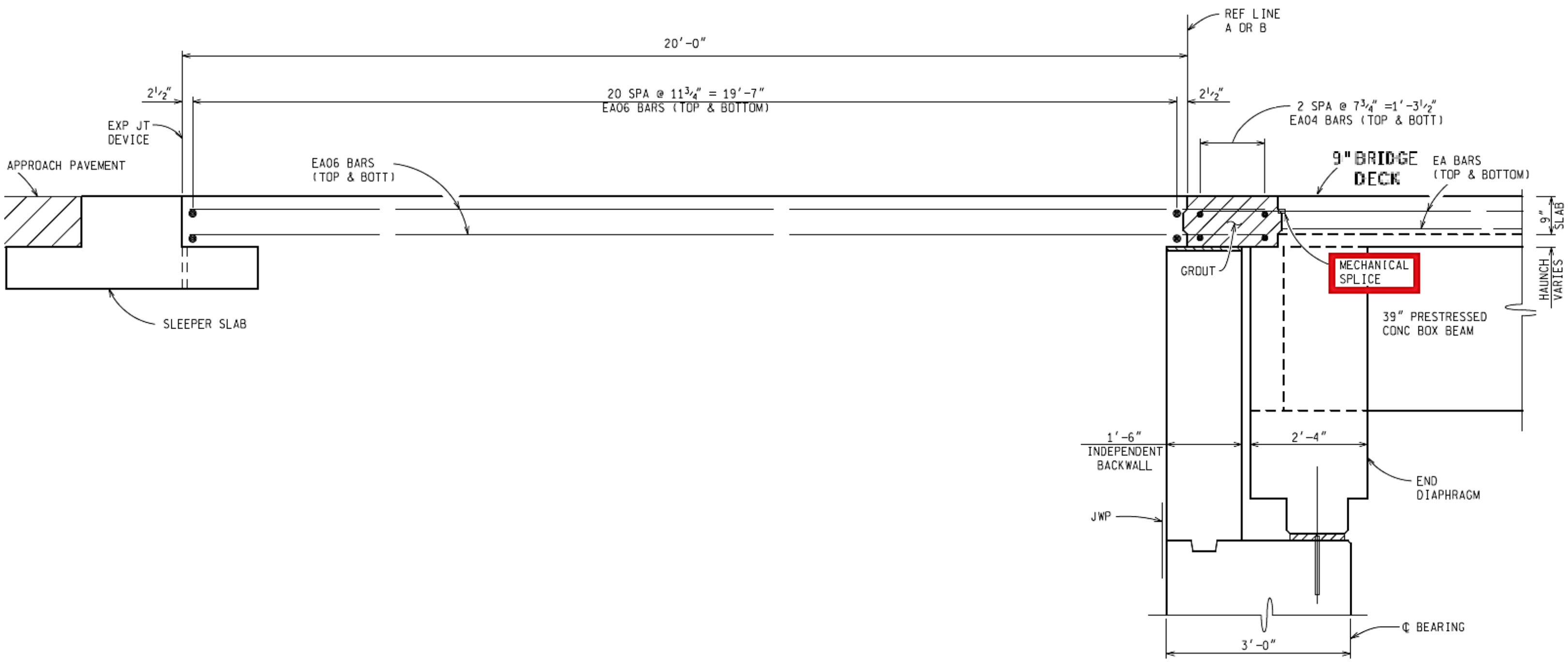


**Figure 1–9  Section through approach slab and abutment with superstructure at final location**

At the time of the showcase, the new superstructure construction was complete on temporary supports on the west side, adjacent to the permanent alignment of the bridge. The old structure was demolished during August 1-3, 2014. The bridge slide operation was planned for early October 2014. The new substructure construction on permanent alignment was progressing. The new structure will be slid with jacks located at the two abutments and the central pier.

At the pier and at the abutments, the sliding shoes were attached to half-depth precast diaphragms. The precast diaphragms were placed on the sliding track attached to a cast-in-place temporary bent and abutments. The cast-in-place temporary bents and abutments were supported on temporary steel piles. The details at the temporary bent and abutments are shown in Figure 1–10 and Figure 1–11. The box beam girders were placed on the half-depth precast diaphragm, and the remaining depth of diaphragm was cast-in-place. This procedure allowed for establishing the crown of the road without using variable depth grout pads after the slide; thus, saving time for the post-slide operations.

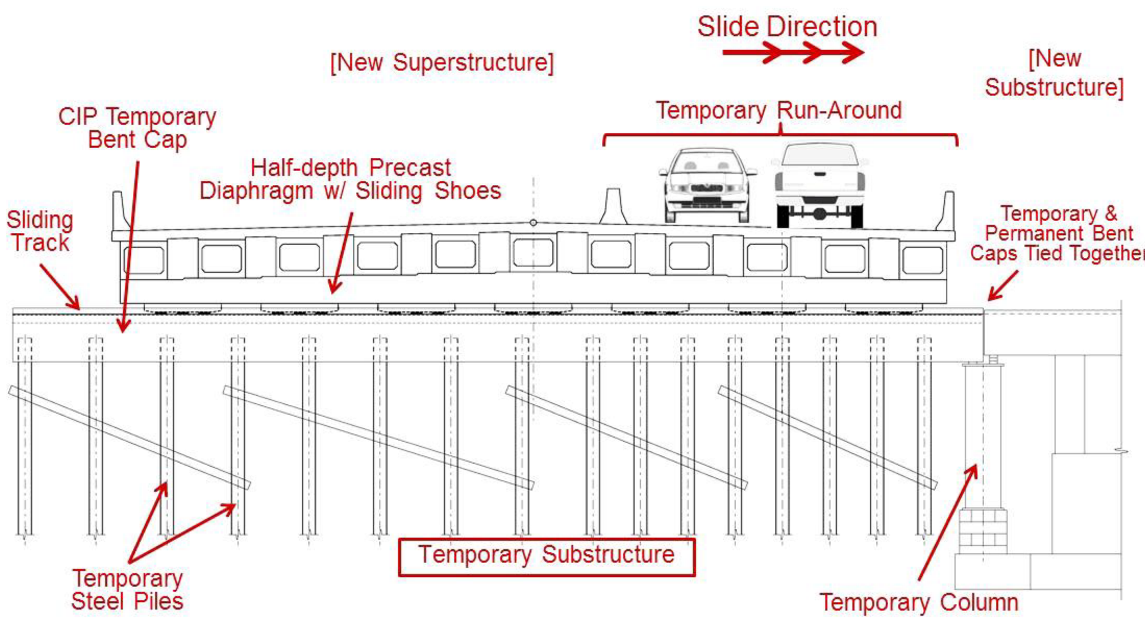


**Figure 1–10 A section through the new superstructure deck (at pier) on temporary location**

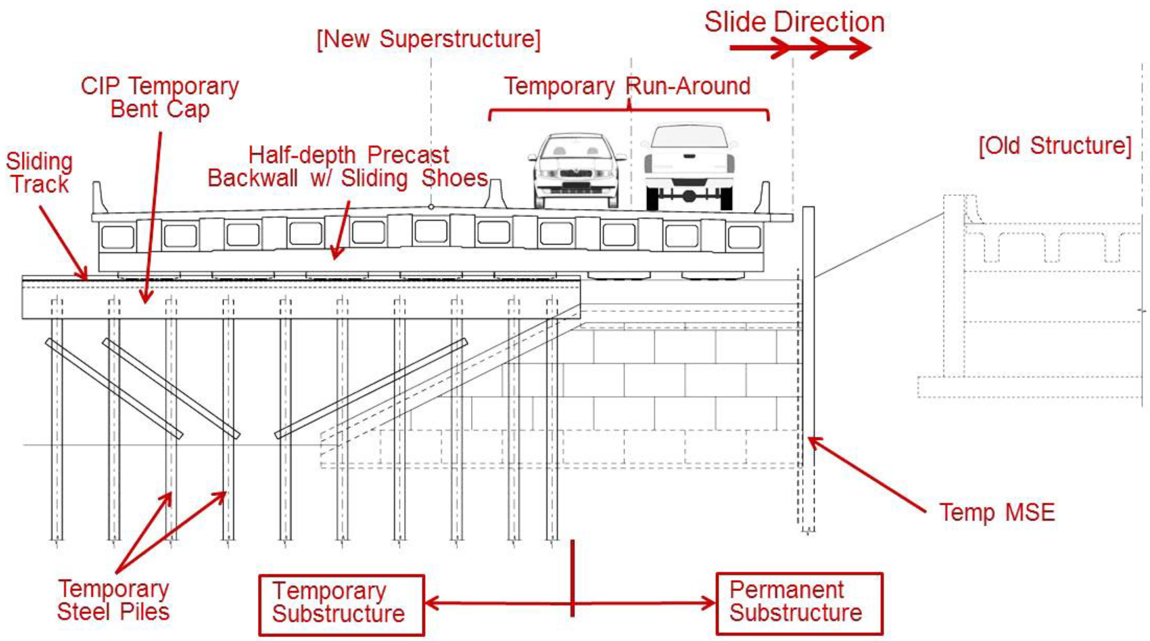


**Figure 1–11 Section through the deck of the new superstructure (at abutment) on temporary location**

The construction staging and maintenance of traffic (MOT) strategies included the following:

- I-96 and M-50 had typical shoulder closures and minor traffic shifts in place for the entire project duration.
- I-96 was closed for the weekend duration of Friday 9 PM to Monday 5 AM twice, for bridge demolition and bridge slide.
- M-50 was closed during the bridge demolition and bridge slide; during that time M-50 traffic detoured, and only right turns from I-96 EB and WB to M-50 were allowed.
- Following the demolition of the old structure, M-50 was reopened after shifting two lanes of traffic to the new superstructure (used as a temporary run-around).

During the demolition of the old structure, M-50 was closed, and the traffic was detoured while I-96 traffic was routed through entrance and exit ramps. Later, two lanes of I-96 EB and WB remained open. M-50 traffic was routed to a two-lane detour as a temporary run-around on to the new superstructure while on temporary supports (one lane for each direction) (Figure 1–10 and Figure 1–11). The temporary approach slabs for the temporary run-around were 3.25 ft by 25 ft precast deck panels with transverse post-tensioning. The temporary approach slabs were supported by the backwall of the new superstructure on one end and a temporary sleeper bent on the other end (Figure 1–12).

The temporary approaches are to be detached before sliding the new superstructure. The method of slide planned to be implemented on this project is Mammoet's push cylinder method with a track system. The pushing jacks will be aligned along the centerline of the bearings to prevent eccentric loading. Temporary support axes are also in-line with the permanent support locations as shown in Figure 1–10 and Figure 1–11. A significant difference between the M-50 over I-96 and US-131 over 3 Mile Road projects is that the M-50 bridge is subjected to traffic loads in its temporary location. Thus, the temporary substructure needed to be designed according to AASHTO LRFD.


**Figure 1–12 New superstructure at temporary location with temporary run-around in-place**

## 1.3 SHOWCASE EXPECTED OUTCOMES

The showcase was expected to (1) provide peer-to-peer exchange for the DOTs and industry participants, (2) describe the details of the bridge slide technology utilized in the two projects for its effective implementation, and (3) generate discussions on the improvements to the lateral bridge slide technology. The showcase presentations and discussions were structured to include the project procurement process, design details, contractor perspective, challenges and lessons learned from the two slide projects: US-131 over 3 Mile Road and M-50 over I-96. The field visit to the project sites showed the site activities involved with the lateral bridge slide. The presentations and field visits generated interactions between the participants, contractors, designer, and owner to inspire potential ideas for effective implementation of the future lateral bridge slide projects.

The showcase presentations were studied; and, this report summarizes and presents the results. The report also documents the questions and answers between the participants and MDOT panel and designer at the conference hall, and discussions with the contractors during the field visits to the lateral bridge slide project sites.

# 2 PART ONE: SHOWCASE PRESENTATIONS

## 2.1 ROGER L. SAFFORD, MDOT, GRAND REGION ENGINEER

### 2.1.1 Welcome and Showcase Overview

Roger L. Safford was the host and moderator of the Bridge Slide Showcase in Grand Rapids. Mr. Safford welcomed the showcase presenters and the participants; he also introduced the agenda with presentations from FHWA, MDOT, the Designer and the Contractor. A total of 156 showcase attendees consisted of local contractors, consultants, and highway agency engineers representing 10 states.

Mr. Safford, on behalf of MDOT, acknowledged and welcomed the 72nd district representative Ken Yonker, along with the 90th district representative Joseph Haveman. The representation from the Michigan House indicates the value of transportation and innovative technologies in Michigan and willingness to find long-term solutions for transportation funding in Michigan.

Mr. Safford indicated that the showcase is intended to provide details of the two slide projects in Michigan: NB and SB US-131 bridges over 3 Mile Road in Morley and the M-50 bridge over I-96 in Lowell.

## 2.2 RUSSELL L. JORGENSON, FHWA, MICHIGAN DIVISION ADMINISTRATOR

### 2.2.1 Welcome and Opening Remarks

Russell L. Jorgenson, on behalf of FHWA Michigan Division, welcomed all the participants to the showcase. Mr. Jorgenson described the transportation infrastructure challenges faced with an increasing population that demands access to better transportation infrastructure at a time when aging bridges and highways are in need of immediate repair and transportation funding is on the decline. To address these issues, the transportation industry is looking at innovation. In 2009, the Every Day Counts (EDC) program was initiated to find a way to accelerate project delivery and increase the use of proven but underutilized technologies. In October 2010, the FHWA launched the EDC program with four pillars: innovation, ingenuity, invention, and imagination. EDC is an initiative designed to identify and promote innovation in three focus areas: (1) Shortening Project Delivery, (2) Enhancing Safety of the Roadways, and (3) Protecting the Environment. EDC encompasses all the transportation infrastructure construction projects including ABC. More information is available at the public website: http://www.fhwa.dot.gov/everydaycounts/. At present, FHWA is promoting the following 13 innovations to state, local, and regional transportation agencies:

1) Programmatic Agreements
2) Locally Administered Federal-Aid Projects
3) 3D Engineered Models for Construction
4) Intelligent Compaction
5) Accelerated Bridge Construction
6) Design-Build
7) Construction Manager/General Contractor
8) Alternative Technical Concepts
9) High Friction Surface Treatments
10) Intersection and Interchange Geometrics
11) Geospatial Data Collaboration
12) Implementing Quality Environmental Documentation
13) SHRP 2 Traffic Incident Management Responder Training.

The State Transportation Innovation Councils (STIC) network is an extension of EDC to disseminate the innovation to the states and industry. The Michigan's STIC includes the following industry partners/members:

- Michigan Department of Transportation (MDOT)
- Federal Highway Administration (FHWA)
- Local and Tribal Technical Assistance Program (LTAP/TTAP)
- National Association of County Engineers (NACE)
- County Road Association of Michigan (CRAM)
- Metropolitan Planning Organizations (MPOs) as participating stakeholders
- Michigan Infrastructure and Transportation Association (MITA)
- American Council of Engineering Companies of Michigan (ACEC of MI)
- American Public Works Association, Michigan Chapter (APWA of MI).

The following is the list of innovative initiatives that MDOT is undertaking in collaboration with the industry partners:

1) Expanded Use of Programmatic Agreements
2) Wetland Banking
3) Enhanced Technical Assistance on Stalled Environmental Impact Studies (EIS)
4) Planning and Environmental Linkages (PEL)
5) Legal Sufficiency Enhancements
6) Clarifying Scope of Preliminary Design
7) Flexibility in ROW
8) Flexibility in Utility Relocation
9) Construction Manager/General Contractor (CMGC)
10) Warm Mix Asphalt
11) Safety Edge
12) Accelerated Bridge Technology
13) Geosynthetic Reinforced Soil
14) Adaptive Signal Control/ACS Lite.

## 2.3 GREGORY C. JOHNSON, MDOT, CHIEF OPERATIONS OFFICER

### 2.3.1 Welcome and Opening Remarks

Gregory C. Johnson, on behalf of MDOT, welcomed the representatives from other states (Alabama, Connecticut, Indiana, Kentucky, Nebraska, Ohio, South Carolina, Tennessee, and Texas) for taking part in the Bridge Slide Showcase.

Mr. Johnson indicated that the world is changing very fast, and the government is expected to change as well. The transportation is integrally linked to the economy and our quality of life. People account MDOT for transportation business and logistics of everyday travel. In addition, freight transportation is critical to the economy. Thus, innovation has become a necessity in MDOT activities. MDOT is challenged with aging highway infrastructure that needs maintenance, rehabilitation, and reconstruction. MDOT recognizes that it cannot do business as was done a decade ago and is looking for ways that will be supported by the travelling public. The EDC program has been a great stimulus for ideas, such as ABC, to perform highway construction Better, Faster, Cheaper, Safer, and Smarter. MDOT has embraced innovation for a number of years and has been a lead state in several areas. Since 2004, MDOT has increased its innovative processes for improving lives in Michigan. Every year, MDOT evaluates its regional offices for innovative implementations to positively impact the customers. MDOT is also in the mobility business to ensure that mobility is always considered because, without mobility, economy cannot be improved. The attention to mobility enhances the ability of businesses to invest in Michigan, and it caters to recreational traffic in Michigan.

Mobility, related to the ease of traffic flow, is a performance measure in Michigan. MDOT's mobility policy defines the following goals:

- Traffic volume capacity ratio of less than 0.80
- Level of Service (LOS) shall be above D and shall not drop 2 levels (e.g., LOS drop from A to C)
- Work zone travel delay less than 10 minutes.

ABC is an essential project delivery option now because the traditional bridge construction process, that involves closing roadways and detouring traffic for an entire season, cannot be justified in this fast era. In 2012, the FHWA EDC program defined a national goal of 25% of bridges to be constructed/ reconstructed with Federal Aid to incorporate at least one ABC element or a major precast component. MDOT began its ABC/PBES (Prefabricated Bridge Elements and Systems) policy in 2012. This was a collaborative and iterative effort with the industry including the American Council of Engineering Companies of Michigan (ACEC of MI) and the Michigan Infrastructure and Transportation Association (MITA). This effort ensured MDOT has a policy that is agreed to by all the stakeholders. Michigan achieved the 25% FHWA EDC goal in 2013, and currently implements ABC techniques on over 50% of its bridges each year.

MDOT implements innovations, such as ABC, to assist in meeting the aforementioned mobility policy goals. For example, the M-50 over I-96 project site is in a rural area; however, it carries significant traffic and is located next to one of the largest and heaviest utilized car pool lots. This situation called for innovation to keep the traffic moving at that site; requiring the implementation of the bridge slide-in. MDOT first implemented bridge slide-in technology in 2014. This showcase highlights an innovation that MDOT is employing.

MDOT, as an organization, has been in the Transportation Business for 110 years. Now, MDOT considers mobility assessment and ABC, including Bridge Slides, as part of its business practice considering projects' impact on the public and the economy. On the other hand, MDOT cannot afford to implement ABC technologies at every bridge site in the state. MDOT, with the assistance of Western Michigan University (WMU) researchers, developed a tool for evaluating bridge sites and identifying the most suitable construction technology for a particular site. The tool assists in considering MDOT's mobility criteria and minimizes the impact of bridge construction to the travelling public.

## 2.4 BENJAMIN BEERMAN, FHWA, SENIOR STRUCTURAL ENGINEER

### 2.4.1 National Perspective: ABC and Slide-In Bridge Construction

Benjamin Beerman, from the FHWA Resource Center, provided to-date statistics on Slide-In Bridge Construction (SIBC) deployment efforts and bridge related technologies promoted under EDC. Mr. Beerman's presentation included a discussion on the activities of technical committees, such as the AASHTO Subcommittee on Bridges and Structures (SCOBS) and the Transportation Research Board (TRB) subcommittee on ABC.

#### *2.4.1.1 Slide-In Bridge Construction Deployment Efforts*

The SIBC technology has been implemented in 19 projects nationwide since 2012. Out of the 19 projects, 5 projects were design-build, 5 projects were CMGC, 8 were design-bid-build, and one was a contractor proposed value engineering proposal. This ABC method is also known as lateral sliding or skidding. One of the following three major strategies is implemented during a bridge slide process:

- Construct temporary substructures on both sides of the old structure. Build the new superstructure on the temporary substructure on one side. Slide the old superstructure out onto the temporary substructure on the other side. Repair and retrofit the existing substructures or build new substructures. Slide the new superstructure onto the upgraded or rebuilt substructure. Demolish the old superstructure on the temporary substructure.
- Construct the temporary substructure on one side of the old structure. Construct the new superstructure on the temporary substructure. Demolish the old structure.

Slide in the new superstructure after constructing the new or retrofitted substructure.

- Construct the temporary substructure on one side of the old structure and construct the new superstructure on the temporary substructure. Construct temporary approaches to route the facility carried traffic to the new superstructure on temporary supports. Demolish the old structure. Slide in the new superstructure after constructing the new substructure or retrofitting the existing substructure.

The SIBC activities, products, and resources are described in the FHWA SIBC website: http://www.fhwa.dot.gov/construction/sibc/. This website is a collaborative effort of the EDC, Iowa State University, Colorado DOT, and Utah DOT. One recent product on the FHWA SIBC website is the *Slide-In Bridge Construction Implementation Guide* that includes owner considerations, design considerations, construction considerations, sample details, and sample specifications. The SIBC team at Colorado DOT is conducting webinars related to owner, engineering, and construction perspectives and can be accessed from the website: http://www.slideinbridgeconstruction.com. The Technical Service Support Center created by Iowa State University provides phone or e-mail support related to the SIBC method. The support center is also conducting half-day SIBC training workshops that interested parties can register for through an e-mail to romeo.garcia@dot.gov.

#### *2.4.1.2 Bridge Related Technologies Promoted under EDC*

The EDC is planning for summit meetings in 8 regions covering the U.S. from October - December 2014. The objectives of the meetings are to discuss the following 11 bridge related technologies under five categories:

- Shortening Project Delivery
    1) Regional models of cooperation
    2) Locally administered federal-aid projects-stakeholder partnering
    3) 3D Engineered models: Cost, schedule, and post-construction
    4) Improving DOT and railroad coordination (SHRP2 R16)
    5) Accelerated bridge construction and geosynthetic reinforced soil-integrated bridge system (GRS-IBS)
    6) e-Construction: Electronic project document management systems

- Mobility
    7) Smart work zones
- Safety
    8) Data-driven safety analysis
    9) Road diets (roadway reconfiguration)
- Quality
    10) UHPC for prefabricated bridge elements
- Environment
    11) e-NEPA, implementing quality and environmental documentation.

*2.4.1.3 AASHTO SCOBS Activities*

The AASHTO SCOBS re-prioritized its main objectives, in 2013, as the following:

1) Extend Bridge Service Life.
2) Assess Bridge Condition.
3) Maintain and Enhance a Knowledgeable Workforce.
4) Maintain and Enhance the AASHTO Specifications.
5) Accelerate Bridge Delivery and Construction.
6) Optimize Structural Systems.
7) Model and Manage Information Intelligently.
8) Contribute to the National Policy.

ABC is one of the priorities for AASHTO SCOBS. AASHTO SCOBS T4 developed the problem statements to initiate the following ABC related National Cooperative Highway Research Program (NCHRP) research projects:

- NCHRP 12-98 project: Guidelines for PBES Tolerances and Dynamic Effects of Bridge Moves (using SPMTs)
- NCHRP 12-102 project: Development of an ABC Design and Construction Specification
- NCHRP 12-105 project: System Performance of ABC Connection in Moderate-to-High Seismic Regions.

#### *2.4.1.4 Activities of the TRB Subcommittee on ABC*

The Transportation Research Board (TRB) is the home for transportation research related activities. A subcommittee on ABC (AFF10-3) was formed in 2013 under the TRB General Structures committee (AFF10). The ABC subcommittee objective is to expand the knowledge and expertise to foster the implementation of ABC related technologies.

The subcommittee website includes a tool to track the ABC projects. The ABC project tracker tool provides web-links to over 120 ABC research projects that include completed projects, ongoing projects, and proposed projects. During the upcoming TRB 2015 Annual Meeting in January 12-16, 2015, the subcommittee for ABC (AFF10-3) is planning a half-a-day Prefabricated Bridge Element (PBE) Workshop, a paper session on ABC, and a subcommittee meeting. The subcommittee encourages the attendees to sign up as friends of the Subcommittee. The subcommittee website can be accessed from the link: https://sites.google.com/site/trbaff103 and the project tracker tool can be accessed from the link: https://sites.google.com/site/trbaff103/research2/project-tracker.

## 2.5 MDOT PANEL

### 2.5.1 Matthew J. Chynoweth, MDOT, Bridge Field Services Engineer

Mr. Chynoweth presented MDOT's ABC policy and ongoing work. In 2012, Mr. David Juntunen, Bridge Development Engineer at MDOT, established a committee on ABC. The committee consists of members from MDOT, consultants, academia, and industry staff. The committee helped MDOT to develop the following goals:

- Move the ABC technology forward from demonstration to standardized deployment.
- Develop a program approach: In this process, MDOT wants to ensure that the industry is tooling up for ABC. MDOT will make ABC part of their business process and ensure a progress is made every year.
- Develop selection criteria and a decision-making framework.
- Develop methods for performance measurement.

MDOT included Section 7.01.19 in its Bridge Design Manual that covers ABC and PBES considerations. This section is considered as work-in-progress and will be further updated as means and methods are further evaluated. MDOT also developed a special provision for *Prefabricated Superstructure, Laterally Slide* with knowledge obtained from the lessons learned from slide-in projects implemented by other states. The special provisions used in the US-131 over 3 Mile Road and M-50 over I-96 projects include the following key requirements:

- Working drawings, calculations, and procedures
- Overall schedule of superstructure move sequence
- Move operations manual
- Geometry control and monitoring plan
- Contingency plan
- Trial horizontal slide
- Movement of superstructure requirements
- Allowable tolerances.

MDOT is currently developing SPMT special provision for potential implementations in 2015. At the same time, MDOT is working continuously on updates to the Project Scoping Manual and Mobility Manual for evaluating ABC/PBES techniques based on the following parameters:

- Site and structure considerations
- Work zone safety and mobility
- Cost
- Technical feasibility
- Seasonal constraints and project schedule
- Environmental issues.

### 2.5.2 Charles W. Stein, MDOT, Innovative Contracting Unit Project Manager

Mr. Stein is the project manager at the MDOTs innovative contracting section under design division. Mr. Stein is involved with the deployment of slide-in technology and provided details from the contract procurement perspective for the two slide projects: US-

131 over 3 Mile Road and M-50 over I-96. The overview of these projects and procurement methods described by him relate to information given in sections 1.2.1 and 1.2.2.

Several aspects of a project need to be considered for the CMGC procurement method. CMGC, as the procurement method, can be employed when a project meets at least 4 characteristics from the following list:

- Requires managing high risk
- Requires deploying innovative technologies and methods due to limitations in traditional means and methods
- Requires managing a highly constrained project schedule
- Requires expertise on many aspects due to technical complexity of the project
- Requires a high level of construction staging/ phasing
- Requires input on constructability, means and methods, and non-standard costs
- Requires an increased level of engagement for outreach and public involvement.

The two projects listed in section 1.2.1 and 1.2.2 met the criteria for the CMGC procurement method. CMGC was utilized with an intention to have an early involvement of contractors. MDOT procured a total of 10 CMGC projects including these two slide projects. The total cost for all 10 CMGC projects was around $250 million. A large percentage of that cost was for the Zilwaukee bridge barrier replacement. Using CMGC, MDOT realized the following benefits:

- Promoting creativity
- Integrating the design process: MDOT was able to analyze several alternatives and obtained early buy-in from the contractor. For example, the M-50 over I-96 bridge project utilizes Mammoet track system for the slide operation. MDOT customized the substructure design to accommodate the Mammoet track system requirements early during the design process.
- Mitigating risks associated with high costs: MDOT worked with the contractor and allowed using the locally available materials for cost control.
- Improving constructability.

On the other hand, with CMGC projects, the following challenges were encountered:

- Dealing with new time frames and needs.
- Estimating costs: This is a major challenge. MDOT generally uses historical cost averages to develop Engineer's Estimate for a project. With CMGC projects, with the various means and methods are utilized, the cost estimation process becomes complex. Thus, an independent qualified cost estimator is included as a part of CMGC process. MDOT recommends an independent qualified cost estimator to be included in the CMGC projects, and requests bottom-to-up cost estimate for labor, materials, etc. In principle, the independent cost estimator performs the task similar to the contractor cost estimation. In addition, the costs need to be estimated with respect to comparable historical project material attributes, rather than historical averages.
- Developing new contracting procedures: CMGC is an iterative process that requires additional effort from the design team to analyze alternatives from contractor's proposed means and methods. Thus, CMGC requires upfront commitment of the design team.

Utilizing an innovative contracting method, 3D modeling and mapping, and slide-in technology allowed MDOT to secure an additional 5% Federal Funds for the two slide projects.

### 2.5.3 Thomas J. Tellier, MDOT, Grand Region TSC Construction Engineer

Mr. Tellier, construction engineer of the M-50 over I-96 bridge slide project, presented details of the associated construction process, challenges, and future plans for the project. He indicated that the project is different from a typical rehabilitation project because of the implementation of slide-in technology. The project schedule was as follows:

- March 7, 2013 – Release of request for qualifications (RFQ)
- April 8, 2013 – Deadline for submission of qualifications
- September 2012 to December 2013 - Design
- January 2014 - Price negotiations
- March 12, 2014 - Contract awarded
- March 17, 2014 - Work began at the site
- August 1-3, 2014 - Bridge demolition
- Late September 2014 - Bridge slide (expected).

By the contract award date (being a CMGS project) the owner, designer, and the contractor had already worked through all the project details including means and methods, and project schedule. This process involved seeking input from all the parties including subcontractors. The details including temporary works analyses and plans, slide operation plans, and contingency plans were ready before starting the work at the site. The CMGC process helped in achieving the project milestones and allowed sufficient time for review and modifications of essential details before the contract award duration.

The M-50 over I-96 bridge slide project's primary challenges were maintaining traffic through the work zone and site access. The following justified implementing bridge slide technology at this project site:

- In a traditional type project at this site, the construction duration would be 5 months and M-50 needed to be closed for that entire duration.
- Use of cross-overs would have significant environmental impact.
- Long detour routes would have impacts to local communities.
- Proximity to the heavily used car pool lot and the interchange providing access to it would have created difficulties to the motorists.
- Routing traffic over the new superstructure on a temporary substructure allowed maintaining access to businesses, neighboring communities, and at the major interchange.

MOT strategies were in place during the entire project duration (discussed in section 1.2.2). The old structure was demolished during the weekend of August 1-3, 2014. The specific structural configuration of the old 4-span continuous variable depth concrete T-beam structure created significant difficulties for removal within a weekend time frame. The bridge slide is planned for the last weekend of September 2014 or the first weekend of October 2014. The new superstructure, with two continuous for live load (CLL) spans, is supported on three tracks with PTFE slide bearing pads. The sliding process will utilize three push cylinders provided by Mammoet. The plan is to remove the temporary approaches before sliding the new superstructure. The scope of work for the planned weekend closure for bridge slide also includes constructing permanent approaches, installing guardrails, and installing pavement markings. A contingency plan is in place to use hot-mix-asphalt (HMA) for the approaches in case the concrete curing requirements cannot be completed during the weekend closure.

### 2.5.4 Kevin McReynolds, MDOT, Grand Region TSC Construction Engineer

Mr. McReynolds, the construction engineer of the US-131 over 3 Mile Road bridge slide project, presented the details of the construction process, including lessons learned and future plans.

The project utilized the CMGC procurement process, and the schedule was as follows:

- February 28, 2013 - Release of request for qualifications (RFQ)
- March 28, 2013 - Deadline for submission of qualifications
- September 2012 to December 2013 - Design
- January 2014 - Price negotiations
- March 27, 2014 - Contract awarded
- April 23, 2014 - Work began at the site
- August 3, 2014 - NB US-131 new cast-in-place concrete bridge deck placement
- August 9, 2014 - NB US-131 bridge demolition
- August 10, 2014 - NB US-131 bridge slide
- Week of September 08, 2014 - SB US-131 closure and bridge slide
- October 15, 2014 - Project completion date.

The following are highlights of MOT strategies:

- Minimal interruptions to be imposed upon US-131 traffic by limiting shoulder closures while the new structures are constructed adjacent to the old structures.
- The contract allowed for 5-day closure and detour of US-131 traffic with NB restriction of no closures from Friday 12 PM to 11:59 PM, and SB restriction of no closures from Sunday 12 PM to 11:59 PM.
- The detour route for US-131 NB and SB is approximately 10 miles via Jefferson Road to Old US-131 (Northland Drive) to 8 Mile Road.

The old NB superstructure box beam tendons under the truck lane were severely corroded, and the concrete was delaminated and spalled (Figure 2–1). This prompted shifting the NB US-131 traffic to the West side curb lane. The old SB superstructure condition was also the same. Condition of the bridges triggered the replacement project. The following reasons qualified the bridge slide at this project site:

- There was a need to maintain access to the NB and SB US-131 freeway.
- Weekend traffic on this route is much greater than the week day traffic. Closure of the freeway would affect NB traffic on Fridays and SB traffic on Sundays.
- Past experience showed long delays on US-131 when reduced to one lane. This limited the implementation of part-width construction.
- Use of cross-overs would have created significant environmental impact.
- Long detour routes would have social impact to the local communities.
- Using the SB bridge as the cross-over for the NB bridge traffic and vice versa was evaluated, but maintaining one lane for NB traffic and one lane of SB traffic on one structure would have resulted in an estimated $2.5 million of user cost. Also, box beam conditions under the truck lane influenced this decision.

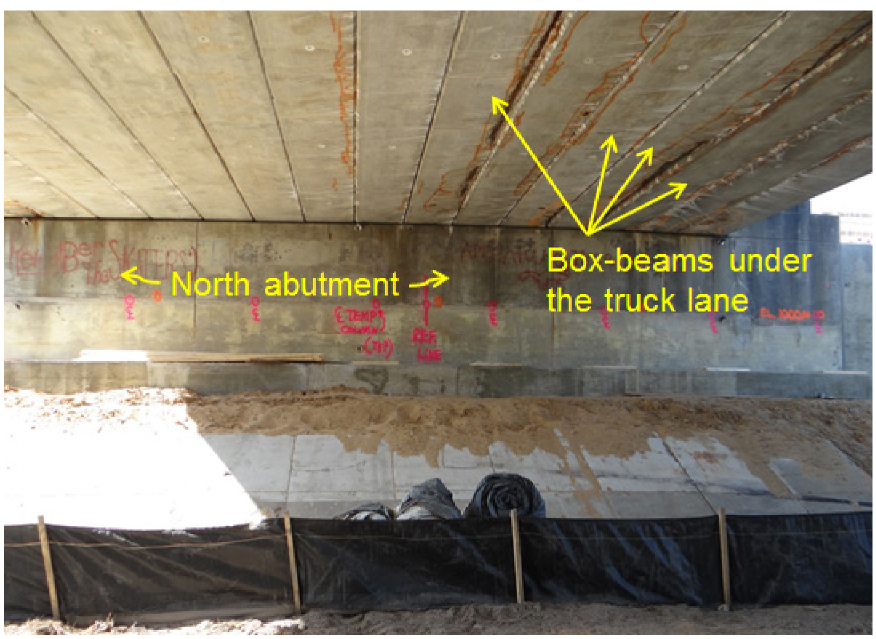


**Figure 2–1 Condition of box-beams under the truck lane of old NB superstructure**

In line with the existing abutments, two temporary structures were constructed to support the new superstructure. Each temporary structure consisted of H-piles, battered H-piles, a railing girder, and a sliding girder (Figure 2–2 and Figure 2–3). The railing girder was a W 18×175 section. The sliding girder consisted of stainless steel sliding shoes that slid on PTFE bearing pads placed on top of the railing girder. To reduce friction, Thermyl-Glyde® synthetic gear oil (commonly known as the Royal Purple) was used to lubricate the top of the PTFE bearing pads.

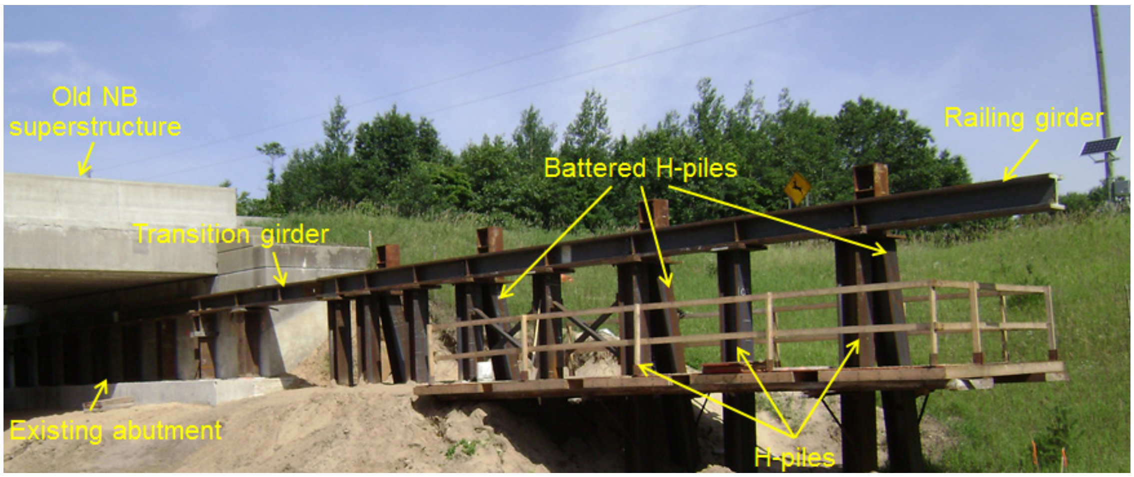


**Figure 2–2 Temporary structure for NB superstructure**

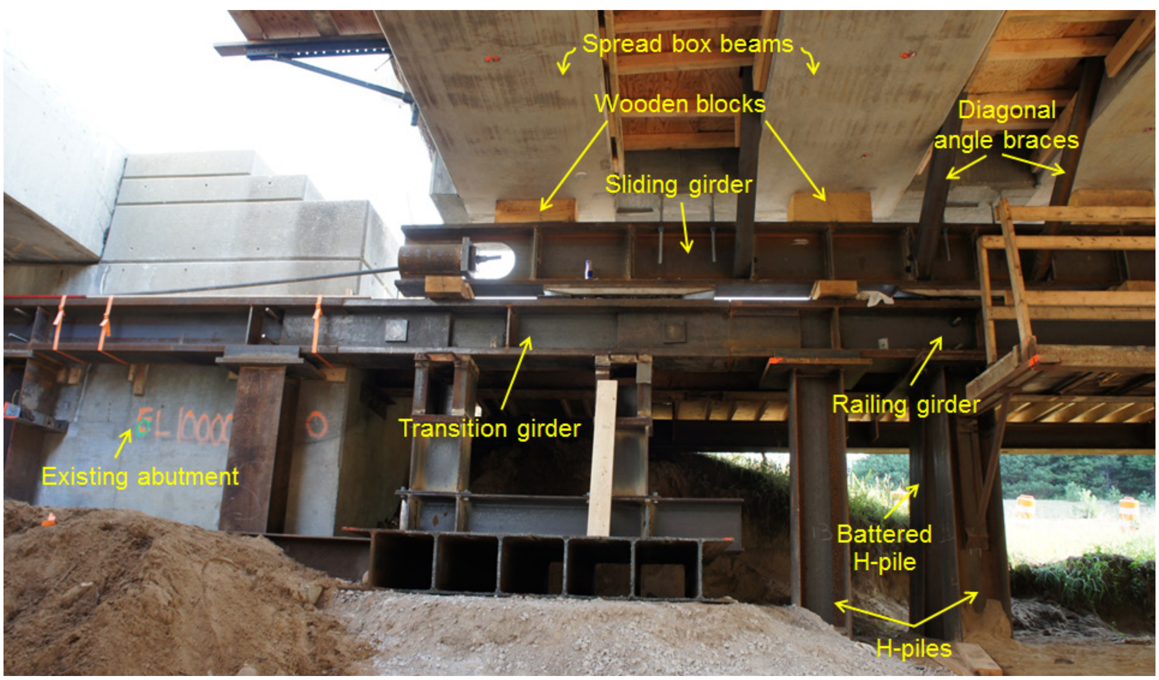


**Figure 2–3 Temporary structure with new NB superstructure**

The spread box beams of the new NB superstructure were supported on the sliding girder using wooden blocks (Figure 2–3). Diagonal angle braces were attached to each side of the box beam and the sliding girder, as shown in Figure 2–3, to maintain box beam stability until the deck and backwall were cast, and the intermediate diaphragms were installed.

The US-131 NB was closed for 5 days from 3 PM on August 9, 2014 (Saturday) to 3 PM on August 14, 2014 (Thursday). The NB bridge superstructure was successfully slid into place on August 12, 2014. The planned lateral slide distance was 65 ft; however, at the end of the sliding operation, the actual slide was measured to be 64 ft 3 in. The total duration of the slide operation was 28 hrs. Following the slide and installation of permanent bearings, the superstructure was jacked for the removal of wooden blocks. The contractor chose to jack one abutment at a time for the removal of blocks.

The contractor, C.A. Hull, Inc., utilized a pulling system with 130 ft long, 1.375 in. diameter Dywidag bars to slide the superstructure. The pulling system included 110 ton hydraulic jacks connected to a hydraulic pump with a manifold for each jack. As recorded on the pressure gauges on the manifolds, approximately 2000 psi was required to initiate the sliding. The maximum stroke of the hydraulic jacks was limited to 2 in. After exhausting the stroke, the jacks were stopped, pulling bars were unlocked and pistons were retracted.

The following difficulties specific to the NB bridge construction and slide were described:

- Setting up the long railing girder at the site was challenging. The railing girder was in two discrete segments: one over the temporary supports connected to the battered H-piles and the other segment on the temporary supports built on top of the exiting footing. Initially, a pin connected the two segments. Later, analysis indicated a potential uplift of the railing girder at the ends under moving load. To mitigate the uplift, additional temporary steel supports were installed (Figure 2–4). This extra work was labor intensive as the preparation and installation were performed on-site. Additional details of the temporary support configurations are discussed in section 2.6.3.

- During the slide, PTFE sliding pads were climbing over the stopper rods and sliding with the superstructure. This altered the slide alignment (centerline) and interrupted the slide operation several times. The contractor used small wooden shims to prevent the sliding pad from climbing over the stopper rods.
- Maintaining the superstructure alignment along the railing girder was challenging because there were no restraints to limit the bridge movement transverse to the slide. In a few instances, the superstructure moved closer to the abutment more than the tolerances allowed in the special provisions. The sliding operation was stopped, and the bridge was pushed back to alignment using multiple jacks. The bridge movement was continuously monitored along the railing girder as well as in the direction transverse to bridge movement. Slight alignment changes were corrected several times with independent jacks. After the bridge repeatedly lost alignment, shims were installed behind the battered H-piles to maintain the alignment. This proved successful and helped complete the sliding operation without the need to repeatedly correct the sliding alignment.

**Figure 2–4 Additional temporary supports at the transition zone for NB superstructure**

The design team was expecting movement of the existing abutment and settlement of the temporary substructure during the slide operation. The slide was continuously monitored by a total station with targets on the railing girder and the new superstructure. Relaxation or the settlement was not observed during the slide operation.

## 2.6 BRUCE L. CAMPBELL, PARSONS, INC., SENIOR PROJECT MANAGER

Bruce L. Campbell, lead senior project manager at Parsons' Michigan office, presented the lateral slide considerations and temporary structure details for both US-131 over 3 Mile Road and M-50 over I-96 projects.

### 2.6.1 Lateral Slide Considerations

The first step in temporary structure design is to decide on the sliding mechanism, pushing or pulling the structure. As an example, the temporary structure of the US-131 bridge over 3 Mile Road was designed for a pull system, whereas the M-50 bridge over I-96 was designed for a push system. In the sliding project, the construction process of the approach pavement needs to be carefully considered: i.e., whether the approach is pre-built or built after sliding the bridge. Also, the details need to be designed and assessed concerning the approach pavement connection to the bridge superstructure and the material specifications to establish the connection. This is essential because the approach pavement construction and connection to the new superstructure are critical activities on the schedule.

Procedures requiring vertical jacking of the superstructure are critical, because of risks and cost. On the US-131 bridge over 3 Mile Road, limited jacking was allowed; whereas, on the M-50 over I-96 project, vertical jacking was not allowed. The temporary support location for the bridge is another critical aspect in design. Ideally, the bridge should be supported at the final bearing locations. On M-50 over I-96, the temporary support locations were in-line with the final bearing locations; however, on US-131 over 3 Mile Road, the temporary support locations were eccentric to the final bearing locations. It is necessary to consider how close the temporary supports can be built adjacent to the old structure since this will also drive several of the design decisions. In both projects, the new superstructures were built in close proximity to the old superstructures.

### 2.6.2 Slide-In Design Issues

The design of the temporary structure needed to ensure uniform and consistent support to all the spread box beams. Local effects on the temporary supports during the sliding operation also needed consideration. The temporary and permanent substructure elements were designed as separate elements. The design of the interface between the temporary and permanent substructures needed to ensure a smooth and level travel path, and provide appropriate interaction between the temporary and permanent foundation. A tie between temporary and permanent substructure elements was designed for resolving the forces internal to the jack/slide system. The lateral jacking was designed to be controlled by a displacement monitoring program. The approach slab details of the M-50 over I-96 bridge were designed to maintain traffic even if the sliding process is interrupted as required by the contingency plan.

### 2.6.3 US-131 over 3 Mile Road Project

Of the two projects, this project included the most complexities. The work scope included NB and SB superstructures replacement without abutment modifications. The only modification was extending the abutment footings for the temporary substructure. The closure allowed for US-131 was 5 days for each, NB and SB, bridge. The 3 Mile Road was allowed to be closed for the entire project duration.

The slide method implemented on this project was a pulling system for a short slide length of 64.75 ft. Pulling is a simple operation that most contractors can perform using post-tensioning strand jacks. However, a structure cannot be pulled for long slide lengths for the following reasons: (1) the spring effect of the pulling strands/bars, (2) differences in resistance on sliding surfaces, and (3) difficulty in maintaining the bridge alignment with the sliding girder.

Vertical jacking was required but was limited to the extent possible. The major challenge encountered at the design phase was to evaluate the effect of eccentric loading onto the existing foundation. Eccentric loading was due to the temporary supports constructed in-front of the existing abutment wall on the abutment footing. The slide interface was PTFE and stainless steel bearing. The jacking forces were resolved internally in the temporary structure without developing external forces, which would have required bracing the substructure.

The new NB superstructure was supported on a temporary structure. The temporary structure consisted of a railing girder (sliding rail) and a sliding girder (slide beam). The sliding girders included pulling nodes that pulled against the railing girder to resolve the forces internally. Wood blocks placed on the sliding girder supported the new superstructure. The sliding girder was supported on the railing girder that extended from the temporary substructure to the permanent substructure. In addition, temporary columns on the abutment footing supported the railing girder at the permanent abutment. Moreover, transition girders were utilized for the transition from the stiff temporary pile substructure system to the existing spread footing substructure with more flexibility. The temporary structure was constructed at least 10 ft away from the old structure to minimize the impact of pile driving vibrations to the bridge in service. The gap between the temporary structure and the permanent structure was covered by a transition girder that connected the two structures. Later, as a precaution, additional temporary supports were installed under the transition girder for support as the superstructure slid across.

The spread footing was extended to help resist the overturning of the abutment under the eccentric load, as shown in Figure 2–5. The railing girder was also anchored to the abutment wall to assure stability. The bridge superstructure was connected to the temporary structure by being anchored to the sliding girder along the backwall. Also, during superstructure construction, the sliding girder was anchored to the battered H-piles for stability. The anchors between the sliding girder and the battered H-piles were removed before sliding.

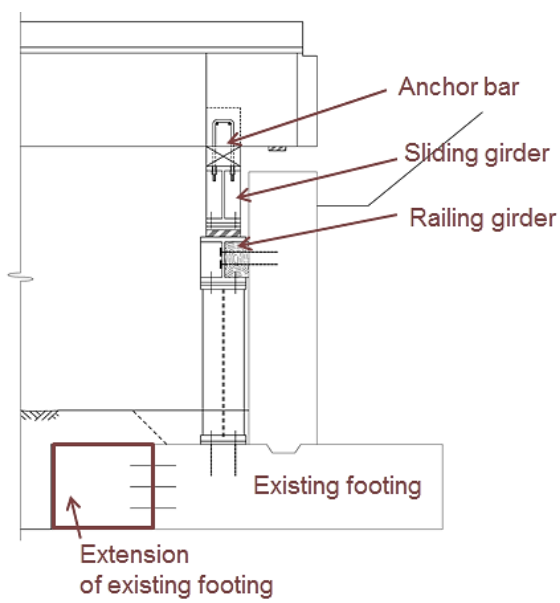


**Figure 2–5 Section through dependent backwall**

The Figure 2–6 shows the original detail designed for connecting the transition girder between the temporary pile and the abutment. A pin-connected member was intended to accommodate any differential settlement of the footing. In addition, each end of the transition girder was supported on elastomeric bearings placed on top of the temporary supports to help accommodate the differential settlement, if any. During the slide, the permanent abutment settlements did not exceed 1/1000$^{th}$ in., contrary to the expectations.

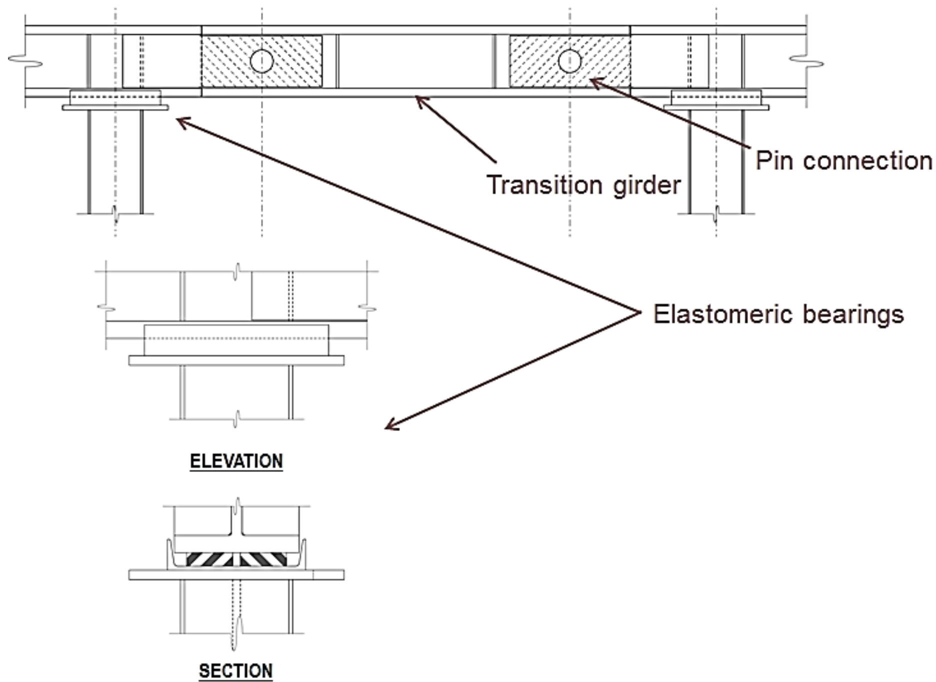


**Figure 2–6 Transition girder details**

Tolerances and the procedures of dealing with them are critical aspects of slide procedures. For example, the railing girders for this project were specified as 311-lb beams with mill tolerances, and they were expected to provide a smooth and level surface. However, they were not smooth and level. Another related aspect that the designers need to consider is the constructability aspects of design details. For example, in this project, a 6 in. pin connection was designed on both sides of the transition girder. However, drilling a 6 in. pin hole in the field proved difficult. Finally, a subcontractor was identified with equipment to drill a 6 in. pin hole in the field.

During the slide, the slide shoe sat on the slide bearing pads and applied compression that resulted in uplift of the pad's leading edge. To restrain the slide bearing pads, 3/8$^{th}$ in.

stopper rods (keeper bars) were installed. However, the slide bearing pads with the leading edge lifted started riding over the stopper rods. Specifying larger 1 in. stopper rods would have resolved this problem. Also, Thermyl-Glyde® synthetic gear oil was used to lubricate the PTFE slide bearing pads. When the superstructure was sliding on the slide bearing pads, the lubricant flowed onto the railing girder, lubricating the bottom of the slide bearing pad. This caused a problem for the following reason: each sliding shoe was supported by at least 3 slide bearing pads, and during the slide, under one sliding shoe all 3 slide bearing pads slid out because of the lubricant. The slide operation was halted, and the lubricant was cleaned. The sliding girder dropped about 3/8$^{th}$ in and needed to be jacked up to position in order to continue with the slide. Later it was deemed that the use of lubricant was not needed.

During the slide, another problem arose in the form of longitudinal drift (North direction) of the superstructure. Vertical alignment of North to South abutments is at a 0.2% slope. During the slide, the superstructure drifted uphill towards the North abutment. This problem was associated to the tolerances of the railing girders. In one instance the longitudinal drift approached the allowable tolerance, so a longitudinal jacking operation was conducted to push the superstructure back into tolerance (i.e., back to sliding centerline). To prevent the drift, shims were installed to the sliding girder against the temporary substructure and against the existing abutment. Contingency plans for the sliding operation were required, such as the contractor making extra jacks with varying capacity available on site to deal with these situations.

The lessons learned from the project are the following:

- Careful consideration of field and mill tolerances is required.
- Complexity of steel erection (getting the pieces to fit together) must be considered: Consider what is shop welded and bolted, what is field welded and bolted, and how the variations in the (driven) piles can be accounted for while attaching components.
- Analyzing the distance of temporary supports from the existing foundation is important to plan solutions for sliding loads.

- Consideration of all loads at each stage of construction and throughout the move is required. Moreover, consideration of the local effects resulting from the change in bearing point across the structure is essential. In addition, all different points of movement and how the system will react to the loads at each stage must be fully understood.
- A method to account for longitudinal drift should be in the contingency plan.
- The slide bearing pad size and an improved approach to restrain the slide bearing pads must be analyzed and planned.

Based on the lessons learned from US 131 NB bridge, for the SB bridge the contingency plan is proposed to include Hillman rollers installed on the sides of the sliding girder to control the drift.

The additional costs for this project's slide-in implementation include temporary supports and the jacking operation. The temporary support included pile abutments that required 144,000 lbs steel and 692 ft piles for the NB and SB bridges respectively; the expensive steel incurred significant cost. The temporary support distance from the old structure (10 ft) also created additional cost for the temporary supports under the transition girder. Alternatively, the jacking operation costs included horizontal jacking, vertical jacking, PTFE/Elastomeric bearings, and construction engineering costs.

The benefit that this project realized with slide-in implementation is reduced user costs. US-131, using conventional part-width construction, would have created $2.5 million in user costs. Specifying ABC slide-in technology, the user costs were reduced to $267,000. The slide-in (lateral bridge slide) cost was about $1.58 million for both NB and SB bridges.

### 2.6.4 M-50 over I-96 Project

The scope of bridge work includes full bridge replacement. The new structure is designed as 71.25 ft wide with five lanes, wider than the old 35 ft three-lane bridge. The project duration allowed M-50 closure for a total of 5-days with no continuous closure duration longer than a weekend. For the remainder of the project, M-50 traffic used the temporary run-around on a portion of the new superstructure in its temporary location.

Two-lanes of traffic (one lane for each direction) were maintained using the temporary run-around. For this project, the temporary structural design was simpler compared to US-131 over 3 Mile Road. However, the staging and planning of the assembly was more complex. Also, the M-50 bridge was designed to carry traffic in its temporary location. Thus, the loads on the temporary structure are about double the construction loads, and the entire temporary substructure was designed according to AASHTO LRFD. The resulting temporary substructure is much heavier and costlier than the one without traffic.

The new superstructure has two spans, weighs about 4.3 million pounds, and is wider than the old structure. The new abutments extend beyond the old superstructure footprint. The portions of abutments that are outside of the old superstructure footprint, including the permanent wingwalls (on the West side), were constructed along with the temporary substructure. At the time of the showcase, the new superstructure at its temporary location is supported in part by permanent abutments and temporary bents at the two abutment locations. Temporary MSE walls and temporary sheet pile walls were installed for supporting the backfill behind the permanent abutments. At the central pier, the new superstructure is completely supported on the temporary pier. A temporary column was constructed to support the transition between the temporary pier and the permanent pier. The temporary column helps the slide operation to: (1) transition the forces from the temporary to the permanent, (2) traverse the cantilever portion of the permanent pier, and (3) transition from pile foundation to spread footing that may settle during the move. Also, at the transition location, the permanent and temporary bent caps were tied together with rebars. The temporary bent caps at the abutments and central pier were initially designed using steel; however, working with the contractor in CMGC, the design was changed to concrete for cost savings. The temporary bent caps support the Mammoet sliding track. The sliding tracks are welded to the two WT sections that were cast in each bent cap. Consequently, the WT sections protrude out of the bent caps and provide a level surface while enabling the inspection of the sliding track weld.

Half-depth pier diaphragm and backwalls with sliding shoes were precast. These half-depth components were placed on the temporary bent caps with the sliding tracks and then the girders (box beams) were placed. When the box beams were being placed on one of the two spans, the half-depth pier diaphragm rotated under the eccentric load. Subsequently, the half-depth diaphragm was jacked back to alignment, and the jacks were removed after the other span was loaded with spread box beams. The remaining half-depth of pier diaphragm and backwalls were cast-in-place.

The method of slide is a pushing system. A pushing system was selected because of the long slide-length of 80 ft. Vertical jacking is not required with the slide bearing pads in-line with the permanent bearings that allowed pushing the superstructure onto the permanent bearings. The sliding is planned to be along the centerline of the bearings to eliminate eccentric loading. The temporary support locations are also in-line with the permanent support locations. In this configuration, lateral forces may develop when the superstructure slides from the sliding track on a temporary substructure to the permanent bearings on the new substructure. *Push Brackets* are installed on the pier diaphragm and backwalls to connect the push system, and to provide external support for lateral forces.

The lessons learned from the project were the following:

- Utilize portions of the new substructure for temporary support when the project includes widening of the bridge; this can reduce the cost of temporary structure.
- Control temporary erosion: Temporary structures will be used for 3 to 4 months; thus, temporary erosion control and slope stabilization is required. In this project, erosion needed to be mitigated during the construction of MSE wall.
- Consider the impact of live loads: The design and cost of the temporary structure is significantly affected when traffic is allowed on the bridge in its temporary location.
- Analyze the costs difference between concrete vs. steel caps for the temporary substructure: The contractors typically opt for the cast-in-place concrete option to mitigate the cost of steel and challenges with on-time steel procurement. A temporary concrete cap is considered feasible and cost effective. Alternatively, steel caps can be utilized if designed using standard steel shapes. This option may mitigate costly welded steel shapes, challenges with steel procurement, and field welding that is time consuming.

- Carefully plan the staging of loads: The temporary structure design shall consider how the staging affects the loading of the substructure.
- Manage excavation staging: Significant excavation is required on projects involving roadway interchanges. Thus, the close proximity of temporary supports and traffic necessitates staging the excavation process appropriately.

The additional costs for this project, with slide-in, included temporary support abutments and pier, temporary run-around roadway and approach, and jacking operations. The temporary support abutments and pier were designed for AASHTO LRFD to account for the traffic; this resulted in a heavier and costlier temporary substructure. Design and construction of the temporary run-round and temporary approach in accordance with the contingency plans also incurred additional cost. The jacking operation costs included horizontal jacking, PTFE/Elastomeric bearing, sliding tracks, and construction engineering costs.

The benefit that this project realized with slide-in is reduced user costs. M-50, using conventional construction, would have required 135 days of closure creating $3 million in user costs. With ABC slide-in technology, M-50 closure will be limited to 4 days reducing the user costs to $536,000. The temporary structure and slide-in (lateral bridge slide) costs are estimated as $2 million.

## 2.7 ANDREW O'CONNOR, C. A. HULL, INC.

### 2.7.1 Contractor Perspective for the US-131 over 3 Mile Road Project

Mr. O'Connor was involved with the accounting, constructability review, and cost calculation activities of the project. He provided an overview of the US-131 over 3-Mile Road project (MDOT Bridge Project No. 54013-118289) (discussed in section 1.2.1).

US-131 closure to traffic for 5 days (ABC window) is allowed during the lateral slide of each structure. The contractor needed to account for sufficient preconstruction time in the schedule to ensure that the work will be complete within the 5-day ABC window. In addition, the contractor requested full closure of 3 Mile Road and limited lane closures on US-131 for the entire duration of the project.

The contracting method was CMGC. The contractor was onboard during the design and constructability evaluation phases of the project. The contractor needed to be prepared for an open and transparent process including the cost, as the contractor was required to share the cost estimates and walk-through the labor rates with other stakeholders. The contractor negotiated and agreed upon the construction cost with the following criteria:

- Guaranteed Maximum Price (Slide and Structure Related)
- Adjustable Items (HMA, Driven Pile, etc.)
- Contingency Allowance, if required.

The north and south approaches of the NB and SB bridges were subcontracted to Rieth-Riley for crushing and shaping. The prime contractor, C. A. Hull, Inc. coordinated with Rieth-Riley and ensured that they use the same subcontractors for the north and south approaches of the bridge. For instance, one guardrail contractor was arranged for both north and south approaches of the bridge. This allowed simplifying the project coordination process.

The contractor controlled hydraulic jacks on both abutments simultaneously using a manifold system. The manifold could be configured to pull only one side at a time by controlling the valves. During the sliding operation, the jacks were limited to 2 in. strokes; at every $5^{th}$ to $8^{th}$ stroke, the pulling at the south abutment needed to be stopped while pulling at the north abutment continued. This process was carried out to keep the superstructure in alignment with its transverse movement. All 5 days of the ABC window were utilized. The total slide operation of the NB superstructure took about 28 hrs. The challenges encountered during the NB superstructure slide are described below:

- Delays were encountered because the survey showed that the abutments were not level and required modifying the temporary structure alignment.
- Additional analysis was performed after the design and construction of the temporary substructure and railing girder has been completed; it indicated that the temporary structure capacity was inadequate to accommodate sliding forces while supporting the new structure. Hence, the transition span required temporary supports. The temporary supports for the transition span needed to be fabricated with tight tolerances and installed within the limited space available. Installing

these temporary supports within the limited space and with tight tolerances was labor intensive and time consuming. All the complications associated with the transition span could have been avoided if all the loading scenarios were considered during the analysis. Also, the use of a continuous railing girder without a transition span could have eliminated some of these complexities.

- During the lateral slide operation, the bridge structure moved about 2 in. towards the abutment. This was near the tolerance limit; hence, the operation needed to be stopped after 10 ft of lateral slide. Then the structure was jacked back to alignment along its longitudinal axis using several jacks. The jacking was done against the battered H-piles in the temporary structure. Later, wooden blocks and shims were installed in between the sliding girder and the battered H-piles on the north abutment to limit the transverse movement (with respect to the slide direction) during the remaining sliding operation. The flanges of sliding girder were lubricated with Thermyl-Glyde® synthetic gear oil to reduce the friction between the shims and the sliding girder.
- During the slide, the PTFE pads (sliding pads) did not function as expected. The stopper rods could not restrain the pads. Thus, wedges were placed to stop the sliding pad from moving forward and lifting up. This could have been avoided by banding the front of the sliding pads to the railing girder and cutting the band once the slide bearing is on those pads, or by bolting the sliding pads to the railing girder.

The lessons learned by the contractor from the NB superstructure slide are described below:

- Place all the slide bearings on the same beam layout (railing girder/sliding rail).
- Install a track or guide to keep the superstructure aligned during the slide.
- Utilize continuous or longer PTFE pads (at least 24 in. long), rather than the 10 in. long PTFE pads that were utilized for the NB superstructure slide.
- Install stopper rods (keeper bars) of 1 in. height or more to prevent the pad from riding over.
- Use jacks with longer stroke to speed up the slide: For the NB superstructure slide, 100 ton jacks with 2 in. strokes were used. The jack capacity exceeded requirements.

For the US-131 SB bridge slide, the contractor planned to make the following changes to the slide operations:

- Install rollers to the sliding girder to control the superstructure's transverse movement with respect to slide direction. The rollers will have 1 in. tolerance before making contact with the abutment, as this is less than the 2 in. specified bearing tolerance for the superstructure.
- Band the front of the sliding pads to the railing girder, and cut the band once the sliding shoe is on those pads.
- Utilize 60 ton jacks with 10 in. stroke for the pulling operation.

## 2.8 DERRICK L. ARENS, ANLAAN CORP., AND MATTHEW BOBEN, MAMMOET USA INC.

### 2.8.1 Contractor Perspective for the M-50 over I-96 Project

The presenters were Derrick L. Arens from Anlaan Corporation, the prime contractor of the project, and Matthew Boben from Mammoet USA South, Inc., the slide subcontractor. The CMGC contract amount was $58,000 and shared by both Anlaan Corporation and Mammoet USA South, Inc. The total construction contract was about $8 million and includes the following:

- Bridge construction: $2,000,000
- Roadway/Ramp construction: $4,000,000
- Temporary structure and slide cost: $2,000,000

Anlaan Corporation is the general contractor while the sliding operation is subcontracted to Mammoet USA South, Inc. Anlaan Corporation is based in West Michigan and primarily deals with bridge construction and rehabilitation projects. At the time of the showcase, Anlaan Corporation was performing projects in Michigan, Indiana, and North Carolina that included two slide-in projects using the Design-Build contracting method.

Mammoet headquarters is based in Schiedam, Netherlands. Mammoet's specialty is heavy lifting serving many industries. They were specialty subcontractors of several self-propelled modular transporter (SPMT) ABC projects in Utah. Mammoet equipment inventory includes 1,600 cranes (5 to 3,600 ton capacity), 3,000 axle lines of SPMT, 2,000 axle lines of trailer, and a 150,000 ton capacity of jacking and skidding equipment.

The new structure (i.e., replacement bridge) is designed as a two-span concrete spread box beam bridge constructed adjacent to the old structure. The required sliding distance is 80 ft. A test slide is performed in every project to test the equipment and break the bond at the sliding surface. The test slide in this project is planned to push the bridge for about 8 ft. The project timeline is as follows:

- Project award date: March 12, 2014
- Project start date: March 17, 2014
- Demolish old structure: August 01, 2014
- Traffic shift to temporary alignment: August 04, 2014
- Slide operation (planned): October 17, 2014
- Final completion (planned): November 21, 2014.

The new superstructure weight is about 4.3 million pounds, and will be slid by pushing at three locations against the diaphragm at the pier and at the backwalls. The ABC window also includes constructing permanent cast-in-place approaches and connecting the approaches to the new superstructure with closure pours at the final location. The traffic management schedule during the ABC window is as follows:

- Friday night: Close I-96 and M-50 for the test slide.
- Saturday: Open I-96 for the daytime traffic.
- Saturday night to Monday 5 AM: Close I-96 and M-50.

At the time of the showcase, the new superstructure was built on 3 temporary pile bents at a temporary location just west of the old structure. The temporary piles are 14 in. HP driven to about 500 kips. Cast-in-place reinforced concrete bent caps were used as the temporary pile bents. The bent caps were designed to include embedded steel T-beams to accommodate the jacking forces on the bent. Generally, Mammoet uses full slide-length skid tracks (sliding tracks) in their projects. However, in this M-50 over I-96 project, the specification did not allow lifting/jacking of the superstructure for permanent bearing installation. Thus, the sliding tracks were placed on the temporary substructure only.

The superstructure will be pushed off of the sliding tracks into the grooved track on the permanent pier and permanent abutments with permanent bearings. The permanent abutments allow 2 in. of tolerance for keeping the superstructure in-line during the slide operation.

The T-beams were included to connect the sliding track with the temporary bent for transferring the reaction force into the temporary structure. Once the sliding tracks were placed on the temporary concrete bent, they were welded to the protruding WT sections. If the sliding tracks were used throughout the sliding length, then the forces would have been confined within the sliding track (internal forces). This would have eliminated the need for the T-beams in the temporary bent cap, and the plywood connection would have been sufficient to connect the sliding track with the temporary bent.

The hydraulic push cylinders connect to the brackets (for reaction) on the sides of the sliding track to push the superstructure. Push brackets are added to the diaphragm and backwall faces for attaching the push system. Thermyl-Glyde® synthetic gear oil will be used for lubrication on the sliding pads. The lubricant is needed because the sliding pads are most likely locked in position after being loaded for around 3 months with the superstructure in the temporary location. Moreover, pins are installed in the sliding track to hold the sliding pads from uplift and sliding during the slide operation. To start the sliding, an 85 ton push cylinder at the pier along with a 64 ton pull cylinder will be used. The abutments will be pushed using two 64 ton push cylinders. As soon as the superstructure starts sliding, one power pack utility (synchronized system) connected to three 64 ton push jacks (standard) via hoses will generate the pushing force. The hydraulic jacks have 4 ft 7 in. of stroke, and the system can push at a rate of 30 ft per hour. For this project, the jacks will retract and reengage after each 3 ft stroke.

At the time of the showcase, the slide operation was not yet complete. The challenges that the contractor and the subcontractor dealt with during the design and construction phase were described as follows:

- Ensuring that the tolerances were correct required significant effort: specifically in ensuring that the diaphragm and backwalls were aligned with the sliding tracks.

- Another tolerance issue that required significant effort was to ensure that the tracks on the pier and the abutments were parallel to each other.
- The CMGC process was effective; however, getting submittals from the precast supplier, the temporary works design team, and others within one week between project award and start date (March 12, 2014 to March 17, 2014) was not sufficient.
- Mammoet worked with Anlaan Corporation and Parsons, Inc. to design the sliding system and the transition connection. Mammoet's past project experiences dictated the sliding surface design of stainless steel on the bridge and slide bearing pads on the substructure. In addition, a pull point on the bridge was added to allow the ability for pull, if necessary.
- Mammoet was not clear on the reasons for the specification requirement of not lifting the bridge to install permanent bearings. Mammoet, as a subcontractor, recommends that the prime contractor/owner should allow the specialty contractor to get involved early during the design phase as for CMGC process. This will help them understand the specification details and to offer cost-effective and speedier solutions. For example, if Mammoet was permitted to lift the bridge, it would have used the sliding track throughout the slide length, and the T-beams in the cast-in-place temporary bent would not have been necessary.

# 3 PART TWO: DISCUSSIONS

Following the presentations, a questions and answers session was arranged to give the participants an opportunity to ask questions of a panel. The panel consisted of presenters from MDOT and Parsons. The participants also had the opportunity to ask questions of the contractor during site visits and during breaks at the conference hall.

The participants discussed several topics during the site visits. Mike Szumigala from C.A. Hull, Inc., at the US-131 over 3 Mile Road project site, responded to questions related to slide details, challenges, lessons learned, and planned improvements. At the M-50 over I-96 project site, discussions were related to pile driving complexities and the Mammoet sliding track.

## 3.1 PANEL RESPONSES TO QUESTIONS

**Q.** *Roger L. Safford, MDOT:* The presenters talked about the methodology of the construction process and also the contract procurement process. What percentage of the success of these projects is based on the contract procurement process?

**A.** *Charles W. Stein, MDOT:* Overall, the CMGC process was a success. The DOT is familiarized with the contractors laying the details together and proposing alternative designs; and it gains benefit by implementing some of the designs in future projects.

*Matthew J. Chynoweth, MDOT:* CMGC was a good starting point for MDOT. MDOT was not sure how prescriptive they would be for the contractors to specify implementing slide-in technology for the first time in Michigan. Thus, MDOT brought contractors in and collected their feedback during the project development process. In future ABC projects, MDOT will not necessarily utilize the CMGC process. In future projects, MDOT wants to design the project and specify the project duration and leave it up to the contractors to select PBES, Slide-In or SPMT.

**Q.** *Benjamin Beerman, FHWA:* Provide some of the contractors feedback on MDOT's future thought of *"designing the project and telling the contractors that you have X amount of days to replace this bridge and leave up to the contractors to select PBES, Slide-In or SPMT;"* because, with more ABC concepts emerging, how will this affect them (the contractors)? Will it be an issue, because they are picking up more of the engineering? Or is it another factor of business that they need to deal with?

*(Note: Contractors were not present on the panel.)*

**A.** *Bruce L. Campbell, Parsons, Inc.:* From Parsons' (designer) perspective, most of the bridge moves were designed for the contractors. These two projects in Michigan are the first that were designed for the owner. It is common to design for the contractors under design-build or under incentive programs that some states practice, such as Missouri. Consequently, with MDOT's future plans, the contractors may not see much difference in their business process.

*Charles W. Stein, MDOT:* An aspect of CMGC is that the schedule comes into play when costs are considered. Thus, it provides some flexibility to the DOT to observe the cost implications with respect to schedule.

**Q.** *Benjamin Beerman, FHWA:* In the CMGC process, when the time came for a cost proposal from the contractor (who was part of the CMGC), were those costs in-line with the DOT expectations? How did those costs compare to the independent cost analysis?

**A.** *Charles W. Stein, MDOT:* MDOT engaged an independent estimator to perform the cost analysis. Because these two projects are the first ones in Michigan, the DOT also did some research about average prices for the Slide component of the project. It was interesting doing that research because there was a large range to those costs, from $1.5 million to $10 million. Overall, the costs of the two projects were within a 10% (threshold) of the MDOT expectations in the first trial of cost proposal.

*Ali Mahdavi, MDOT:* In 2015, MDOT is planning to have the regular process of design-bid-build. They are looking forward to ABC slide-in implementation with design-bid-build and getting a comparable result to CMGC. With design-bid-build, they are expecting a comparative situation to CMGC in terms of the process and the construction progress.

**Q.** *Jeremy Day, Alabama DOT:* Alabama DOT is evaluating slide technologies to implement on their projects scheduled for September 2014, such as comparing Hillman Rollers to Sliding Pads. What methodology did MDOT use to decide on using Sliding Pads rather than Hillman Rollers?

**A.** *Bruce L. Campbell, Parsons, Inc.:* Many projects in the US were reviewed. Several of them that utilized Hillman Rollers encountered problems with racking and rollers getting bind-up. With PTFE pads and stainless steel sliding surfaces, significant directional flexibility can be achieved. Moreover, the sliding pads allowed the use of an unguided system that will not bind if the ends of the bridge move at different rates. When the bridge is being pulled, there will be variations in the sliding resistance at different locations of the pulling edges of the bridge. These variations will be present at the breakout and also during the slide, resulting in one end of the bridge advancing faster than the other end. The sliding friction at different locations is different; thus, the pulling needs to be adjusted during the slide, such as stopping one end and pulling the other. These aspects prompted the design team to use Sliding Pads rather than Hillman Rollers. It is recommended that, whether using Hillman Roller or a sliding track system, tolerances should not be tight. Also, tolerances may be exempted to a certain extent during the slide operation, so as to ensure adjusting the superstructure orientation is possible.

**Q.** *Paul Froede, Alabama DOT:* How does MDOT decide on the criteria for selecting ABC or traditional for a site? Is there some kind of program that qualifies a site for an ABC? For example, in the Alabama DOT slide-in project, scheduled for September 2014, the cost for just implementing ABC is an additional \$1.3 million, i.e., half of the cost of the bridge. MDOT mentioned that it foresees to do 50% of their bridges utilizing ABC; obviously if you are spending 1/3rd of the money on ABC and 2/3rd on rest of the bridges, there will not be a lot of bridges that can utilize ABC.

**A.** *Matthew J. Chynoweth, MDOT:* ABC does not always mean additional cost. For example, utilizing precast panels, decked bulb-tee beams, etc., does not necessarily represent additional cost. However, the bridges that call for implementing technology such as the slide-in may require additional cost. MDOT decisions for selecting slide-in or SPMT are mostly driven by traffic, detour length, and construction duration. In addition, MDOT evaluates risks at the project site and calculates a tangible dollar value for user cost. MDOT is working with Western Michigan University for developing the criteria for making decisions: entering qualitative and quantitative data in a program that will generate costs for traditional construction and ABC.

Additionally, the program will provide the savings in terms of reduction in user cost, life-cycle cost, etc. At this time, this is in early stages for implementing the decision-making process. These two projects (the US-131 over 3 Mile Road project and the M-50 over I-96 project) are demonstrations, and they were selected based on the traffic, detour length, and impact on surrounding communities.

*Charles W. Stein, MDOT:* For the US-131 over 3 Mile Road project, MDOT estimated additional cost for the temporary works as $1.7 million and the user cost for the 5-day ABC closure as $267,000. Using crossovers to allow NB and SB traffic on one structure, the user cost alone was $1.6 million, plus the cost for constructing the crossovers. Additionally, it would have been challenging to maintain NB and SB traffic on one bridge with limited width. For the M-50 over I-96 project, MDOT estimated additional cost for the temporary works as $2.4 million and the user cost for ABC closure as $536,000. Using traditional construction with full detour, the user cost alone would have been $3.0 million. Also, M-50 over I-96 is a heavily used interchange. Its closure for a season and the detour would have caused significant inconvenience to the travelling public.

**<u>Q.</u>** *Paul Froede, Alabama DOT:* Did MDOT look for cheaper alternative for the temporary works other than steel?

**<u>A.</u>** *Charles W. Stein, MDOT:* Yes, MDOT looked for different alternatives for the temporary works, such as spread footings. However, the geotechnical report and the anticipated settlement during the sliding operation necessitated using pile foundation. For example, at the US-131 over 3 Mile Road project, about 1 in. of settlement was anticipated with spread footing.

*Matthew J. Chynoweth, MDOT:* Michigan has a lot of clay in several of its regions, which results in long and short-term settlements in the bridge foundations. Thus, MDOT, in all of their bridge projects, uses pile foundations except for some raise-and-stay projects.

**<u>Q.</u>** *Justin Wiatrek, Texas DOT:* While MDOT is sliding a bridge, what type of monitoring or quality control do they practice? For example, how do they identify if one end of the bridge is advancing faster than the other and if the bridge is moving longitudinally?

**A.** *Matthew J. Chynoweth, MDOT:* MDOT special provision for the slide projects requires the contractors to submit a geometry control plan, monitoring plan, and contingency plan upfront, considering the restricted ABC window. The geometry control plan and monitoring plan includes targets on the bridge and targets on the railing girders (slide rails). These targets were periodically monitored using total station in a 3D space. The targets on the bridge and the railing girder are measured during the sliding operation and when the bridge is in its final position. While moving the US-131 over 3 Mile Road Bridge, periodically (every couple of feet of sliding), the contractor halted the sliding and allowed the surveyors to record all the target readings, compare with the original values, and provide the total movement of the structure in a 3D space. If the deviation of the structure was within the tolerance limits, then the sliding process was resumed. Contingency plans were in place, if the deviation of the structure would have been off the limits. Also, vertical rods were installed on both ends of sliding girders, and their positions were measured continuously with respect to the railing girder's center line during the sliding operation. These measurements provided a means to check the structure drift or rotation. The vertical rods also allowed identifying the case if one end of the bridge was advancing faster than the other.

*Bruce L. Campbell, Parsons, Inc.:* One of the questions that the design team had for the surveyors was that "how quickly can they provide feedback of the structure deviation after performing the survey?" The design team was pleased to learn that the surveyors can provide almost real-time feedback. On the US-131 over 3 Mile Road project, the design team was concerned about the eccentric load on the existing abutment footing that may cause rotation of the existing abutment, and rotation will be reflected to the railing girder. To monitor, targets were installed at the ends of existing abutments, and the targets were monitored for rotation or elevation differentials. The survey measurements fortunately indicated that neither the abutments rotated nor the temporary substructure settled. However, each bridge structure is different, and the corresponding monitoring plan should consider the applicable monitoring procedures, locations, and tolerance limits.

**Q.** *Ali Mahdavi, MDOT:* Did the survey that was implemented for the slide monitoring require additional procedures and/or advanced techniques compared to conventional survey procedure?

**A.** *Bruce L. Campbell, Parsons, Inc.:* The survey did not require any procedures out of the ordinary, and the survey personnel did not seem to be challenged with the process. The surveyors utilized two total stations, one at the top (i.e., elevation of the facility carried) and one below (i.e., on feature intersected). The data collected was remotely transferred to a control unit and instantly analyzed by the surveyors. The results were periodically reported to the contractor.

**Q.** *David Juntunen, MDOT:* Is there concern on the amount of survey that needs to be conducted before the design process? What is the lesson learned regarding the need to identify if the bridge is identical to the as-built plans and if MDOT implementations need to change in future projects?

**A.** *Bruce L. Campbell, Parsons, Inc.:* Whenever a new superstructure is planned to be constructed on an existing substructure, the perception is that a detailed survey is not required, and the design relies on the old as-built plans. However, the bridge may not match the as-built plans. For example, on the US-131 over 3 Mile Road project, the design team relied on the as-built plans for the design. However, the design team needed to make some adjustments (such as offsetting the railing girders from the abutment walls in order to construct parallel sliding paths), when the construction surveyor identified that the existing abutment walls were not flat and parallel, and the wingwalls were also not at the locations shown on the as-built plans. The lesson learned was that a detailed survey needs to be performed before the design, and the designer should not rely solely on the as-built drawings. MDOT needs to include filled-survey requirements in their conventional process for future projects when implementing new technologies such as the slide-in.

*Kevin McReynolds, MDOT:* On the US-131 over 3 Mile Road project, the abutments were off by 2 in. compared to as-built drawings; overall, the plan was modified to offset the railing girders by 2 in. This modification was not as critical and did not cause project delay. For future projects, it is recommended that MDOT specifies the detail survey of the bridge before the design process.

**<u>Q.</u>** *Representative from FHWA:* Since the US-131 NB bridge over 3 Mile Road is the first lateral slide bridge for MDOT, is there any special post-construction monitoring or post-construction inspection that MDOT is planning over the next few years? For example, monitoring any superstructure moments that might happen over time?

**<u>A.</u>** *Charles W. Stein, MDOT:* MDOT will have a meeting after the project with the contractors and designers to document the lessons learned. This will help MDOT and designers for improving the process in future projects. At this time, we do not have health-monitoring plans for this project.

*Matthew J. Chynoweth, MDOT:* The superstructure consists of spread prestressed box beams and was slid on temporary bearings. The US-131 NB bridge over 3 Mile Road made into its final position within 1.125 in. longitudinal tolerance. The permanent bearings were grouted in-place, and the contractor over-sized the grout pad to account for that tolerance. The 1.125 in. deviation from the designed position is anticipated to have no effect on the abutment. After the railing girder and temporary works are removed, it will be difficult to distinguish the US-131 over 3 Mile Road bridges as laterally slid bridges. However, a few aspects, such as the over-sized grout pad, etc., will be noted in the bridge inventory data for future inspections so that the bridge inspectors are informed. MDOT is not anticipating the bridge to behave differently from a conventional spread box beam bridge.

*Nate VanDrunen, Grand Region Bridge Engineer, MDOT:* The only difference in the US-131 over 3 Mile Road bridges compared to conventional bridges is the grout pads. In the Grand Region, Michigan, there are no bridges with bearings set on the grout pads. Thus, the inspectors will pay particular attention to the grout pads during the inspections.

**<u>Q.</u>** *Joel Rossman, Nebraska Department of Roads:* Was there anything different in the superstructure design of slide bridges compared to conventional bridges?

**<u>A.</u>** *Bruce L. Campbell, Parsons, Inc.:* Yes, the design changed. For the US-131 over 3 Mile Road bridges, the backwall is heavier than conventional. In addition, the end blocks of the prestressed box beams are extended to support the temporary bearings that were offset from the permanent bearing locations. For the M-50 over I-96 bridge, design is much different from the conventional. The bridge is being slid on the diaphragm at the pier location and on the backwalls at the abutments. The design of the diaphragm was different as the contractor decided to precast half of the pier diaphragm with sliding shoes and cast-in-place the other half with the bridge deck. The backwall design is similar to MDOT standards except for the sliding shoes. Generally, a contractor will get a bridge that has gone through final design (standard) in a design-bid-build process, and then they may need to make few modifications to accommodate the slide-in technology. Thus, it is necessary to stay as close to standards as much possible.

**Q.** *Joel Rossman, Nebraska Department of Roads:* Can the MDOT panel provide details of joints, as we always hear about issues with joints? How does MDOT expect the joints to perform in these projects?

**A.** *Bruce L. Campbell, Parsons, Inc.:* The US-131 bridges over 3 Mile Road consist of sleeper slabs and concrete approaches that rest on a pavement seat on the backwall of the bridge. The bridges are only 86 ft spans, and minor expansion or contraction is expected at the backwall. The M-50 bridge over I-96 consists of sleeper slabs and concrete approaches that tie in and slide over the backwall, which is one of the MDOT standard designs. In this case, all the expansions will be off of the sleeper slab.

**Q.** *Panchy Arumugasaamy, TranSystems Corporation of MI:* Did MDOT determine the remaining strength of the side-by-side prestressed box beams of old US-131 NB and SB bridges over 3 Mile Road? How does MDOT determine the remaining strength of the girders? During the demolition of the NB superstructure, the box beams appear to be held by asphalt pavement. Looking at the SB bridge before demolition, the box beams seem to have lost several prestressing strands because of corrosion. How does MDOT know that the SB bridge box beams could carry the traffic load, and are any measures taken to prevent traffic from the bridge?

**A.** *Matthew J. Chynoweth, MDOT:* The old US-131 bridges over 3 Mile Road were selected for the lateral slide because of the extensive deterioration. MDOT load rated the bridges and identified that there was not much life left in the side-by-side box girders. The shoulders were closed because of extensive deterioration of the girders at those locations on both bridges. If the calculations would have shown something dire, then MDOT would have closed the bridges completely; however, this was not the case.

*Nate VanDrunen, Grand Region Bridge Engineer, MDOT:* MDOT inspected both US-131 over 3 Mile Road bridges as per the guidelines. The fascias were sounded and marked up, and the missing strands were counted. For a couple of beams, half of the strands were corroded all the way through or were absent.

*David Juntunen, MDOT:* For the information of representatives from other states, we need to point out that Michigan allows very heavy loads. A few of the trucks are 77 tons, and one configuration consists of an 82 ton load. Fortunately, the bridges are designed for those loads and also load rated for those loads. Since Michigan is a big prestressed beams state, it has numerous research projects that include testing the capacity or remaining strength of the box girders. The research projects can be found on MDOT's research website. MDOT is pretty comfortable when they load rate and adjust the postings on the bridges. Alternatively, Michigan is also a very heavy salt usage state and encounters freeze-thaw effects in its bridges. With MDOT's experience, when corrosion product is seen on the bottom of a prestressed beam, one or more of the prestressing strands are often compromised. Fortunately, the prestressed beams are designed for serviceability and ultimate strength capacity; thus, there is a reserve capacity.

**Q.** *Paul Froede, Alabama DOT:* I have a question with regard to MDOT's sleeper slab and the pedestal at the back of the bridge diaphragm. Is the approach slab a precast panel or is it a cast-in-place? Are the approach slabs post-tensioned? Is MDOT designing the approach slab like a one-way slab? What about the compaction of soil? Does MDOT put soil behind the backwall and compact it or does MDOT implement another method? Is the sleeper slab cast-in-place or precast? If the sleeper slab is cast-in-place, then does MDOT cast it simultaneously with the approach slab, or is there a time gap? Did MDOT consider using flowable backfill between the sleeper slab and the backwall? What type of seal does MDOT use in their expansion joints?

**A.** *Matthew J. Chynoweth, MDOT:* Typically MDOT uses a 20 ft approach slab for the bridges. The approach slabs are designed as one-way slabs including the rebar design that allows 10 ft unsupported span. The rebar design includes #6 bars both ways at the bottom and #4 bars both ways at the top. The unsupported span accommodates any settlement or soil loss under the approach slab. The approach slabs are cast-in-place and are not post-tensioned. Regarding the compaction of soil, yes MDOT uses structural backfill that is high quality sand and is compacted to 95%. Recently, MDOT modified their sleeper slab support details to implement a thicker base because there were some settlement issues with the thinner (6 in.) base on the structural backfill. The sleeper slab is also cast-in-place. The casting sequence of the sleeper slab depends on the project. MDOT had situations where the contractor casted just the bottom (flat part, not the T) of the sleeper slab; then they casted the T portion of the sleeper slab along with the approach slab and backwall. In other situations, the contractor casted the complete sleeper slab (full T), waited for it to get strength and then casted the approach slab from the sleeper to the backwall. MDOT does not use the flowable backfill in their design nor their specifications; however, there were situations where flowable backfill was used for filling in voids. For the expansion joints, MDOT utilizes a mechanical expansion joint device. The device consists of a rail on the sleeper slab T, a second rail on the approach slab, with a bellow in between them. The device has shear studs in the middle of the rail.

*Bruce L. Campbell, Parsons, Inc.:* For the US-131 over 3 Mile Road project, the design team looked at sliding the superstructure along with the approach slabs as a possible configuration. In that configuration, the approach slabs were to be casted along with the deck and to be slid on precast sleeper slabs. That configuration is considered as a potential slide configuration as it has been implemented in several slide projects in other states; however, the tolerances would be more restricted. For various site constraints, that configuration was not implemented on the US-131 over 3 Mile Road project.

**Q.** *Paul Sharp, Tennessee DOT:* At the US-131 over 3 Mile Road project, Mike Szumigala from C.A. Hull, Inc. was talking about the plans for sliding the new bridge along the centerline of the existing abutment, rather than via the railing girder in front of the existing abutment; can the panel expand on that?

**A.** *Bruce L. Campbell, Parsons, Inc.:* Yes, there were discussions for sliding the new superstructure along the existing abutment centerline. That operation required either raising the abutment wall using grout or saw-cutting for preparing the abutment wall. However, the contractor was concerned with both of those approaches to complete the task within the 5-days ABC closure period. In addition, the abutment-top condition was uncertain after the demolition, and the preparation of the sliding path and sliding the bridge in that 5-days of closure would be difficult. An alternative option was considered by having a railing girder in front of the existing abutment for sliding and casting grout pads for the bearings.

*Charles W. Stein, MDOT:* For any of the CMGC projects, it is essential to have appropriate team structure from the contractor side. A person who will be on site during the construction and sliding shall be always present in the group discussion meetings, so that the constructability issues and in-time completion challenges can be discussed upfront.

**Q.** *Benjamin Beerman, FHWA:* For the M-50 over I-96 bridge project, how did MDOT handle the traffic during the demolition of old structure? What kind of public outreach media did MDOT use?

**A.** *Thomas J. Tellier, MDOT:* The traffic control was set up to maintain one lane of I-96 using the ramps, and M-50 was closed at the intersection. Only right turns were allowed from EB I-96 to SB M-50 and WB I-96 to NB M-50. Considering the user delay, when the costs are estimated, there is a certain prediction for diversion. For this project the diversion was not at all observed during the demolition; there were backups that MDOT did not anticipate. This is included in the lessons learned. Moreover, for future, during the superstructure slide ABC closure, MDOT is planning for increased public-outreach such as advertising the alternative routes and increasing the signs for the alternative routes. During the slide, MDOT is planning to maintain two lanes of I-96 using the ramps, along with implementing Late Merge (commonly known as Zipper Method). MDOT uses newspapers, radio, television, open houses, local meetings, advertising boards, Intelligent Transportation System (ITS) devices, and social media such as Facebook®/Twitter® for the public-outreach.

**Q.** *David Juntunen, MDOT:* Considering the different details that were used on the US-131 over 3 Mile Road project and the M-50 over I-96 bridge project, what level of durability is expected for these bridges compared to conventional details: equal durability, less durability, or greater durability?

**A.** *Matthew J. Chynoweth, MDOT:* On the US-131 over 3 Mile Road project, Master Flow 928 grout was used for casting the pads for the bearings. The grout heats up and is very hot; thus, reinforcement was added to the grout pads to accommodate temperature expansion and shrinkage. However, pads are expected to crack. The bridge inspectors will be instructed to pay more attention to the pad condition during the inspections. On the M-50 over I-96 bridge project, attention may be required for the joint between the top of pier cap and the diaphragm; ensure that it is properly sealed after the superstructure slide. In addition, other minor design changes that were made for the slide operation need attention during the inspections. Besides those, the bridges are expected to exhibit equal durability compared to conventional designed bridges.

**Q.** *Haluk Aktan, Western Michigan University:* From these pilot slide projects lessons learned will be documented; besides the discussions and documentations, what is the best way to carry forward the experience that MDOT gained from these projects?

**A.** *Matthew J. Chynoweth, MDOT:* MDOT will be implementing the lessons learned immediately, as in the parallel projects itself. The ABC section in MDOT's bridge design manual will be constantly updated with new experiences.

*Charles W. Stein, MDOT:* There will be several meetings to gather and spread all the thoughts throughout the department. MDOT is planning to have several meetings with project offices, contractors, and the design group to discuss the aspects that need to be considered in future projects, such as additional design details. In addition, on inspection side, the bridge inspectors will be educated about the details that need to be observed closely during the inspections.

*Kevin McReynolds, MDOT:* The US-131 over 3 Mile Road project is not yet complete; the SB bridge portion is remaining. After the whole project is complete, a post-construction meeting will be conducted that intends to include the design group, contractor, TSC, and the DOT staff. The meeting is expected to bring forward the best practices for future slide-in implementations.

**Q.** *Chris Watson, Kokosing Construction, Inc.:* On the M-50 over I-96 bridge project, are typical MDOT approach slabs used that include rebars to connect the approach slab to the backwall? If so, then at the M-50 bridge over I-96, there are no rebars protruding out of the backwall. In this case, how is the approach slab going to be tied to the backwall, once the bridge is in place?

**A.** *Matthew J. Chynoweth, MDOT:* Yes, typical MDOT approach slab details are being used at the M-50 bridge over I-96. The rebars protruding from the backwall for lapping with the approach slab were not used to prevent them from coming in the way of the sliding operation. In this case, a cantilever splicing will be utilized. Splicers are embedded in the backwall where the lapping bars will be threaded and connected to the approach slab. The splicers that are used for this operation are on MDOTs qualified products list.

## 3.2 DISCUSSIONS WITH CONTRACTORS AT SITE VISIT

**Q.** *Tennessee DOT:* What stability measures did C.A. Hull, Inc. undertake during sliding the US-131 NB bridge over 3 Mile Road?

**A.** *Mike Szumigala, C.A. Hull, Inc.:* For supporting the railing girder during the sliding operation, channel sections were installed (vertically installed) from the existing footing to the sides of railing girder. Also, channel sections were installed (horizontally) from the existing abutment wall to the sides of pedestals (few) under the railing girder. In addition, channel sections were installed from the sliding girder to both sides of each box girder (inclined channel sections).

**Q.** *Alabama DOT:* Did C.A. Hull, Inc. encounter any challenges during installing the railing girder and sliding girder at the US-131 NB bridge over 3 Mile Road?

**A.** *Mike Szumigala, C.A. Hull, Inc.:* Yes, installing the transition girder that included the pin connection was a very time consuming operation. This was because the railing girders on existing footing and on temporary piles were installed prior to installing the transition girder that was not fit-tested. Installing additional supports for the transition girder was also time consuming. In future slide projects, we are planning to connect the transition girder with the railing girders before installing the railing girders (on existing footing and temporary piles).

**<u>Q.</u>** *Alabama DOT:* How is the new superstructure connected to the existing abutment wall, and how is the water penetration prevented at the abutment to backwall connection at the US-131 NB bridge over 3 Mile Road?

**<u>A.</u>** *Mike Szumigala, C.A. Hull, Inc.:* The new superstructure rests on the abutment via neoprene bearing pads on grout pads. No dowel bars are used in the design. Before placing the backfill, the connection at the abutment wall and the backwall is covered with an oversized heavy rubber pad and a metal deck on top of it. This ensures preventing the water penetration at the connection.

**<u>Q.</u>** *Representative from FHWA:* What changes in the sliding plan or design does C.A. Hull, Inc. recommend for improving the sliding operation and its time in the future?

**<u>A.</u>** *Mike Szumigala, C.A. Hull, Inc.:* In future projects, before sliding, the bearing pads can be bolted to the box beams. The crown can be accommodated in the haunches rather than placing the box beams at different elevations on top of sliding girder. This will allow casting and curing (24 hrs) of equal height grout pads while the sliding is performed. After the sliding, only the vertical jacking operation will remain. This process will improve the sliding and the vertical jacking operations as everything on the sliding girder will be flat. With the changes, the ABC closure time can be reduced.

**<u>Q.</u>** *Tennessee DOT:* Are there any deck joints in the US-131 NB bridge over 3 Mile Road? What about other bridge replacement projects?

**<u>A.</u>** *Mike Szumigala, C.A. Hull, Inc.:* No, because the span is not long and the superstructure is simply supported on the abutments. The new bridges in Michigan are mostly constructed by simply supporting the box beams on abutments or piers and then casting the integral pier diaphragm (in case of multiple spans) along with the deck for continuous design. All the deck joints are off the superstructure in all new designs. The joints are at the approach slabs and sleeper slab locations. In earlier bridge designs in Michigan, multi-span bridges had joint(s) at the pier(s); several of the ongoing rehabilitation projects of old structures involve rehabilitating the joints at the piers.

**Q.** *Alabama DOT:* Did the contractor encounter challenges during the construction in following the provided design details?

**A.** *Mike Szumigala, C.A. Hull, Inc.:* Yes, the design details had some discrepancies. On the steel diaphragms, slotted holes are utilized. The design detail showed plate washers on both sides of the slotted holes. However, a plate washer is different from a washer, and it shall be used on the slotted side only. The shop drawings used the standard of having the plate washer on only the slotted side. The contractor needed to call several people for the approval for installing the plate washer on only the slotted side of the steel diaphragms.

**Q.** What were the major challenges that the contractor encountered at the M-50 over I-96 bridge project?

**A.** *Personnel from Anlaan Corporation:* Up to the date of the showcase, the old superstructure has been demolished, and the new superstructure, in its temporary alignment, is being used as temporary run-around for the M-50 traffic. The pile driving operation for the new substructure is undergoing. The major challenges we encountered to date are related to the pile driving operation for both the temporary structure and new substructure. The test piles showed a firm base at 114 ft; however, when piles were driven, a firm base was not reached until 120 ft and below in some cases. In addition, the pile splice welding operation consumed additional time because of a shortage of certified welders.

*Matthew Boben, Mammoet USA South, Inc.:* For the slide projects, generally, Mammoet uses slide tracks throughout the sliding length. Then the superstructure is vertically jacked into its final position to remove the slide tracks and install permanent bearings. However, for the M-50 over I-96 bridge project, Mammoet was restricted from vertical jacking of the superstructure. Thus, they needed extra effort to modify their sliding operation to have sliding tracks only on the temporary structure and push the new superstructure from the sliding tracks directly onto the permanent bearings on the new substructure. We plan for an 85-ton push cylinder at the pier along with a 64-ton pull cylinder, while pushing the abutments using 64-ton push cylinders.

# 4 SHOWCASE OUTCOME

The showcase brought together the owner, designer, and contractor representatives to document their perspectives on the slide projects in Michigan. In particular, the US-131 NB bridge slide over 3 Mile Road, that was completed by the time of the workshop, allowed the discussions of lessons learned during the slide operation. At the time of the showcase, the US-131 SB bridge slide over 3 Mile Road and M-50 bridge slide over I-96 were remaining. The lessons learned gathered during the showcase will be useful for the US-131 SB bridge over 3 Mile Road and the M-50 bridge over I-96. The participants of the showcase had the opportunity to learn the bridge slide technology and associated challenges at the site. The presentations, field visits, and discussions at the site allowed participants to interact and ask questions of the contractors, designer, and owner. The summaries of the presentations and discussions will form the basis for implementing the lessons learned from the contractor, designer, and owner’s perspective to improve future lateral bridge slide projects. Representatives from other states expressed their views on implementing the bridge slide technology and obtained answers to their questions that may affect the projects planned in their respective states. Ultimately, the showcase provided knowledge for state DOTs to effectively implement the bridge slide technology in upcoming projects.

# Michigan Department of Transportation Bridge Slide Showcase

## Appendices

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**Submitted to:**

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# APPENDIX A

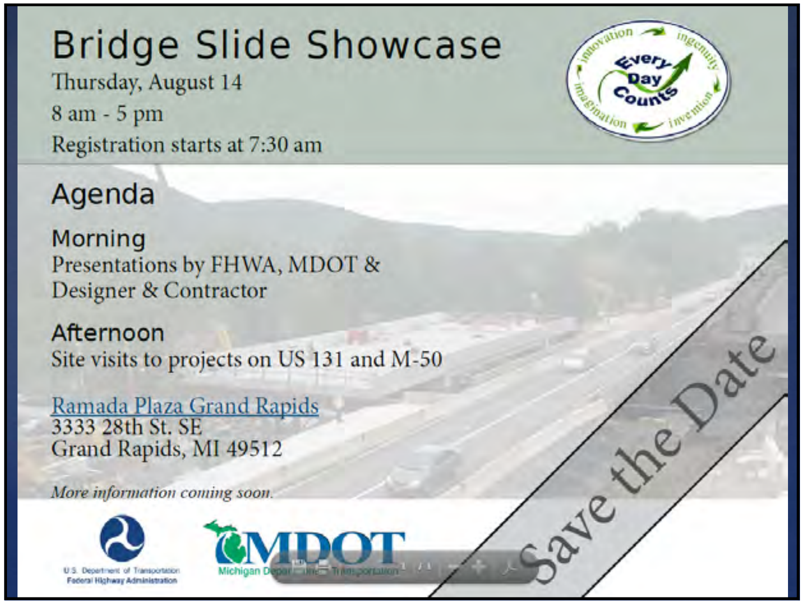
# AGENDA

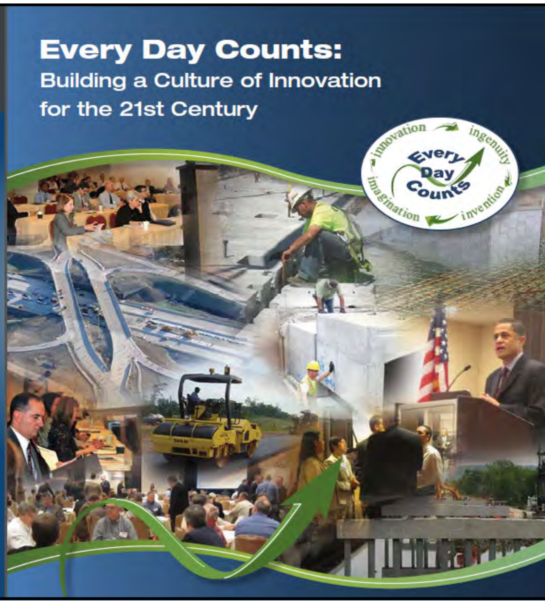
# Federal Highway Administration
# Michigan Department of Transportation
# Every Day Counts - Bridge Slide Showcase
# Three Mile Road Over US-131 & M-50 Over I-96
# August 14, 2014 – Grand Rapids, Michigan

| | | |
|---|---|---|
| 9:00 a.m. | Welcome and Opening Remarks | Roger Safford, MDOT, Grand Region Engineer<br>Russell Jorgenson, FHWA, Michigan Division Administrator<br>Gregory Johnson, MDOT, Chief Operations Officer |
| 9:30 a.m. | National Perspective: ABC and Slide-In Bridge Construction (SIBC) | Ben Beerman, FHWA |
| 9:45 a.m. | DOT Perspective<br>▪ Owner's Objectives<br>▪ CMGC<br>▪ Project Schedule<br>▪ Project-specific highlights<br>▪ Bridge Slide – Closure, Detour<br>▪ Cost Discussions<br>▪ Challenges Encountered<br>▪ Public Outreach and media<br>▪ Lessons Learned – Fulfillment of Everyday Counts on safety, congestion, quality, and public response | Matthew Chynoweth, MDOT<br>Kevin McReynolds, MDOT<br>Charlie Stein, MDOT<br>Tom Tellier, MDOT |
| 10:15 a.m. | Break | |
| 10:30 a.m. | Designer Perspective - Design Methodology and Technical Details | Bruce Campbell, Parsons |
| 11:00 a.m. | Contractor Perspective<br>▪ Observations<br>▪ Contracting Method<br>▪ Staging<br>▪ Project Coordination<br>▪ Construction Details: Bridge Slide<br>▪ Challenges Encountered<br>▪ Lessons Learned | Andy O'Connor, C.A. Hull, Inc.<br>Mike Szumigala, C.A. Hull, Inc.<br>Derrick Arens, Anlaan Corporation<br>Matt Boben, Mammoet USA South, Inc. |
| 11:30 a.m. | Field Itinerary and Safety Instructions | Charlie Stein, MDOT |
| 4:30 p.m. | Panel Discussion and Q&A | Technical Panel |
| 5:15 p.m. | Closing | Roger Safford, MDOT |

# APPENDIX B

# POWERPOINT PRESENTATIONS


Bridge Slide Showcase
Thursday, August 14
8 am - 5 pm
Registration starts at 7:30 am
innovation
ingenuity
Every Day Counts
imagination
invention
Agenda
Morning
Presentations by FHWA, MDOT & Designer & Contractor
Afternoon
Site visits to projects on US 131 and M-50
Ramada Plaza Grand Rapids
3333 28th St. SE
Grand Rapids, MI 49512
More information coming soon.
U.S. Department of Transportation
Federal Highway Administration
MDOT
Save the Date




2

Launched in Nov 2009 w/ 3 initial focus areas:

- Shortening Project Delivery
- Accelerating Technology & Innovation Deployment
- FHWA's Going Greener initiative

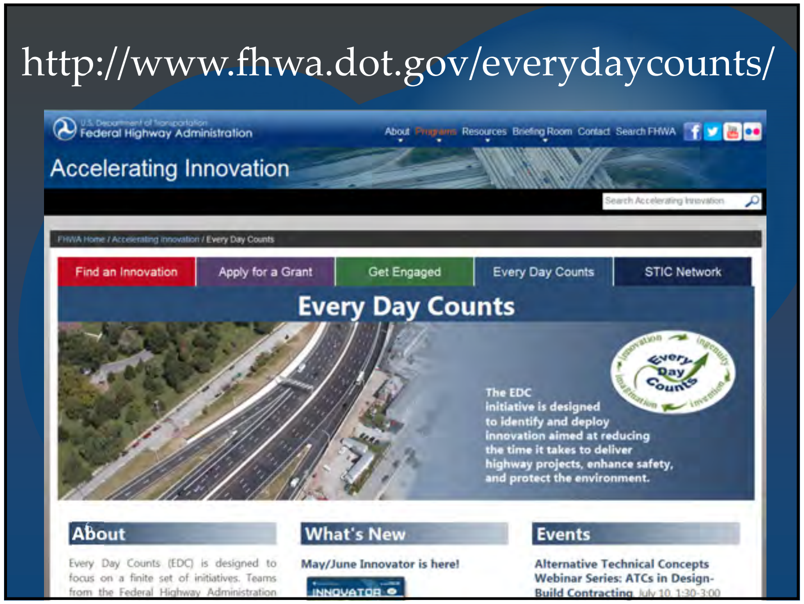
EDC has transformed the way FHWA does business - externally and internally.

3

Every Day Counts (EDC) Overview.mp4

4


5


http://www.fhwa.dot.gov/everydaycounts/
Federal Highway Administration
About Programs Resources Briefing Room Contact Search FHWA
Accelerating Innovation
Find an Innovation
Apply for a Grant
Get Engaged
Every Day Counts
STIC Network
Every Day Counts
The EDC initiative is designed to identify and deploy innovation aimed at reducing the time it takes to deliver highway projects, enhance safety, and protect the environment.
About
What's New
Events
May/June Innovator is here!
Alternative Technical Concepts Webinar Series: ATCs in Design-Build Contracting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STIC Network
EDC News, August 8, 2014
EDC News
Keeping You Informed About the Every Day Counts Initiative
CONTACTS
Kathleen Bergeron
Highways for LIFE
202-366-5508
E-mail Kathleen
EVENTS
Project Demonstration Showcase: Grand Rapids, Michigan, August 14, 2014
7


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Accelerating Innovation
Find an Innovation
Apply for a Grant
Get Engaged
Every Day Counts
STIC Network
STIC
State Transportation Innovation Councils
State-Based Innovation Deployment - The STIC Network helps to establish a group of representatives from various levels of the highway community in each State to comprehensively and strategically consider all sources of innovation. Learn about STIC
8


MDOT
Michigan Department of Transportation
Lake Superior provides a colorful palette of stones along its shores.
MDOT > ABOUT MDOT > MDOT - FHWA PARTNERSHIP
Every Day Counts (EDC) - An MDOT / FHWA Partnership
Every Day Counts-1 Initiatives
Every Day Counts is a national initiative to accelerate project delivery through project streamlining and technology implementation. The Michigan Department of Transportation (MDOT) along with the Federal Highway Administration (FHWA), Local Public Agencies and tribal transportation agencies own the MI transportation system and make key decisions on how to deliver projects, as well as what techniques and technologies to use in the operation and safety on our highway system. The Michigan State Transportation Innovation Council (MI-STIC) can bring together stakeholders that represent all those market forces and work together to lead innovation in their state transportation program.
List of Members
http://www.michigan.gov/mdot/0,4616,7-151-9623_61313---,00.html
EDC-1 Initiatives
Accelerated Bridge Technology
Adaptive Signal Control/ACS Lite
Clarifying Scope of Preliminary Design
Construction Manager General Contractor (CMGC)
Enhanced Technical Assistance on Stalled Environmental Impact Studies (EIS)
Expanded Use of Programmatic Agreements
Flexibility in Utility Relocation
Geosynthetic Reinforced Soil
Planning and Environmental Linkages (PEL)
Safety Edge
Warm Mix Asphalt
Wetland Banking
Quick Links
Title VI Nondiscrimination
Tribal Governments
Twitter-Facebook-YouTube
Mi Drive
State Map

### Every Day Counts-1 Initiatives

The Michigan Department of Transportation (MDOT), Local Public Agencies and tribal transportation agencies own the MI transportation system and make key decisions on how to deliver projects, as well as what techniques and technologies to use in the operation and safety on our highway system. The Michigan State Transportation Innovation Council (MI-STIC) can bring together stakeholders that represent all those market forces and work together to lead innovation in their state transportation program.

Following is the list chairs for the Every Day Counts initiatives:

- Expanded Use of Programmatic Agreements - Margaret Barondess
- Wetland Banking - Margaret Barondess
- Enhanced Technical Assistance on Stalled EIS's - Gerri Ayers
- Planning and Environmental Linkages - Roger Safford and Margaret Barondess
- Legal Sufficiency Enhancements - Gerri Ayers
- Clarifying scope of Preliminary Design - Mark Chaput
- Flexibility in ROW - Matt Delong
- Flexibility in Utility Relocation - Matt Delong
- Construction Manager General Contractor (CMGC) - Mark Van Port Fleet
- Warm Mix Asphalt - Curtis Bleech
- Safety Edge - Curtis Bleech
- Accelerated Bridge Technology - Brenda O'Brien
- Geosynthetic Reinforced Soil - Dick Endres
- Adaptive Signal Control/ACS Lite - Paul Corlett

### Michigan's STIC
### List of Members

The MI-STIC's membership shall reflect the diversity of the highway industry in the state by representing a balanced cross-section, including entities from various geographic locations and agencies of varying size. At a minimum, membership represents the following:

MDOT - Michigan Department of Transportation

FHWA - Federal Highway Administration

LTAP/TTAP - Local and Tribal Technical Assistance Program

NACE

CRAM - County Road Association of Michigan

MPOs - Several Metropolitan Planning Organizations are participating stakeholders.

MITA - Michigan Infrastructure and Transportation Association

ACEC of MI - America Council of Engineering Companies of Michigan

APWA of MI - American Public Works Association, Michigan Chapter

U.S. Department of Transportation
Federal Highway Administration

MDOT
Michigan Department of Transportation

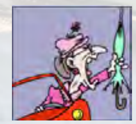
Michigan Department of Transportation
Bridge Slide Showcase

US-131 over 3 Mile Road, Reed City
&
M-50 over I-96, Lowell Michigan

Gregory Johnson
MDOT Chief Operations Officer

# Why ABC? Why Now?

- FHWA Leadership – Every Day Counts (EDC)
- Michigan's Continuing Efforts to Innovate
  - Better, Smarter, Cheaper, Safer, Faster
- We're in the TRANSPORTATION BUSINESS
- Mobility
  - Mobility
    - Mobility

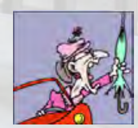



# Every Day Counts (EDC)

- Goal: **25% of bridges constructed/reconstructed with Federal Aid to incorporate at least one Accelerated Bridge Construction (ABC) or major precast component.**
- Michigan achieved this goal in 2013. We currently use ABC on over 50% of our bridges each year.

## Why Accelerated Bridge Construction ?
## MDOT Mobility Policy

- Traffic volume capacity ratio less than .80
- Level of service shall not be D or less or drop from A to C.
- Work zone travel delay less than 10 minutes.



# MDOT ABC Policy


# Why Innovate?

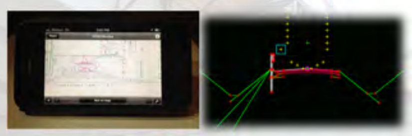
- The world is changing very fast. Government is expected to change also.
- Transportation is integrally linked to the economy and our quality of life.
  - Mobility, Mobility, Mobility!

Necessity Is the mother of invention

If you always do what you always did, you will always get what you always got. [Albert Einstein]

# MDOT Successful Innovations

- **E-Construction**
  - 3D Modeling allows contractors to use GPS for machine grading
  - E-Sign technology eliminates 7.4 million sheets of paper and could save $4 million a year
- **Carbon Fiber**
  - M-102 over Plum Creek in Detroit is MDOT's first use of CFRP pre-stressing strands
- **Accelerated Bridge Construction**
  - Prefabricated Bridge Elements (PBES)
  - Bridge Slide-In Technology



# MDOT is in the Transportation Business!

- **Mobility assessment, ABC and bridge slides are part of our business practice, and must now be part of our culture when thinking about how our projects impact the public, the economy, and ultimately how we facilitate transportation in Michigan.**


Thank You
Enjoy the Showcase!
MDOT
Better.Faster.Cheaper.Safer.Smarter
Customer Service is Important
Please take our customer survey:
www.michigan.gov/mdotsurvey
How is MDOT doing?
Customer Satisfaction Survey

# NATIONAL ABC UPDATES

MDOT

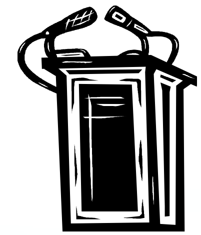
MICHIGAN DEPARTMENT OF TRANSPORTATION

AUGUST 14, 2014
BENJAMIN BEERMAN, PE

U.S. Department of Transportation
Federal Highway Administration

## OVERVIEW

- Lateral Slide Deployment Efforts (2 years)
- AASHTO SCOBS
- TRB
- ABC-UTC Center
- EDC

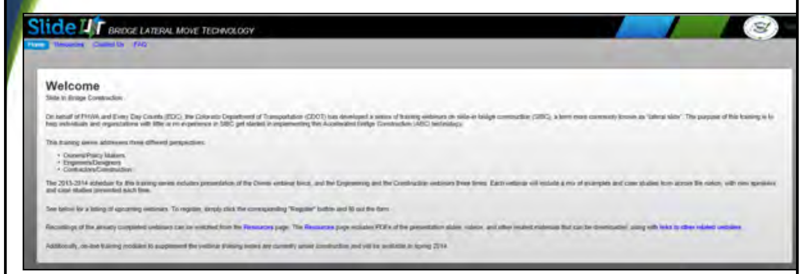


## WHAT IS SIBC?

- A method of accelerated bridge construction also known as lateral sliding or skidding.
- New bridge (normally) built parallel to existing bridge on temporary supports.
- Once the new bridge is constructed, the old bridge is demolished, and the new substructure constructed, the new bridge is slid into place. In some instances, the old substructure is reused.
- Typically moved laterally using hydraulics or a winch. Some minor vertical jacking is typically needed.

## SIBC ACTIVITIES & PRODUCTS

http://www.fhwa.dot.gov/construction/sibc/

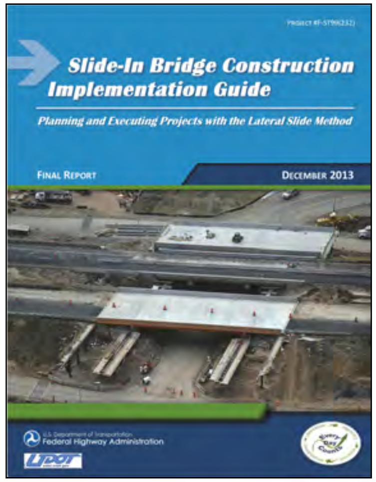



IOWA STATE UNIVERSITY

## SIBC ACTIVITIES & PRODUCTS –CONT.

**Implementation Guide**

- Owner Considerations
- Design Considerations
- Construction Considerations
- Sample Details
- Sample Specifications




udot.utah.gov

## SIBC ACTIVITIES & PRODUCTS - CONT.

**Webinars**

- Owner (1)
- Engineering (2)
- Construction (1)

**Next Webinar**

- TBD

Colorado DOT Department of Transportation

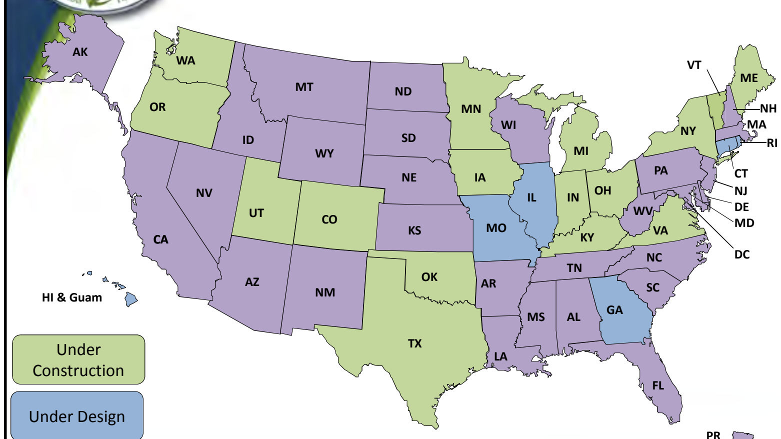
Register @ [www.slideinbridgeconstruction.com](www.slideinbridgeconstruction.com)

## SIBC ACTIVITIES & PRODUCTS - CONT.

- **Technical Service Support Center**
  - Justin Dahlberg
- **Half day training workshops**
  - Email [romeo.garcia@dot.gov](mailto:romeo.garcia@dot.gov)

Iowa State University

## NATIONAL GOAL STATUS: SIBC BRIDGES DURING EDC 2




As of March 20, 2014

1) Extend Bridge Service Life
2) Assess Bridge Condition
3) Maintain and Enhance a Knowledgeable Workforce
4) Maintain and Enhance the AASHTO Specifications
**5) Accelerate Bridge Delivery and Construction**
6) Optimize Structural Systems
7) Model and Manage Information Intelligently
8) Contribute to National Policy

## Develop, Further Develop, Initiate…

1 identify technical and cultural barriers, both real and perceived
2 ***database*** *to track accelerated bridge*
3 implement and further develop ***rapidly assembled connection details and joints***
4 develop ***prefabricated seismically resistant systems***, including substructures
5 develop ***more efficient modular sections***
6 ***develop maintenance needs***, accessibility, repairability, and inspection criteria
7 identify ***transportation and erection issues***
8 implement and further develop ***innovative construction methods,*** including total bridge movement systems, such as Self Propelled Modular Transporter (SPMT), launching, etc.
9 implement and further develop ***cost analysis*** and ***risk assessment***
10 develop ***quality assurance measures for accelerated techniques*** for superstructure and substructure construction
11 implement ***advanced materials and continue materials research***, e.g., ***high performance materials, materials durability, lightweight concrete*** to provide lower self-weight for larger components, etc.
12 implement and further develop design considerations for hardening of existing structures and rapid recovery after disasters (natural and manmade)
13 implement and further develop ***contracting strategies*** that encourage speed and quality
14 disseminate information on available technologies including development of ***decision-making tools*** and successful accelerated bridge construction projects to both decision-makers and designers
15 identify methods to accelerate construction of ***bridge foundations and earthwork***, demonstrated sources of construction delays

NCHRP NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

- **12-98**: Guidelines for PBES Tolerances and Dynamic Effects of Bridge Moves
- **12-102**: Development of an ABC Design and Construction Specification
- **12-105**: System Performance of ABC Connection in Moderate-to-High Seismic Regions

## Formation of ABC Subcommittee

***AFF10 General Structures – parent committee***
***AFF10(3) – Subcommittee for ABC***

***Chair: Ben Beerman, FHWA***
***Vice Chair: Mary Lou Ralls***

https://sites.google.com/site/trbaff103

TRB TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

- Welcome
- Registration
- Members
- News/Events 2014
- ABC Research Projects
  - Project Tracker
- Annual Meetings
  - 2014
- Comments

**TRB**
**Committee on General Structures (AFF10)**
**Subcommittee on Accelerated Bridge Construction (AFF10-3)**

*Approximately one-fourth of the Nation's 600,000 bridges require rehabilitation, repair, or total replacement. The construction-related work used to address these needs can have significant impact to the surrounding area including mobility, safety, and other social-economic related impacts. Throughout the U.S., owner agencies are realizing that the results of using ABC strategies not only help address onsite related constraints, but can also improve how a bridge program is delivered when used in a more routine, programmatic manner.*

**Scope:** The TRB Accelerated Bridge Construction (ABC) Subcommittee supports research, technology transfer, and implementation to advance ABC technologies related to policy, planning, procurement, design, materials, construction and contracting. The ***objective*** of the subcommittee is to expand the knowledge and expertise to foster the implementation of ABC related technologies.

TRB TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

- **ABC – Precast Alternate for Slab Spans** NEW
  *Clemson University*
- **Inverted T pier caps** NEW
  *U. of Texas/Austin*
- **Full Closure Strategic Analysis** NEW
  *CODOT*
- **Decks** NEW
  NUDECK (*NB*), Composites (*FL*), Transverse Joint (*NH*)

TRB TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

**2015 Annual Meeting** Jan 12-16, 2015

- PBElement Workshop
- ABC Paper Session
- Subcommittee Meeting

**Sign up as a Subcommittee Friend!!!**

# Monthly Webinars - FIU

FIU Accelerated Bridge Construction (ABC) Center
FLORIDA INTERNATIONAL UNIVERSITY

**Thursday, August 21, 2014 - 1:00 to 2:00 p.m. EST**

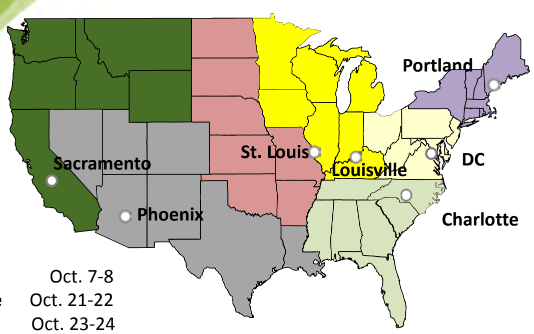
**Semi-Integral Abutments using UHPC**

**Wahid Albert, P.E.**
**Director of Structures NYSDOT**

**www.abc.fiu.edu**

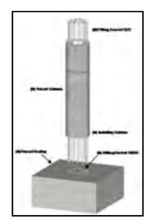
[www.abc-utc.fiu.edu](http://www.abc-utc.fiu.edu)


- ABC Project dBASE
- ABC short to medium spans
- SDL/CLL for Seismic Regions
- Cost Estimating for ABC
- Enhanced Service Life
- Rapid Rehab Synthesis
- Grouted Couplers
- Couplers in Seismic Regions
- Piers w/ Pocket Connections and PT/UHPC columns




| | | |
|---|---|---|
| 1 | DC | Oct. 7-8 |
| 2 | Louisville | Oct. 21-22 |
| 3 | St. Louis | Oct. 23-24 |
| 4 | Phoenix | Oct. 27-28 |
| 5 | Sacramento | Oct. 29-30 |
| 7 | Portland | Nov. 13-14 |
| 8 | Charlotte | Dec. 9-10 |

- Alaska
- Hawaii/Guam
- Puerto Rico/US VI



| Category and Initiative | New |
|---|---|
| **Shortening Project Delivery** | |
| Regional Models of Cooperation | ☑ |
| Locally Administered Federal-Aid Projects - Stakeholder Partnering | |
| 3D Engineered Models: Cost, Schedule, and Post-Construction | |
| Improving DOT and Railroad Coordination (SHRP2 R16) | ☑ |
| Accelerated Bridge Construction; Geosynthetic Reinforced Soil – Integrated Bridge System | |
| e-Construction: Electronic Project Document Management Systems | ☑ |
| **Mobility** | |
| Smart Work Zones | ☑ |
| **Safety** | |
| Data-Driven Safety Analysis | ☑ |
| Road Diets (Roadway Reconfiguration) | ☑ |
| **Quality** | |
| UHPC for Pre-Fabricated Bridge Elements | ☑ |
| **Environment** | |
| e-NEPA and Implementing Quality Environmental Documentation | ☑ |


Every Day Counts
innovation
ingenuity
imagination
invention

# MDOT

# Slide-In Bridge Construction

Matt Chynoweth, PE – Bridge Field Services
Charlie Stein, PE – Innovative Contracting Unit
Tom Tellier, PE – Grand Rapids TSC, Construction Engineer
Kevin McReynolds, PE – Grand Rapids TSC, Construction Engineer

## MDOT ABC Policy

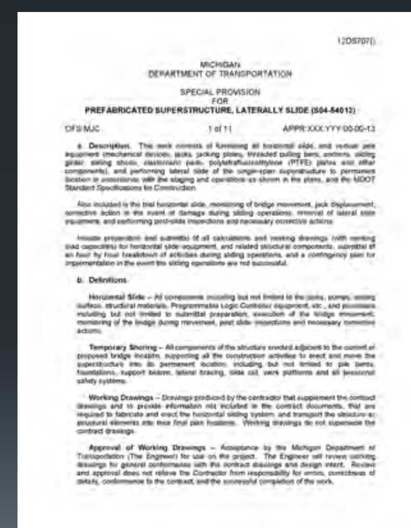
- Progress at MDOT:
  - **Committee established with members from MDOT, Consultant, and Industry staff**
  - **Goals over the Next Few Years:**
    - Move this Technology Forward from demonstration to standardized deployment
    - Gain additional experience
    - Develop a Program Approach
    - Develop Selection Criteria and a Decision Making Framework
    - Develop methods for Performance Measurement
  - Developed process as part of our Annual Call for Projects

## MDOT ABC Policy

- Section 7.01.19 of the MDOT Bridge Design Manual covers ABC and PBES considerations
- This section will be further updated as means and methods are further evaluated

## MDOT ABC Policy

- Special provision for Prefabricated Superstructure, Laterally Slide



## MDOT ABC Policy

- Prefabricated Superstructure, Laterally Slide SP requirements:
  - Working drawings, calculations and submittals
  - Move Operations Manual
  - Geometry Control and Monitoring Plan
  - Contingency Plan
  - Trial Horizontal Slide
  - Movement of Superstructure requirements
  - Allowable Tolerances
- Also working on SPMT special provision for potential applications in 2015

## MDOT ABC Policy

- Currently working on updates to MDOT Project Scoping Manual and Mobility Manual for evaluation of ABC/PBES techniques with respect to:
  - Site and Structure considerations
  - Work zone Safety and Mobility
  - Cost
  - Technical Feasibility
  - Seasonal Constraints and Project Schedule
  - Environmental Issues

## M-50 (Alden Nash Highway) over I-96, Kent County

I-96: 2012 ADT – 44,600; Commercial – 11.0%
M-50: 2012 ADT – 11,100; Commercial – 6.0%

**Scope**: Full Structure Replacement and Widening, minor ramp improvements and widening
- Existing structure – 4 span, 227'-0" long, 30'-0" clear width (37' 5" out to out)
- New structure – 2 span, 198'-0" long, 68'-0" clear width (71'3" out to out)

**Procurement Method:** Construction Manager / General Contractor (CMGC)

**Prime Contractor**: Anlaan Corporation

**Designers:** MDOT Bridge Design and Parsons Transportation Group

**Significant Traffic Impacts:** Two Weekend Shutdowns of M-50, Single Lane Closures on I-96

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**Significant Traffic Impacts:** Two Weekend Shutdowns of M-50, Single Lane Closures on I-96

## US-131NB & SB over 3 Mile Road, Mecosta County

US-131: 2014 ADT – 20,400; Commercial – 9%
3 Mile Road - low ADT local route

**Scope:** Superstructure Replacement and Widening for NB & SB US-131 Structures & 3 Mile Road improvements

- Existing structures – 1 span, 86'-0" long, 42'-0'" clear width (45'-10 1/2" out to out)
- New structure – 1 span, 86'-0" long, 53'-8'" clear width (56'-11" out to out)

**Procurement Method:** Construction Manager / General Contractor (CMGC)

**Prime Contractor**: C.A. Hull

**Designers:** MDOT Bridge Design and Parsons Transportation Group

**Significant Traffic Impacts:** Five Day Detour for NB and SB US-131

## Why use CMGC?

- CMGC - recommended to use when:
  - High levels of project risk needs to be mitigated
  - Traditional means and methods may not apply
  - Have challenging schedules
  - Projects that are technically complex
  - A high level of construction staging/phasing may be appropriate
  - Input is needed on constructability, means & methods, and non-standard costs
  - Significant Public Involvement

## CMGC: Project Benefits and Challenges

**Benefits**

- Promotes Ingenuity
- Integrated Design Process
- Risk Mitigation
- Improved Constructability

**Challenges**

- New Time Frames and Needs
- Determination of Cost
- New Contracting Procedures for MDOT, Design and Construction Industries

## M-50 over I-96

**Schedule:**
March 7, 2013 – Posted Request for Qualifications (RFQ)
April 8, 2013 – Qualifications Submitted
Fall 2012 – December 2013 – Design
January 2014 –Price Negotiations
**March 12, 2014 – Contract Award**
**March 17, 2014 – Begin Work**
August 1-3, 2014 – Bridge Demo
Late September – Expected Slide

## M-50 over I-96: Construction Staging and Detour

I-96

- Typical Shoulder Closures and minor shifts
- Weekend Shutdowns (Friday 9:00pm to Monday 5:00am)
  - During Bridge Demolition
  - During Bridge Slide

M-50

- Typical Shoulder Closures and minor shifts
- Detours in place during Demo & Slide
  - Right Turns from I-96 are allowed
- After Demo– traffic is shifted onto the new superstructure (temp location)

## M-50 over I-96

Why Slide?

- Maintain access at major interchange
- Maintain access to businesses and neighboring communities
- Use of cross-overs would have had large environmental impacts
- Long Detour routes would have had social impacts to local communities
- Car Pool Lot implications

## M-50 over I-96

**Next Steps**

## US-131over 3 Mile Road

**Schedule:**

February 28, 2013 – Posted RFQ
March 28, 2013 – Qualifications Due
Fall 2012 – December 2013 - Design
January 2014 –Price Negotiations
March 27, 2014 – Contract Award
April 23, 2014 – Begin Work
August 3, 2014 – Bridge Deck Pour
August 10 – NB Bridge Slide
September – SB Bridge Slide

## US-131: Construction Staging & Detour

**US-131:**

- Minimal impacts – miscellaneous shoulder closures
- Contract allows for 5 Day Detour
  - NB Restriction – no closures 12:00pm Friday to 11:59pm Friday
  - SB Restriction – no closures 12:00pm Sunday to 11:59pm Sunday

**US-131 NB & SB Detour Route**

- Jefferson Road, Old US-131 (Northland Drive), 8 Mile Road
  - Approximately 10 Miles

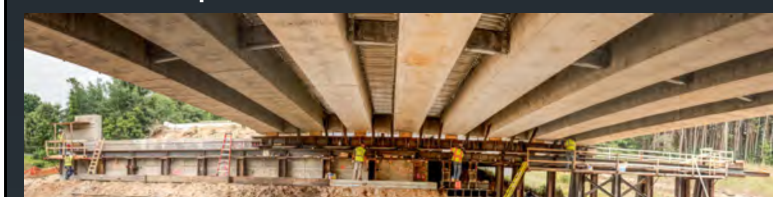
## US-131 over 3 Mile Road

Why Slide?

- Maintain access to heavily travelled north/south freeway
- Very large weekend volumes
- Past experience with long delays when reduced to one lane
- Use of cross-overs would have had large environmental impacts
- Long Detour routes would have had social impacts to local communities

## US-131 over 3 Mile Road

**Next Steps**



PARSONS

# Grand Region Slide-In Bridges

*Bruce L. Campbell, PE – Senior Project Manager*

## Lateral Slide Considerations

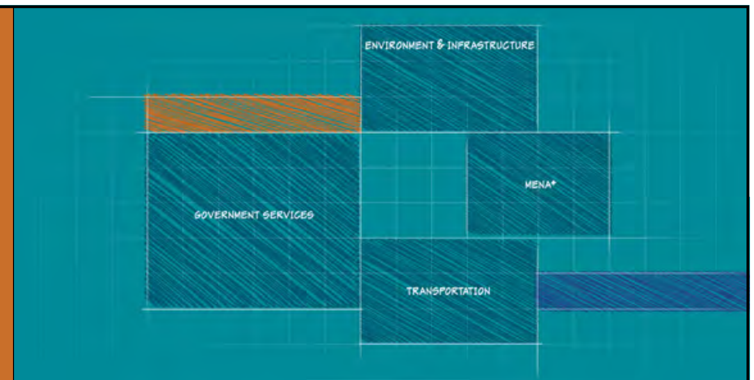
- Scope of Bridge Work
  - Superstructure Repl.
  - Bridge Replacement
- Duration of Closure Allowed
- Approach Pavement
- Method of Slide
  - Push versus pull
  - Vertical jacking
  - Temporary support location
    - *Eccentric*
    - *In-line*
- Temporary Support
  - Proximity to existing structure

PARSONS

## Slide-In Design Issues

- Support Points
  - Uniform and consistent support to all girders
  - Local effects on temporary supports
- Horizontal Jacking Control
  - Displacement monitoring program
- Interface
  - Interface between temporary and permanent substructure to ensure smooth and level travel path
  - Temporary/permanent foundation interactions
- Resolving Forces
  - Design a tie between the temporary and permanent substructure elements
  - Design the temporary and permanent substructure elements as separate elements
  - Resolution internal to jack/slide system
- Approach Slab Details
  - Coordinate with maintaining traffic

PARSONS

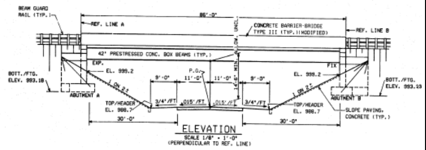



## US-131 over 3 Mile Road, Mecosta Co.

PARSONS

## US-131 over 3 Mile Road, Mecosta County

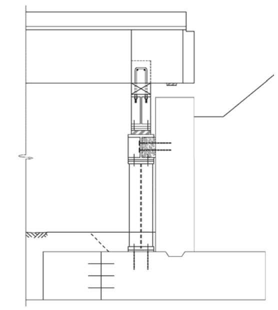
- NB & SB Pair of bridges
- Existing Bridge
  - 1 span (86’)
  - 2 lanes + shoulder
- Scope of Work
  - Corridor crush & shape
  - Superstructure replacement
- Design Issue
  - MOT for NB/SB summer tourism traffic
  - 3 Mi. low volume road
- Solution:
  - Lateral Bridge Slide






## Solutions: US-131/3 Mile Road

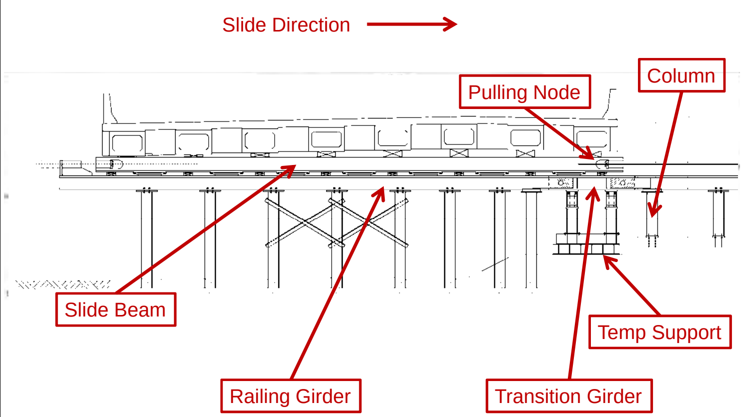
- Scope of Bridge Work
  - Superstructure Replacement – no abutment modification
  - Extend abutment footing
- Duration of Closure Allowed
  - 5 days – US-131
  - 3 Mi. Rd. full duration
- Approach Pavement
  - Temporary asphalt/concrete
  - Integral backwall
- Method of Slide
  - Pull – short length (64.75’)
  - Vertical jacking required
  - Temporary support location
    - *Eccentric footing load*
  - PTFE/Stainless bearing slide interface
  - Internally resolved jacking forces



SECTION THRU DEPENDENT BACKWALL



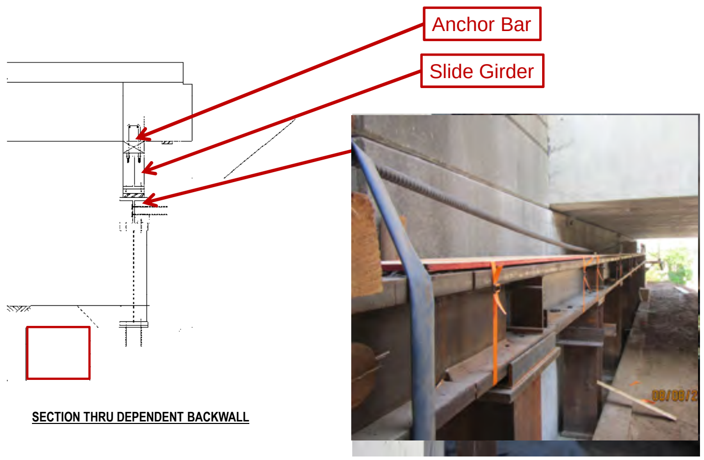
## Design Details




Superstructure Weight: 1.6 million lbs

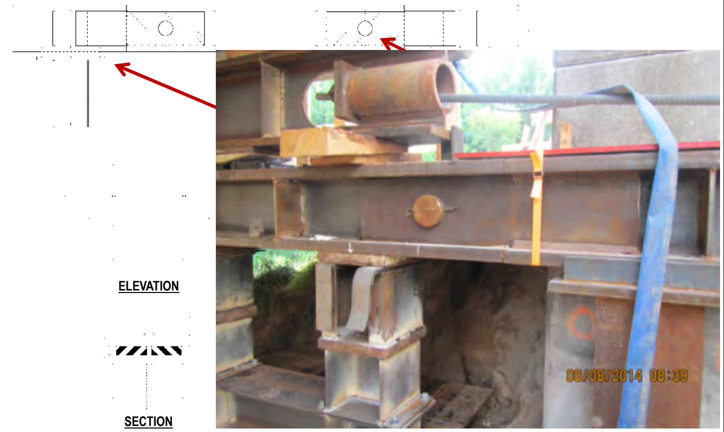


## Design Details




PARSONS

## Transition Girder

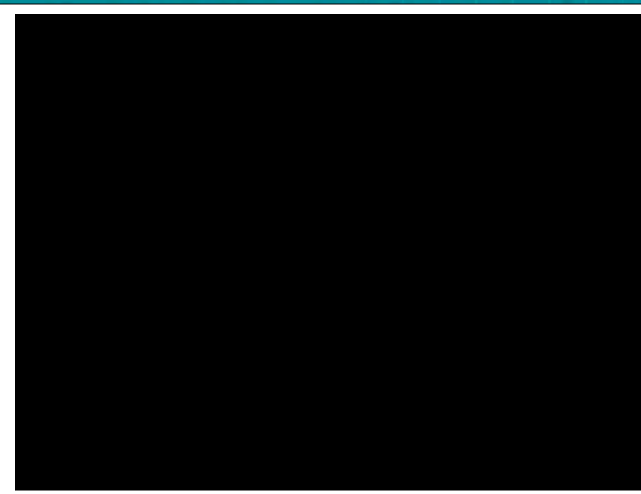



PARSONS

## Temporary Support

PARSONS

## Bearings



PARSONS

## Bearings



## Longitudinal Drift



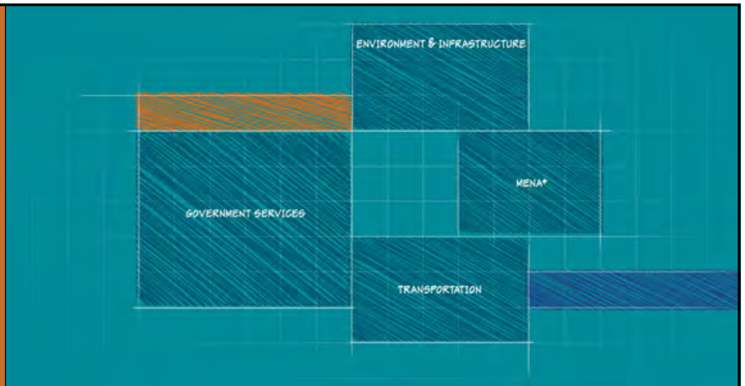

## Costs and Benefits

- Costs
  - Temporary support
    - *Pile abutment (144,000 lb steel & 692 ft piles each bridge)*
    - *Distance from existing bridge*
  - Jacking Cost
    - *Horizontal*
    - *Vertical*
    - *PTFE/Elastomeric Bearings*
    - *Construction Engineering*
- Benefits – Reduced user delay costs
  - US-131 – part-width construction = $2.5 million in user delay costs
  - US-131 w/ lateral slide = $267K
  - Lateral slide cost < $1.58 million (both bridges)



## Lessons Learned

- Careful consideration of field and mill tolerances
- Complexity of steel erection (getting the pieces to fit)
- Proximity of temporary support to existing foundation
- Consideration of all loads at each stage of construction and throughout the move
- Method to account for longitudinal drift
- Bearing size and restraint




# M-50 over I-96, Lowell

PARSONS

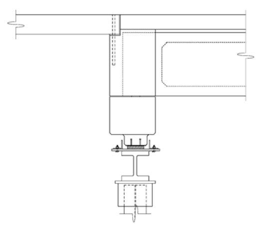
## M-50 over I-96, Lowell, MI

- Scope of Work
  - Interchange reconstruction
  - Bridge replacement
- Existing Bridge
  - 4 span (227')
  - 2 lanes + shoulder
- Design Issues
  - Widen bridge and raise grade
  - MOT for Lowell – long detours
  - I-96 impact: MSU football games
- Solution:
  - Lateral Bridge Slide w/ traffic

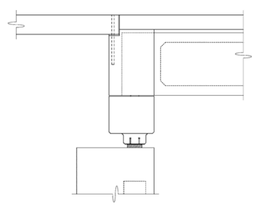

PARSONS

## Solutions: M-50/I-96

- Scope of Bridge Work
  - Bridge Replacement
- Duration of Closure Allowed
  - M-50 - 5 days total for project
  - M-50 - No duration longer than weekend
  - Temporary run-around
- Approach Pavement
  - Concrete
  - Independent backwall w/ closure pour
- Method of Slide
  - Push – long length
  - Vertical jacking not required
  - Temporary support location
    - *In-line*
  - External support for lateral forces



SECTION @ TEMP ABUTMENT

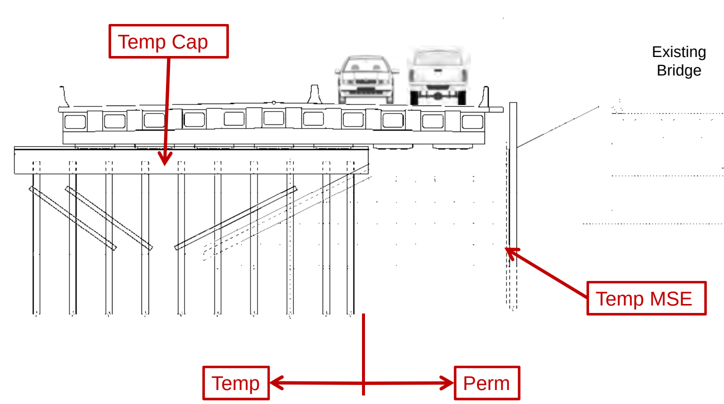


SECTION @ PROPOSED WINGWALL

PARSONS

## Temporary Abutment

Superstructure Weight: 4.3 million lbs



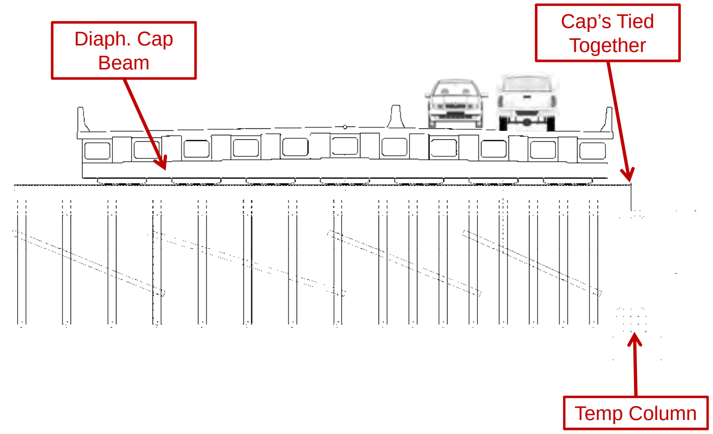

TEMPORARY AND PROPOSED ABUTMENT ELEVATION

PARSONS

## Design Details


PARSONS

## Temporary Pier



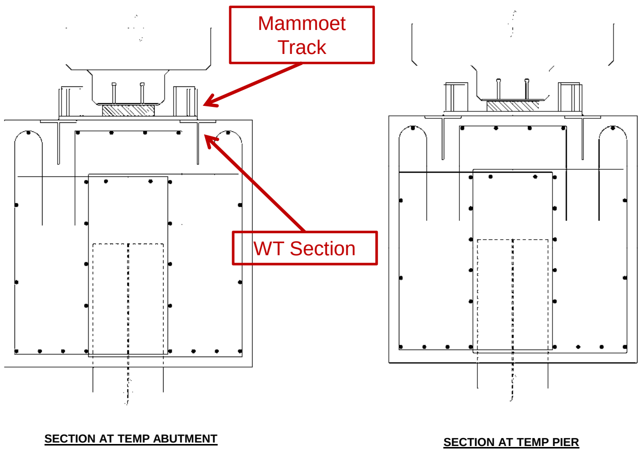

PARSONS

PARSONS

## Design Details


PARSONS

## Temporary Caps



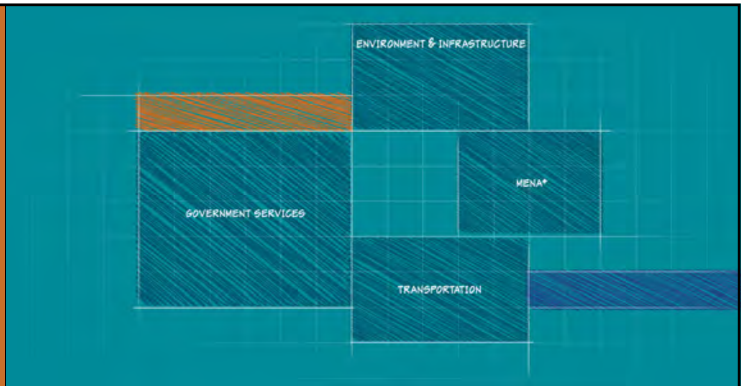

## Design Details


## Costs and Benefits

- Costs
  - Temporary support abutment/pier
    - *Traffic load > size*
    - *Distance from existing bridge*
    - *Concrete temporary cap < steel*
  - Temporary runaround roadway & approach
  - Jacking
    - *Horizontal*
    - *PTFE/Elastomeric Bearings*
    - *Jacking Track*
    - *Construction Engineering*
- Benefits – Reduced user delay costs
  - M-50 – 135 day of closure = $3 million in user costs
  - M-50 – 4 days of closure = $536K
  - Lateral slide cost = $X,YYY,ZZZ

## Lessons Learned

- Utilize portions of new structure for temp support
- Temporary erosion control
- Impact of live loads
- Concrete cap vs. Steel
- Staging of loads
- Excavation staging




## Questions

PARSONS

# US-131 over 3 Mile Rd

MDOT # 54013-118289

Contractor Perspective

## Project Overview

## Project Overview

- Superstructure Replacement Utilizing Lateral Slide (ABC)
- Temporary NB & SB Structures Built Outside of Existing
- Temporary Structure Supported on Driven Pile, Railing & Sliding Girders
- Full Detour of US-131 for 5 Calendar Days During Lateral Slides

## Contracting Method

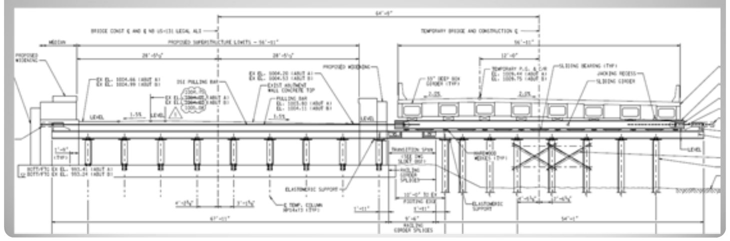
- CMGC
- Onboard During Design/Constructability Phase
- Negotiated And Agreed Upon Construction Cost
  - Guaranteed Maximum Price (Slide & Structure Related)
  - Adjustable Items (HMA, Driven Pile, etc.)
  - Contingency Allowance If Required

# Observations

- Project Coordination
  - Rieth-Riley Crush & Shape Project
  - Simplify utilizing same subcontractors if possible
- Staging
  - Full closure of 3 Mile was critical and necessary
  - Limited lane closures on US-131 were required
- Schedule
  - Ensure enough preconstruction time is accounted for
  - Slide window of 5 calendar days seems adequate

# Construction Details (Slide)

- Temporary Structure Plan
  - Pile supported (14x73)
  - Tight tolerances (1/4”)
  - Transition span difficulties



# Construction Details (Slide)

# Challenges Encountered

- Delays
  - Late Frost Laws
  - Survey Alignment
  - Temporary Structure Capacity (Temp Supports Needed)
- Constructability
  - One Slide Bearing Landed On Transition Span
  - Transition Span
- Slide
  - Structure Slide North During Slide (Jacking & Shimming Required)
  - PTFE Pads Wanted to Climb During Loading

## Challenges Encountered

## Challenges Encountered

## Challenges Encountered

## Lessons Learned

- Slide Bearings Should All Lay on Same Beam
- Install a Track or Guide to Keep Structure Aligned During Slide
- Order a Continuous or Longer PTFE Pads
- Taller Pad Keepers To Prevent Pad Climbing
- Longer Stroke For Jacks Will Speed Up Slide

## Lessons Learned

# M-50 over I-96
# Lateral Bridge Slide

**Contractors:** Anlaan Corporation
Mammoet USA Inc.

**Owner:** Michigan Dept. of Transportation

## Anlaan Corporation

- Bridge Construction & Rehabilitation Contractor
- Based in West Michigan
- Currently working in Michigan, Indiana & North Carolina


## Market segments

- Petrochemical
- power (fossil, nuclear, renewables)
- mining & metals
- offshore
- civil (construction, infrastructure, shipbuilding)
- salvage

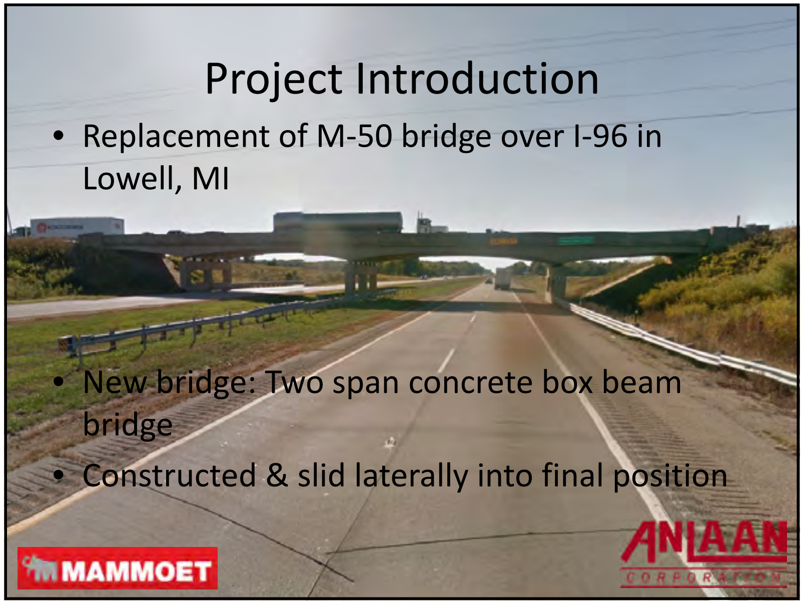
**Largest state-of-the art fleet of equipment**

- built/maintained for reliability and safety
- continuous improvement and innovations

> 1,600 cranes, 5 – 3,600 ton
> 3,000 axle lines of SPMT
> 2,000 axle lines of trailer
> 150,000 ton capacity of jacking and skidding equipment

## Project Introduction

- Replacement of M-50 bridge over I-96 in Lowell, MI
- New bridge: Two span concrete box beam bridge
- Constructed & slid laterally into final position



MAMMOET

ANLAAN CORPORATION

## Contracting Method

- CMGC – Construction Manager/General Contractor
- Contact Amount:
  - CMGC Contract: $58,000
  - Construction Contract Total: $7,962,000
    - Bridge Construction: $2,000,000
    - Roadway/Ramp Construction: $4,000,000
    - Temporary Structure & Slide Cost: $2,000,000

MAMMOET

ANLAAN CORPORATION

## Schedule / Milestone Dates

- Award date: 3/12/2014
- Project start date: 3/17/2014
- Demolish existing bridge: 8/1/2014
- Traffic shifted to temp. alignment: 8/4/2014
- Expected Slide Weekend: 10/17/2014
- Final Completion: 11/21/2014

MAMMOET

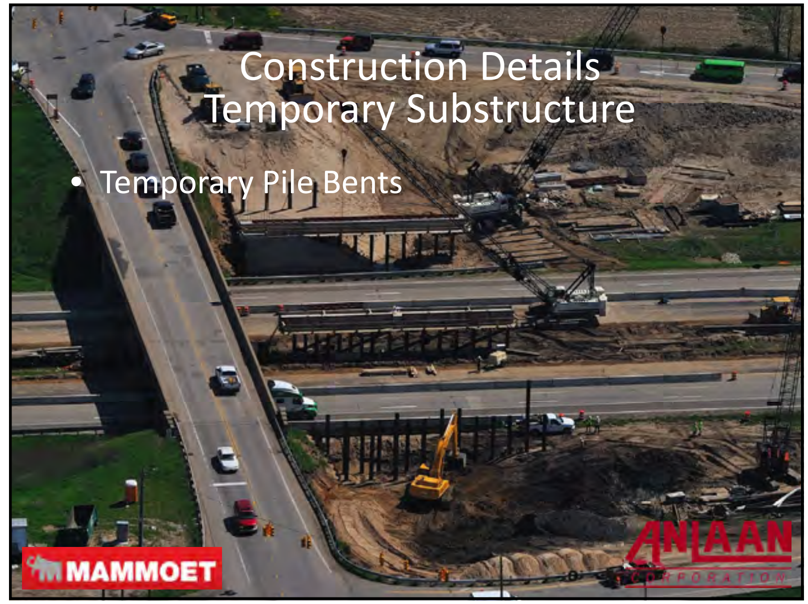
ANLAAN CORPORATION

## Staging

MAMMOET

ANLAAN CORPORATION


Staging
MAMMOET
ANLAAN


Construction Details
Temporary Substructure
• Temporary Pile Bents
MAMMOET
ANLAAN
CORPORATION


Construction Details
Temporary Substructure
MAMMOET
ANLAAN


Construction Details
Temporary Substructure
MAMMOET
ANLAAN
CORPORATION

## Construction Details
## Superstructure

- Skid Tracks

## Construction Details
## Superstructure

- Precast sliding diaphragms with stainless steel shoes

## Construction Details
## Superstructure

# Construction Details
## Superstructure

MAMMOET

ANLAAN CORPORATION

# Construction Details
## Bridge Slide

Bridge weight – 4.5 million lbs

Lateral Slide Distance – 80 ft

Schedule –

Friday Night - Close I-96 & M50 – Test Slide 8 ft
Saturday – Open I-96 for daytime traffic
Saturday Night to Monday 5 AM – Close I-96 & M50
Perform slide and construct temporary HMA approaches.

MAMMOET

ANLAAN CORPORATION

# Construction Details
## Bridge Slide

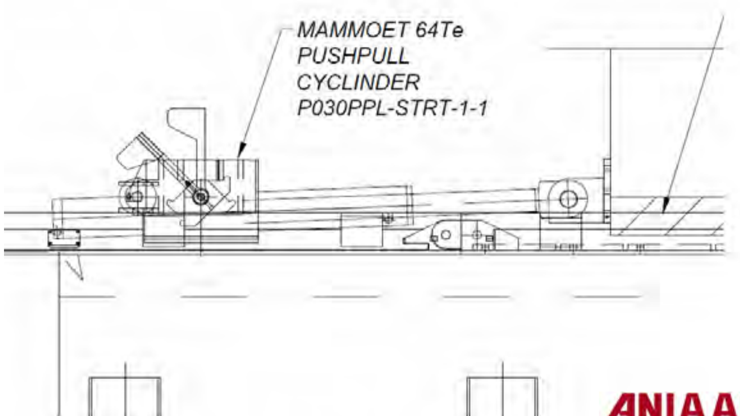
Mammoet Details

- Providing skid track for bridge to slide upon.
- Hydraulic Push/Pull system to move bridge laterally.
- Provide PPU and hoses to hook up push/pull system.
- Adding push brackets onto bridge to allow system to be hooked up.
- Can push 30’ an hour.

MAMMOET

ANLAAN CORPORATION

## Mammoet Skidding Details




MAMMOET

ANLAAN CORPORATION

## Construction Details Bridge Slide

## Mammoet Skidding Details

## Challenges & Lessons Learned

- Substructure tolerances
- Ensuring tracks are parallel to each other
- Lead time for submittals
- Ability to have a pull point on other side of bridge if necessary.

# APPENDIX C

# PARTICIPANTS

Bridge Slide Show. .e-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Kay | Adefeso | MDOT - Metro Region Bridge Engineer | Kay Adefeso | |
| | Oladayo | Akinvemi | MDOT - Metro Region Detroit (SE Michigan) TSC Manager | | |
| | Haluk | Aktan | Western Michigan University | Haluk Aktan | |
| | Bener | Amado | FHWA Invitational Traveler - SCDOT | Bener Amado | |
| | Derrick | Arens | Anlaan | [illegible] | |
| | Natina | Ariss | Ohio DOT | Natina Ariss | |
| | Panchy | Arumugasaamy | TranSystems Corporation of Michigan | Arumugasaamy | |
| | Upul | Attanayake | Western Michigan University | Attanayake | |
| | Sam | Awwa | IBI Group | | |
| | Nick | Baker | Anlaan | [illegible] | |
| | Tim | Barry | MDOT | Timothy Barry | |
| | Al | Bedford | OHM Advisors | [illegible] | |
| | Ben | Beerman | FHWA | [illegible] | |
| | Matt | Bellgowan | MDOT - Grand Region Operations & Construction Construction Engineer | | |
| | Jeff | Bigelow | HNTB Corporation | | |
| | Pam | Blazo | MDOT - Grand Region Grand Rapids TSC Traffic and Safety Engineer | Pam Blazo | |

2 of 13

Bridge Slide Show‑ ‑e-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Matt | Block | Grand Region Muskegon TSC Consultant Coordinator | [illegible] | |
| | Matt | Boben | Mammoet Inc | | |
| | Andrew | Bouvy | MDOT - OFS Structures Management Engineer | [illegible] | |
| | Jim | Bradley | Ohio DOT | [illegible] | |
| | Jon | Bruinsma | MDOT - Grand Region Region Development Bridge Program Engineer | [illegible] | |
| | Linda | Burchell | MDOT - Bay Region Davison TSC Manager | Linda Burchell | |
| | Cindy | Butler | Ohio DOT | Cindy Butler | |
| | Bob | Campbell | Parsons | [illegible] | |
| | Andrew | Cardinali | FHWA Invitational Traveler - CTDOT | [illegible] | |
| | Dennis | Charvat | Ohio DOT | [illegible] | |
| | MT | Chaudhry | FHWA - MI | MT Chaudhry | |
| | Matt | Chynoweth | MDOT - OFS Structure Management Engineer | [illegible] | |
| | Keith | Cooper | MDOT - Local Agency Programs | [illegible] | |
| | David | Cutler | FHWA Invitational Traveler - CTDOT | [illegible] | |

38, 13

Bridge Slide Show e-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Justin | Dahlberg | Iowa State University | | |
| | Cedric | Dargin | MDOT - Metro Region Construction Engineer | | |
| | Craig | Dashner | OHM Advisors | | |
| | Karl | Datema | MDOT - Grand Region Grand Rapids TSC Transportation Technican | | |
| | Jeremy | Day | FHWA Invitational Traveler - ALDOT | | |
| | Jim | DeLaFuente | Grand Region Grand Rapids TSC Assistant Delivery Engineer | | |
| | Gerard | Feuerstein | MDOT - Bridge Design | | |
| | Tom | Fox | MDOT - Grand Region Grand Rapids TSC Transportation Technican | | |
| | Paul | Froede | FHWA Invitational Traveler - ALDOT | | |
| | Hector | Garcia | FHWA - TX | | |
| | Jose | Garcia | MDOT - Bridge Design | | |
| | Chris | Gilbertson | LTAP | | |
| | Bethany | Goodrich | URS Corporation | | |
| | Mike | Gramza | Ohio DOT | | |
| | Vincent | Guadagni | Fishbeck, Thompson, Carr & Huber | | |
| | Don | Gunderman | MDOT - Grand Region Grand Rapids TSC Transportation Technican | | |

4 & 12

Bridge Slide Showcase-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Rachel | Gehrcke | MDOT | Rachel L Gehrcke | |

printed certificate 9-2-14
JK

Bridge Slide Show e-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Dawn | Gustafson | MDOT - Superior Region Construction Engineer | | |
| | Mahmoud | Hailat | FHWA Invitational Traveler - INDOT | [illegible] | |
| | Alan | Halbeisen | HH Engineering Ltd. | [illegible] | |
| | Mike | Halloran | MDOT - Southwest Region Bridge Engineer | [illegible] | |
| | Marilyn | Hansen | MDOT - University Region Bridge Engineer | | |
| | Lewis | Harden | FHWA - AL | [illegible] | |
| | Wayne | Harrall | Kent County Road Commission - Deputy Managing Director of Engineering | Wayne [illegible] | |
| | Mark | Harrison | MDOT - Local Agency Programs | Mark Harrison | |
| | Ruth | Hepfer | FHWA - MI | [illegible] | |
| | Judy | Hinkle | MDOT - Executive | PRESENT | |
| | Keith | Hoernschemeyer | FHWA - IN | [illegible] | |
| | Sarah | Hoffman | Grand Region Grand Rapids TSC Permits Engineer | | |
| | Jeremy | Hunter | FHWA Invitational Traveler - INDOT | | |

Bridge Slide Show e-Attendees
August 14, 2014

6 8 13

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Peter | Jansson | MDOT - OFS Traffic, Safety & Operations | [illegible] | |
| | Raja | Jildeh | MDOT - Bridge Design | Raja Jildeh | |
| | Greg | Johnson | MDOT - Executive | Greg Johnson | |
| | Russ | Jorgenson | FHWA - MI | [illegible] | |
| | Dave | Juntunen | MDOT - Executive | [illegible] | |
| | Albert | Kaltenthaler | TranSystems Corporation of Michigan | [illegible] | |
| | Dennis | Kent | MDOT - Grand Region Planning Transportation Planning | | |
| | Dav | Kessinger | FHWA Invitational Traveler - KYDOT | [illegible] | |
| | Sami | Khaldi | Wayne County | | |
| | Erick | Kind | MDOT - Grand Region Grand Rapids TSC Manager | [illegible] | |
| | Ray | Klucens | MDOT - Metro Region Detroit (SE Michigan) Project Manager ITS | | |
| | Melissa | Knauff | MDOT - Bridge Management | Melissa Knauff | |
| | Kyle | Kopper | MDOT - Bridge Design | [illegible] | |

Bridge Slide Show .e-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Dave | LaCross | MDOT - Design Land Surveyor | [illegible] | |
| | ~~David~~ | ~~LaCross~~ | ~~MDOT - Land Surveyor~~ | | |
| | Mark | Lewis | FHWA - MI | PRESENT | |
| | Tim | Little | MDOT - Grand Region Assoc Region Engineer - Operations & Construction | | |
| | Lizmert | Lopez | Western Michigan University | Lizmert Lopez | |
| | Duane | Maas | MDOT - Bay Region Construction Engineer | [illegible] | |
| | Ali | Mahdavi | MDOT - Bridge Design | [illegible] | |
| | Sara | Martin | MDOT - Photography Unit | [illegible] | |
| | George | Masinda | MDOT - Local Agency Programs | | |
| | Simon | Matar | Western Michigan University | | |
| | Aaron | Mattson | MDOT | [illegible] | |
| | Jay | Maufort | MDOT - North Region Construction Engineer | [illegible] | |
| | Tom | Mayan | Village of Merrill | [illegible] | |
| | Michael | McCool | Beam, Longest and Neff, L.L.C. | [illegible] | |
| | Kevin | McReynolds | MDOT - Grand Region Grand Rapids TSC Construction Engineer | [illegible] | |
| | Stuart | McTiver | MDOT - Superior Region Newberry TSC Design Engineer | [illegible] | |

8 of 16

Bridge Slide Show [illegible]e-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Paul | Miller | FHWA Invitational Traveler - TNDOT | Paul A Miller | |
| | Abdul | Mohammed | Western Michigan University | [illegible] | |
| | Janelle | Musch | URS Corporation | Janelle Musch | |
| | Doug | Needham | MITA | [illegible] | |
| | Brad | Noll | Ohio DOT | Bradley P Noll | |
| | Kimberly | Nowack | MDOT - Mackinac Bridge Authority | Kim Nowack | |
| | Chuck | Occhiuto | MDOT - Bridge Design | [illegible] | |
| | Andy | O'Connor | C. A. Hull | [illegible] | |
| | Michelle | ONeill | MDOT - Southwest Region Kalamazoo TSC Operations Engineer | | |
| | Kim | O'Rear | OHM Advisors | | |

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Bridge Slide Showcase-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Charles | Parmerlee | URS Corporation | Dan Brockhuizen | Dan Brockhuizen taking Doug's spot |
| | Greg | Perry | MDOT - University Region Construction Engineer | G. Perry | |
| | Michael | Phelps | Z-Contractors Inc | | |
| | Payton | Piggott | MDOT - Student/Bridge Load Rating | Payton Piggott | |
| | Chris | Pinnow ~~Pillow~~ | LTAP | [illegible] | |
| | Allison | Porrett | Grand Region Grand Rapids TSC Operations Staff Engineer | | |
| | Adam | Price | FHWA Invitational Traveler - TNDOT | Adam Price | |
| | Frank | Raha | MDOT - Michigan State Transportation Commission Advisor | PRESENT | |
| | Linda | Reed | MDOT - Bridge Management | Linda M Reed | |
| | Kathrean | Reincke | MDOT - Executive | Kathy Reincke | |
| | Mike | Roberts | MDOT - Grand Region Grand Rapids TSC Assistant Construction Engineer | Mike Roberts | |
| | Joel | Rossman | FHWA Invitational Traveler - NEDOT | Joel B. Rossman | |
| | Adam | Rychwalski | OHM Advisors | [illegible] | |
| | Doug | Sabin | Materials Testing Consultants | Doug Sabin | |
| | Roger | Safford | MDOT - Grand Region Engineer | Roger Safford | |
| | Timothy | Schnell | Western Michigan University | Timothy Schnell | |

10 8 13

Bridge Slide Showcase-Attendees
**August 14, 2014**

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Phil | Senn | Ohio DOT | | |
| | Thomas | Sereseroz | RS Engineering, LLC | | |
| | Paul | Sharp | FHWA - TN | | |
| | Rich | Stack | MDOT - Grand Region Development Bridge Operations Engineer | PRESENT | |
| | Andy | Stamm | MDOT - Southwest Region Construction Engineer | | |
| | Charlie | Stein | MDOT - Innovative Design/Contracting | | |
| | Mike | Stoltz | Grand Region Grand Rapids TSC Transportation Technican | | |
| | Jon | Stratz | MDOT | | |
| | Coreen | Strzalka | MDOT - Hydraulics Engineer | | |
| | Larry | Strzalka | MDOT - Specifications and Estimates | | |
| | Chris | Sullivan | IBI Group | | |
| | Bradley | Swanson | MDOT - North Region Soils Specialist (for Tony Olson) | | |
| | Mike | Szumigala | C. A. Hull | | |

11 8 1

Bridge Slide Show[illegible]se-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Julia | Tanner | MDOT - Bridge Development | Julia Tanner | |
| | Mike | Tarazi | URS Corporation | Michel Tarazi | |
| | Tom | Tellier | MDOT - Grand Region Grand Rapids TSC Construction Engineer | [illegible] | |
| | Radka | Todorova | MDOT - Plan Review Engineer | Radka [illegible] | |
| | Jennifer | Transue | MDOT - Plan Review Engineer | Jennifer Transue | |
| | Jeff | Triezenberg | MDOT - Design Program Support | [illegible] | |
| | Gregory | Turco | FHWA Invitational Traveler - TXDOT | [illegible] | |
| | Stacey | Valentine | MDOT - Student/Bridge Development | Stacey R Valentine | |
| | Mark | Van Port Fleet | MDOT - Executive | | |
| | Randy | VanPortFliet | MDOT - Executive | [illegible] | |
| | Nate | VanDrunen | MDOT - Grand Region Development Region Bridge Engineer | [illegible] | |
| | Bradley | Wagner | MDOT - Bridge Design | [illegible] | |
| | Mark | Walls | FHWA Invitational Traveler - KYDOT | [illegible] | |
| | Chris | Watson | Kokosing Construction | C Watson | |
| | Deb | Wedley | MDOT - Executive | Deb Wedley | |
| | Vicki | Weerstra | MDOT - Grand Region Development Associate Region Engineer-Development | | |

12 & 13

Bridge Slide Showcase-Attendees
August 14, 2014

| Attended | First Name | Last Name | Organization | Signatures | Comment |
|---|---|---|---|---|---|
| | Justin | Wiatrek | FHWA Invitational Traveler - TXDOT | Justin Wiatrek | |
| | Brad | Wieferich | MDOT - Executive | [illegible] | |
| | Tyler | Wolf | Beam, Longest and Neff, L.L.C. | [illegible] | |
| | Chris | Youngs | MDOT - Innovative Design/Contracting | [illegible] | |
| | Marji | Zabel | MDOT - Metro Region Detroit TSC Transportation Engineer | | |
| | Gregg | Zack | MDOT - Grand Region Muskegon TSC Construction Engineer | | |
| | Brian | Zakrzewski | MDOT - Bridge Management | [illegible] | |
| | Kyle | Zillig | FHWA Invitational Traveler - NEDOT | [illegible] | |
| | Vladimir | Zokvic | MDOT - Design Standards | Vladimir Zokvic | Have a Nice Day! |
| | Dave | Rusch | MDOT | | |
| | Larry | Tibbits | Consultant | [illegible] | |
| | Jason | Cole | MDOT | Jason E. Cole | |
| | Joe | Haveman | State Representative | Joe Haveman | |
| | Tonya | Schuitmaker | " " | | |
| | Rob | VerHeulen | " " | PRESENT | |
| | Roger | Victory | " " | | |

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Bridge Slide Showcase-Instructors
**August 14, 2014**

| Attended | First Name | Last Name | Organization | Signature | Comments |
|---|---|---|---|---|---|
| | Ken | Yonker | State Rep | Ken Yonker | |
| | Matt | Longfield | Alfred Benesh + Co. | Matt [illegible] | mlongfield@ |
| | Brian | Rochon | | B. Rochon | benesh.com |
| printed | Mark | Harbison | MDOT - CAP | Mark W. Harbison | |
| certificates | Mike | Phillips | MDOT - Bay Region | Mike Phillips | |
| 9-2-14 | Glenn | Bokoski | MITA | [illegible] | |
| | Matt | McClintick | MITA | M. McClintick | |
| | Chuck | Horning | Hanover Ins | Chuck Horning | |
| | Lisa | Lyons | State Rep | PRESENT | |
| | Brian | French | Ohio Dot | PRESENT | |

printed certificates 9-2-14

brian.french@dot.state.oh.us