Minnesota Demonstration Project: Rapid Replacement of the Maryland Ave. Bridge over I-35E in St. Paul

Final Report
March 2015

HIGHWAYS FOR LIFE
Accelerating Innovation for the American Driving Experience.

U.S.Department of Transportation
Federal Highway Administration

FOREWORD

The purpose of the Highways for LIFE (HfL) pilot program is to accelerate the use of innovations that improve highway safety and quality while reducing congestion caused by construction. **LIFE** is an acronym for **L**onger-lasting highway infrastructure using **I**nnovations to accomplish the **F**ast construction of **E**fficient and safe highways and bridges.

Specifically, HfL focuses on speeding up the widespread adoption of proven innovations in the highway community. Such "innovations" encompass technologies, materials, tools, equipment, procedures, specifications, methodologies, processes, and practices used to finance, design, or construct highways. HfL is based on the recognition that innovations are available that, if widely and rapidly implemented, would result in significant benefits to road users and highway agencies.

Although innovations themselves are important, HfL is as much about changing the highway community's culture from one that considers innovation something that only adds to the workload, delays projects, raises costs, or increases risk to one that sees it as an opportunity to provide better highway transportation service. HfL is also an effort to change the way highway community decisionmakers and participants perceive their jobs and the service they provide.

The HfL pilot program, described in Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) Section 1502, includes funding for demonstration construction projects. By providing incentives for projects, HfL promotes improvements in safety, construction-related congestion, and quality that can be achieved through the use of performance goals and innovations. This report documents one such HfL demonstration project.

Additional information on the HfL program is at www.fhwa.dot.gov/hfl.

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16. Abstract
As part of a national initiative sponsored by the Federal Highway Administration under the Highways for LIFE program, the Minnesota Department of Transportation (MnDOT) was awarded a $2 million grant to demonstrate the use of proven, innovative technologies for accelerated bridge removal and replacement. This report documents accelerated bridge construction (ABC) techniques used to remove and replace the Maryland Ave. bridge on County State Aid Highway 31 (CSAH 31) over Interstate 35E in St. Paul over a weekend.

This report includes construction details of the bridge superstructure built offsite on temporary abutments and prefabricated and cast-in-place bridge components and substructure built following removal of the existing bridge with minimal intereference to traffic flow on I-35E. It also discusses use of a self-propelled modular transporter (SPMT) to move the new bridge into place. Under conventional construction, the closure of Maryland Ave. was estimated at 4 months, but with the use of accelerated construction techniques, the closure of Maryland Ave. was reduced to 2 months. I-35E lane restrictions were also reduced from 12 days to 3 days.

Using an SPMT and other ABC techniques added approximately $0.8 million to the initial construction cost of the project. However, the project saved road users about $2.9 million, resulting in a net savings of $2.1 million. Because of the success of this project, MnDOT has decided to use ABC techniques more routinely on future projects as appropriate.

17. Key Words	18. Distribution Statement
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
(none)	mil	25.4	micrometers	µm
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 yards	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	millimeters	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 per square meter	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	Newtons	N
lbf/in^2 (psi)	poundforce per square inch	6.89	kiloPascals	kPa
k/in^2 (ksi)	kips per square inch	6.89	megaPascals	MPa
		DENSITY		
lb/ft^3 (pcf)	pounds per cubic foot	16.02	kilograms per cubic meter	kg/m^3

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
µm	micrometers	0.039	mil	(none)
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		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela per square meter	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 (psi)
MPa	megaPascals	0.145	kips per square inch	k/in^2 (ksi)

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ABBREVIATIONS AND SYMBOLS

ABC	accelerated bridge construction
ADT	average daily traffic
ASR	alkali silica reactivity
ATC	alternative technical concept
CSAH	County State Aid Highway
CIP	cast-in-place
dB(A)	A-weighted decibels
DOT	department of transportation
EPS	expanded polystyrene
FHWA	Federal Highway Administration
HfL	Highways for LIFE
IRI	International Roughness Index
MnDOT	Minnesota Department of Transportation
OBSI	on-board sound intensity
OSHA	Occupational Safety and Health Administration
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SPMT	self-propelled modular transporter

INTRODUCTION

HIGHWAYS FOR LIFE DEMONSTRATION PROJECTS

The Highways for LIFE (HfL) pilot program, the Federal Highway Administration (FHWA) initiative to accelerate innovation in the highway community, provides incentive funding for demonstration construction projects. Through these projects, the HfL program promotes and documents improvements in safety, construction-related congestion, and quality that can be achieved by setting performance goals and adopting innovations.

The HfL program—described in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)—may provide incentives to a maximum of 15 demonstration projects a year. The funding amount may total up to 20 percent of the project cost, but not more than $5 million. Also, the Federal share for an HfL project may be up to 100 percent, thus waiving the typical State-match portion. At the State's request, a combination of funding and waived match may be applied to a project.

To be considered for HfL funding, a project must involve constructing, reconstructing, or rehabilitating a route or connection on an eligible Federal-aid highway. It must use innovative technologies, manufacturing processes, financing, or contracting methods that improve safety, reduce construction congestion, and enhance quality and user satisfaction. To provide a target for each of these areas, HfL has established demonstration project performance goals.

The performance goals emphasize the needs of highway users and reinforce the importance of addressing safety, congestion, user satisfaction, and quality in every project. The goals define the desired result while encouraging innovative solutions, raising the bar in highway transportation service and safety. User-based performance goals also serve as a new business model for how highway agencies can manage the project delivery process.

HfL project promotion involves showing the highway community and the public how demonstration projects are designed and built and how they perform. Broadly promoting successes encourages more widespread application of performance goals and innovations in the future.

Project Solicitation, Evaluation, and Selection

FHWA issued open solicitations for HfL project applications in fiscal years 2006, 2007, 2008, 2009, and 2010. State highway agencies submitted applications through FHWA Divisions. The HfL team reviewed each application for completeness and clarity, then contacted applicants to discuss technical issues and obtain commitments on project issues. Documentation of these questions and comments was sent to applicants, who responded in writing.

The project selection panel consisted of representatives of the FHWA Offices of Infrastructure, Safety, and Operations; the Resource Center Construction and Project Management team; the Division offices; and the HfL team. After evaluating and rating the applications and

supplemental information, panel members convened to reach a consensus on the projects to recommend for approval. The panel gave priority to projects that accomplish the following:

- Address the HfL performance goals for safety, construction congestion, quality, and user satisfaction.
- Use innovative technologies, manufacturing processes, financing, contracting practices, and performance measures that demonstrate substantial improvements in safety, congestion, quality, and cost-effectiveness. An innovation must be one the applicant State has never or rarely used, even if it is standard practice in other States.
- Include innovations that will change administration of the State's highway program to more quickly build long-lasting, high-quality, cost-effective projects that improve safety and reduce congestion.
- Will be ready for construction within 1 year of approval of the project application. For the HfL program, FHWA considers a project ready for construction when the FHWA Division authorizes it.
- Demonstrate the willingness of the applicant department of transportation (DOT) to participate in technology transfer and information dissemination activities associated with the project.

HfL Project Performance Goals

The HfL performance goals focus on the expressed needs and wants of highway users. They are set at a level that represents the best of what the highway community can do, not just the average of what has been done. States are encouraged to use all applicable goals on a project:

- **Safety**
  - Work zone safety during construction—Work zone crash rate equal to or less than the preconstruction rate at the project location.
  - Worker safety during construction—Incident rate for worker injuries of less than 4.0, based on incidents reported on Occupational Safety and Health Administration (OSHA) Form 300.
  - Facility safety after construction—Twenty percent reduction in fatalities and injuries in 3-year average crash rates, using preconstruction rates as the baseline.
- **Construction Congestion**
  - Faster construction—Fifty percent reduction in the time highway users are impacted, compared to traditional methods.
  - Trip time during construction—Less than 10 percent increase in trip time compared to the average preconstruction speed, using 100 percent sampling.
  - Queue length during construction—A moving queue length of less than 0.5 miles in a rural area or less than 1.5 miles in an urban area (in both cases at a travel speed 20 percent less than the posted speed).
- **Quality**
  - Smoothness—International Roughness Index (IRI) measurement of less than 48 inches/mile.

    - Noise—Tire-pavement noise measurement of less than 96.0 A-weighted decibels (dB(A)), using the onboard sound intensity (OBSI) test method.
- User satisfaction—An assessment of how satisfied users are with the new facility compared to its previous condition and with the approach used to minimize disruption during construction. The goal is a measurement of 4 or more on a 7-point Likert scale.

REPORT SCOPE AND ORGANIZATION

This report documents the Minnesota Department of Transportation's (MnDOT's) HfL demonstration project featuring removal and accelerated replacement of a bridge over an urban interstate highway using a self-propelled modular transporter (SPMT). The report presents project details relevant to the HfL program, including bridge replacement and construction highlights, methods and materials, and HfL performance metrics measurement and economic analysis. No technology transfer activities (e.g., seminars, webinars, workshops, showcases, open houses) were performed for this project. However, to promote further interest and to encourage implementation of the ABC technology used in this project, MnDOT organized a formal site visit by MnDOT staff and local industry during the bridge move.

PROJECT OVERVIEW AND LESSONS LEARNED

PROJECT OVERVIEW

The Maryland Ave. bridge on County State Aid Highway 31 (CSAH 31) in St. Paul was built in 1958. The four-span bridge crossed Interstate 35E and served as an important access point for local businesses and residents. The bridge was in very poor condition, with delaminated, distressed concrete columns, pier caps, girders, and decks, as well as badly exposed and corroded reinforcing steel. On a scale of 0 to 100, the overall sufficiency rating for the structure was 77, which is considered structurally deficient. The condition of the bridge, along with plans for corridor improvements, prompted MnDOT to expedite the removal and replacement of the bridge. After exploring alternatives and evaluating project and user costs, MnDOT decided to use innovative accelerated bridge construction (ABC) methods to remove and replace the bridge. These strategies include the following:

- Offsite construction of the superstructure, including girders, deck, curb, gutter, side railings, etc. A few feet was left off of each span and completed via a closure pour.
- Construction of substructures following demolition and removal of the Maryland Ave. bridge with minimal impact on I-35E traffic.
- Dramatic reduction in user costs and increase in motorist and worker safety and user satisfaction through the use of a revolutionary construction engineering aid—the SPMT. This tool made it possible to move the new bridge into place within a 15-hour closure of I-35E.
- Implementation of an effective public information campaign involving both outreach and communication efforts.

The innovations employed on the project represented many firsts for MnDOT, including the use of an SPMT, the details of which are included in *Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges*[(1)]. Equipped with 288 wheels and operated remotely by a single operator using a joystick control, the SPMT made two trips to move the two-span superstructure (one trip per span). The entire move was performed on Saturday, August 18, 2012. Many local residents and professionals from MnDOT and FHWA observed the process. Local news outlets were also at the site to cover the move. I-35E reopened to traffic on Saturday, August 18, at 8:35 p.m, 15 hours after closure.

The Maryland Ave. bridge reopened to traffic on September 18, 2012, approximately 2 months following demolition, after the approach slabs, closure joints, and bridge detail work were completed. MnDOT estimated that, under conventional construction that would have employed partial lane closures, the user impact would have been felt for 4 months.

DATA COLLECTION

Safety, construction congestion, quality, and user satisfaction data were collected before, during, and after construction to demonstrate that accelerated bridge technologies can be used to achieve the HfL performance goals in these areas.

No worker injuries were reported during construction, which means MnDOT exceeded the HfL requirements for worker safety. MnDOT expected the innovation used on this project to increase worker safety by constructing the superstructure on grade versus over traffic, thus eliminating the risk of falling during construction and eliminating cantilever temporary work bridges over traffic. Traditional construction methods would require constructing the bridge superstructure over mainline I-35E traffic. The innovation moved the majority of this construction away from traffic, resulting in minimal impact on I-35E users.

Traditional methods would use a linear approach to constructing this bridge. The innovation reduced overall project construction closure of Maryland Ave. from 4 months to approximately 2 months. This savings results in a 50 percent reduction in construction time impacts to users of Maryland Ave. This innovation had an even more significant effect on I-35E users. Traditional construction would require many lane closures to construct the superstructure over traffic. MnDOT engineers anticipated that traditional construction would result in 12 days of off-peak lane closures. The innovation of this project significantly reduced this time to 3 days.

This project did not address the HfL performance goal of an IRI of less than 48 inches/mile. This project did not include any mainline, ramp, or roadway construction areas in which speeds reach 45 mph. The bridge deck was longitudinally planed (diamond ground) to achieve the desired roughness, as is MnDOT's standard practice on bridge decks within the Twin Cities metro area.

This project also did not address the HfL performance goal of achieving tire-pavement noise measurements of less than 96.0 dB(A). This project does not impact mainline I-35E, from which the majority of traffic noise is generated. The project does not include work on any roadway on which speeds reach 60 mph, the rate at which OBSI is typically measured. For these reasons, and due to the short length (210 ft) for the replacement bridge 62626, noise and smoothness data are not meaningful and were not collected for this project.

The use of an SPMT to construct the bridge superstructure offered many quality innovations that are expected to improve the durability and performance of this structure. The bridge superstructure was constructed away from traffic and other hazards, which allowed the workers to pay closer attention to the quality of the construction. MnDOT also used 3Y33HP high performance concrete for the I-35E/Maryland Ave. interchange bridge deck. This mix is being utilized in locations throughout Minnesota to prolong the life of bridge decks. Using the SPMT for the bridge move also contributed to the improved quality of the superstructure construction. Since the bridge superstructure was expected to see different stresses during transport by the SPMT than while in service, the deck was designed (e.g. posttensioning) to accommodate these stresses and construction quality monitored closely. The contractor chose to use fiber-reinforced concrete for paving the bridge deck and monitored the superstructure through the use of stringlines while it was being moved into position to make sure excessive deck cracking and twisting didn't take place.

During the planning and construction of the Maryland Ave. bridge, MnDOT implemented an aggressive, comprehensive communication effort with residents and businesses in the affected zones. Through fliers, newsletters, and e-mails, the public was kept aware of key project

schedules and milestones on a weekly or as-needed basis. In addition, a project summary page posted on the MnDOT web site was updated periodically to reflect project progress. A postconstruction survey indicated that residents and businesses were extremely satisfied with the construction approach and the final product. As a result, MnDOT exceeded the HfL customer satisfaction expectations.

ECONOMIC ANALYSIS

Construction costs for the MnDOT Maryland Ave. bridge project totaled about $14,119,182, which resulted in an increase of $800,000 over the conventional alternative. However, a savings of $2,900,000 in road user cost was estimated from the reduction of Maryland Ave. closure days from 4 months to 2 months. While not directly recouped by the agency, this indicates an estimated savings of about $2,100,000 using ABC technology.

LESSONS LEARNED

There were minimal issues identified with the use of ABC technology on this project. MnDOT believes that it is important to gain experience with this technology so that contractors become familiar with the technology, hopefully resulting in lower bids in the future. While the initial cost of ABC is higher, the agency believes that there are situations where it is a good alternative, especially in cases where there would be extended closure of the roadway, long detours, or dramatically increased travel times. This would be especially true in areas with a high traffic volume. In the case of this project, the SPMT was also used a few days later on another project in Minnesota. This synergy helped reduced transport and labor costs and may be a model for cost reduction in the future.

CONCLUSIONS

Overall, despite the minor glitch associated with the placement of the spans (15-hour closure vs. planned 12-hour closure), the removal and replacement of the Maryland Ave.bridge was a great success. Arguably, the biggest payoff from this project is the change in bridge construction practice in Minnesota. As a result of the success of this project, MnDOT is in the process of implementation plans to use ABC technologies on future structural projects in the State.

PROJECT DETAILS

BACKGROUND

The Maryland Ave. bridge on CSAH 31 over I-35E is located approximately 1.5 miles north of downtown St. Paul and is a significant east-west route in the city. I-35E is a heavily traveled route that originates near Forest Lake, continues into downtown St. Paul, and ends in Burnsville. The average daily traffic (ADT) for Maryland Ave. was 28,000 east of I-35E and 18,800 west of I-35E in 2010, and ADT is expected to increase to an average of 32,100 by 2030. I-35E carried 140,000 passenger cars and 5,000 heavy commercial vehicles per day in 2010.

The four-span structure (bridge 6513), originally built in 1958, consisted of a concrete deck on steel beams and included a centerline median, driving lanes, turn lanes, curbs, gutters, sidewalks, and guardrails. Figure 1 shows the existing bridge surface.

Figure 1. Photo. Existing Maryland Ave. bridge 6513 surface.

The bridge was remodeled in 1973 and received minor repairs in 1992. By 2007, the structure was in poor condition, due to a combination of age, freeze-thaw cycles, and salt. It was given a sufficiency rating of 77 out of 100, which is considered structurally deficient. In 2008, 1,200 lb of concrete fell from the underside of the bridge onto I-35E. Two vehicles were hit by the falling debris, resulting in traffic in I-35E being shut down for over 8 hours. Traffic was backed up for miles, as crews inspected the bridge and knocked off other loose concrete as a precautionary measure. While the bridge's structural capacity was unaffected by the loss of concrete, the delamination and spalling (figures 2 through 4) were indicators of deterioration. The poor overall condition of the bridge, the need for increased capacity on Maryland Ave., and the consequence of further deterioration and associated delays on the high volume of traffic on I-35E prompted MnDOT to expedite the removal and replacement of the bridge.

Figure 2. Photo. Delaminated bottom of bridge 6513 deck.

Figure 3. Photo. Delaminated and spalled bent caps of bridge 6513.

Figure 4. Photo. Fallen debris from end bent cap and column spalling on bridge 6513.

PROJECT DESCRIPTION

Using construction approaches centered on ABC methods, MnDOT replaced the existing Maryland Ave. bridge (6513) with a new two-span structure (bridge 62626). The primary goal of using ABC methods was to reduce traffic impacts on I-35E and Maryland Ave. Additional scope for the project included signal installation at the ramp terminals and L'Orient St., reconstruction of the sidewalks on either side of Maryland Ave. and continuing over the bridge, reconstruction of the ramps in all four quadrants, drainage construction, traffic management system construction, reconstruction of the medians, lighting construction, and construction of a tunnel structure under Maryland Ave. to accommodate the Gateway Trail (between L'Orient St. and the west I-35E ramps). The project did not include any permanent work on mainline I-35E.

The selected reconstruction approach represents the core principles of the HfL program and MnDOT's approach to bridge construction: to deliver projects expeditiously, safely, economically, and with minimal impact on the environment and highway users.

Figures 5 though 7 show the plan, elevation, and transverse sectional views of the proposed new structure. The innovative elements of the project include the following:

- Construction of the superstructure offsite, supported by falsework.
- Construction of the substructure without interfering with traffic flow.
- Use of prefabricated components.

- Use of expanded polystyrene-block (EPS-block) geofoam as a lightweight embankment fill.
- Limited closures and lane rentals to minimize effect on the traveling public.
- Use of an SPMT for bridge replacement.

These innovative elements are described in the following subsections.

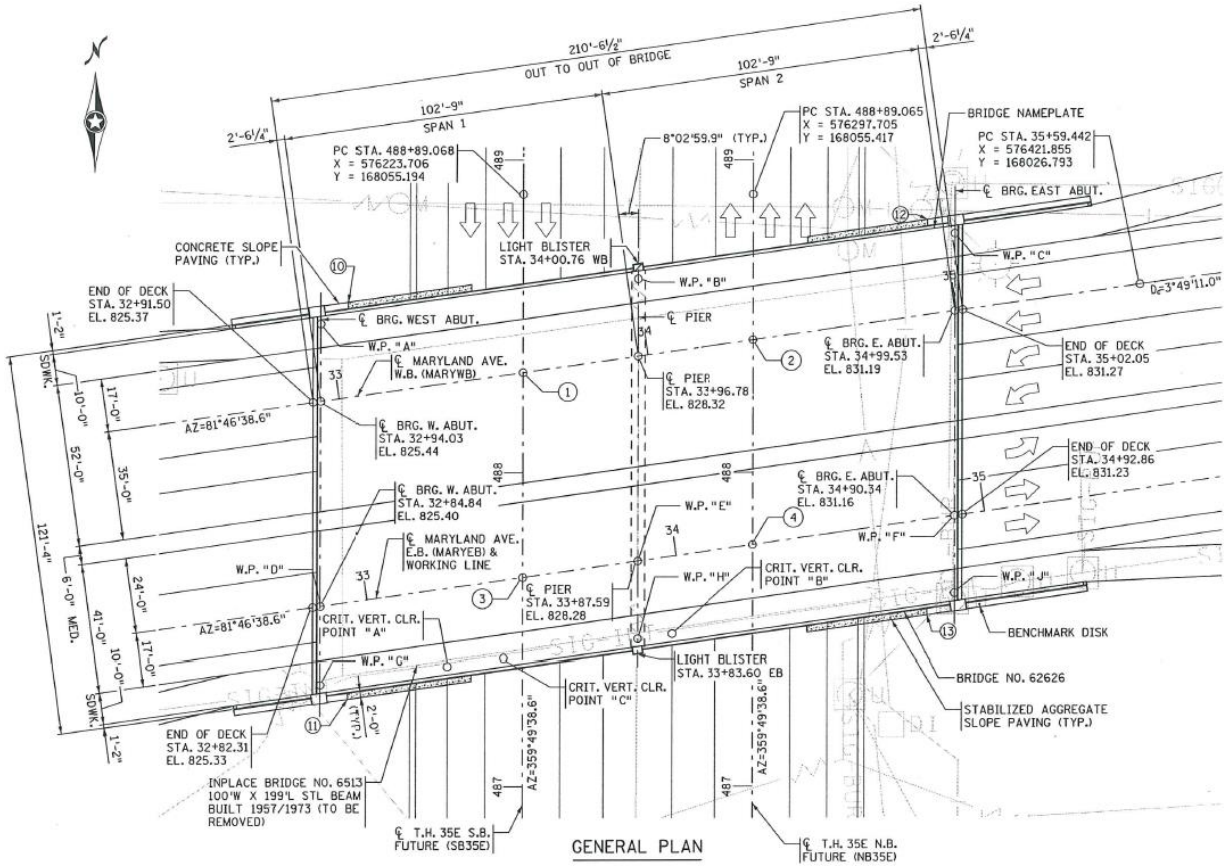

Figure 5. Diagram. Plan view of the new Maryland Ave. bridge 62626.

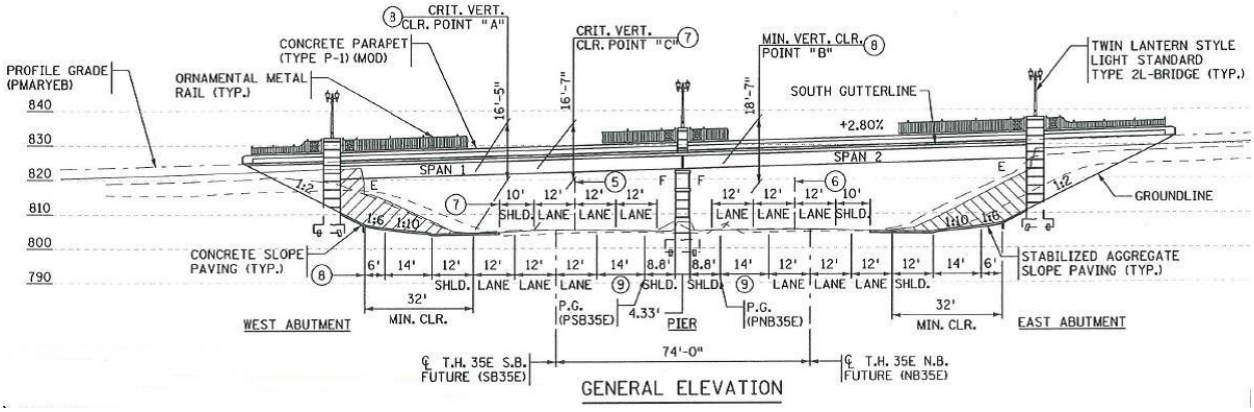

Figure 6. Diagram. Elevation view of the new Maryland Ave. bridge 62626.

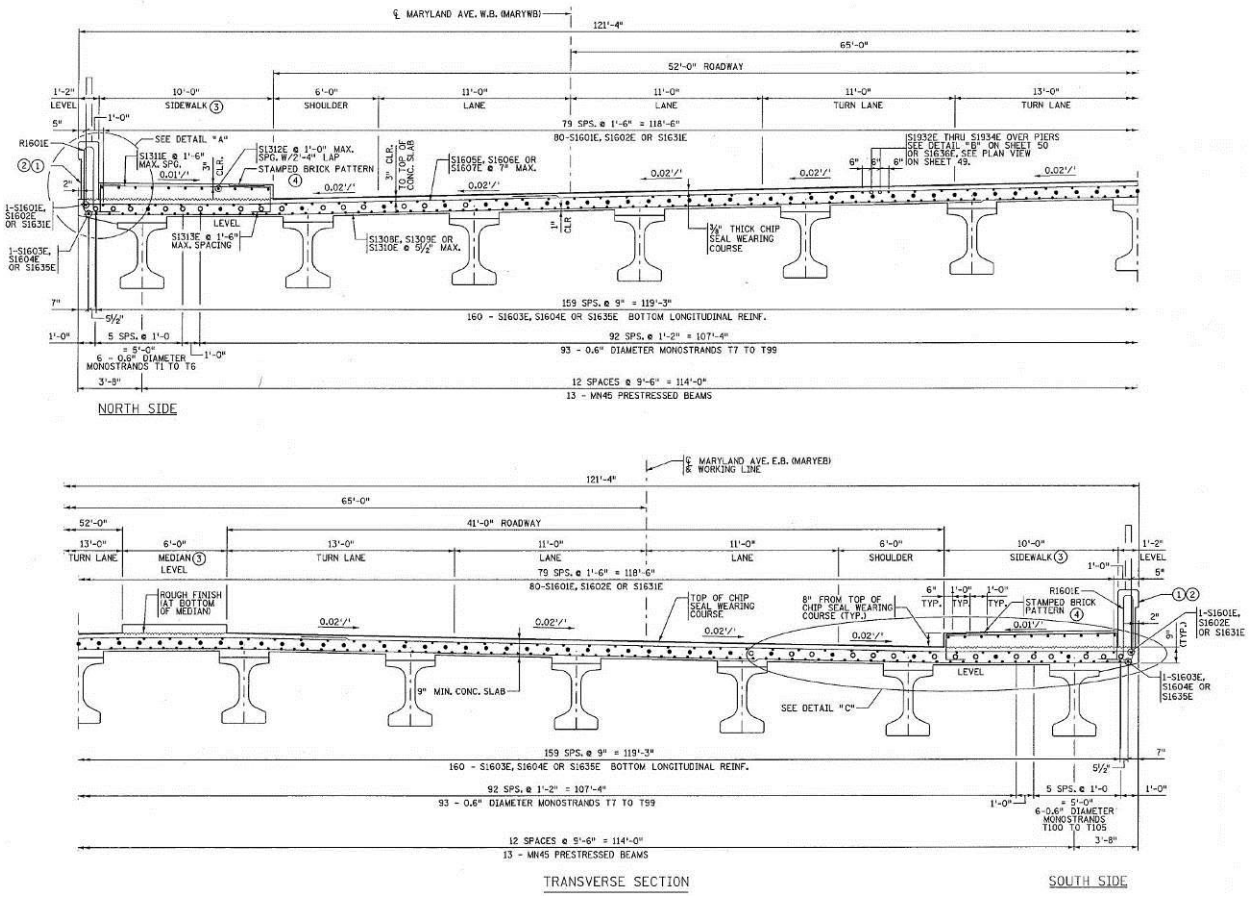

Figure 7. Diagram. Transverse sectional view of the new Maryland Ave. bridge 62626.

Superstructure Construction

One of the major decisions made to accelerate the replacement of the existing structure was to construct the superstructure offsite, at the bridge staging area, approximately 1,000 ft from the existing bridge alongside southbound I-35E and the on-ramp from Maryland Ave. to I-35E South (figures 8 through 10).

The construction of each span of the bridge superstructure began with the erection of the falsework for each span at the bridge staging area to support the superstructure (figures 11 through 13). The prefabricated girders were trucked one at a time from the fabrication plant to the bridge staging area by trucks equipped with steering trailers (figure 14). Following completion of erection of the falsework, the girders were hoisted on the falsework using two cranes until all the girders were properly positioned onto the falsework (figures 15 through 17). The girders were positioned as per plans using bearing plates and reference plates (figures 18 and 19) and were laterally braced using steel braces (figures 20 and 21). Figures 22 and 23 show span 1 of the bridge superstructure following placement of the girders before construction of the deck. Figure 24 shows the detailed plans for the concrete girders. As shown in the plans, each girder was over 103 ft long and measured 45 inches from the top of the girder to the bottom of the girder.

After assembling the girders, the deck was cast in place over the girders. This included assembling the forms (figures 25 through 27), installing the reinforcing steel and post-tensioning cables (figures 28 through 30), placing the concrete (figures 31 through 34), curing the concrete (figure 35 and 36), and stressing the post-tensioning cables (figures 37 and 38). The contractor proposed the use of fiber-reinforced concrete in the bridge deck and barriers to control macro- and micro-cracking mechanisms, reduce plastic settlement, and improve low ermeability, toughness, and durability. MnDOT accepted this proposal as an alternate technical concept (ATC). Figure 39 shows the built superstructure resting on the falsework.

The deck surface was paved using a Terex® Bid-Well 4800 roller paver. The paver carriage performs four functions to help finish the concrete deck: (1) the augers forward of the carriage trim excess concrete, (2) the Rota-Vibe® system consolidates the top 2 to 3 inches of concrete, (3) the paving rollers finish the concrete, and (4) the drag pan system seals and textures the deck.

The benefits of constructing the superstructure offsite include the following:

- Minimized traffic disruptions on Maryland Ave. and I-35E and maintained normal traffic flow without altering the present roadway configuration.
- Provided a safer environment for the traveling public and workers by drastically reducing exposure to traffic and construction activities.
- Potentially improved quality because bridge elements were fabricated in a more protected environment.

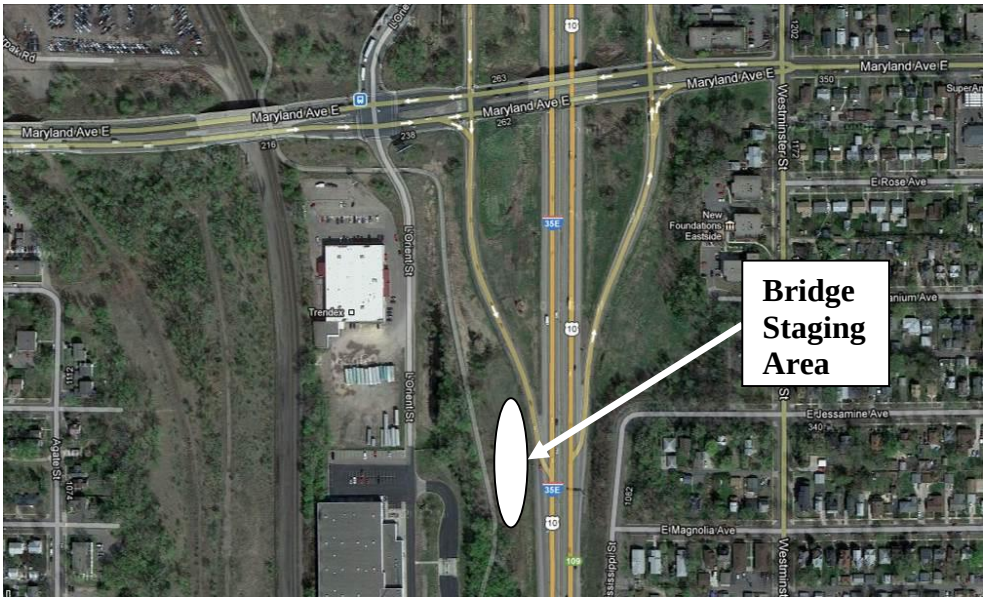

Figure 8. Photo. Staging area for bridge 62626 superstructure construction, approximately 1,000 ft from existing Maryland Ave. bridge 6513.

Figure 9. Photo. Long-shot view of staging area for bridge 62626 superstructure construction alongside southbound I-35E.

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Figure 12. Photo. Medium-shot view of construction of the falsework at the bridge staging area to support bridge 62626 superstructure.

Figure 13. Photo. Long-shot view of construction of the falsework at the bridge staging area to support bridge 62626 superstructure.


Figure 14. Photo. 103-ft prefabricated concrete girders were shipped one at a time from the fabrication plant to the bridge staging area on trucks equipped with steering trailers.

Figure 15. Photo. Two cranes were used to hoist each girder onto the falsework.

Figure 16. Photo. Hoisting girders onto the falsework at the bridge superstructure staging area.

Figure 17. Photo. Long-shot view of hoisting girders onto the falsework at the bridge superstructure staging area.

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Figure 19. Photo. Girder resting on the bearing pads supported by the falsework.

Figure 20. Photo. The girders were braced to each other using steel braces to minimize stresses during transport of the bridge superstructure using the SPMT.

Figure 21. Photo. Bracing the girders to each other using steel braces.


Figure 22. Photo. View of span 1 of the bridge superstructure from beneath following placement of the girders before construction of the deck.

Figure 23. Photo. Side view of span 1 of the bridge superstructure following placement of the girders before construction of the deck.

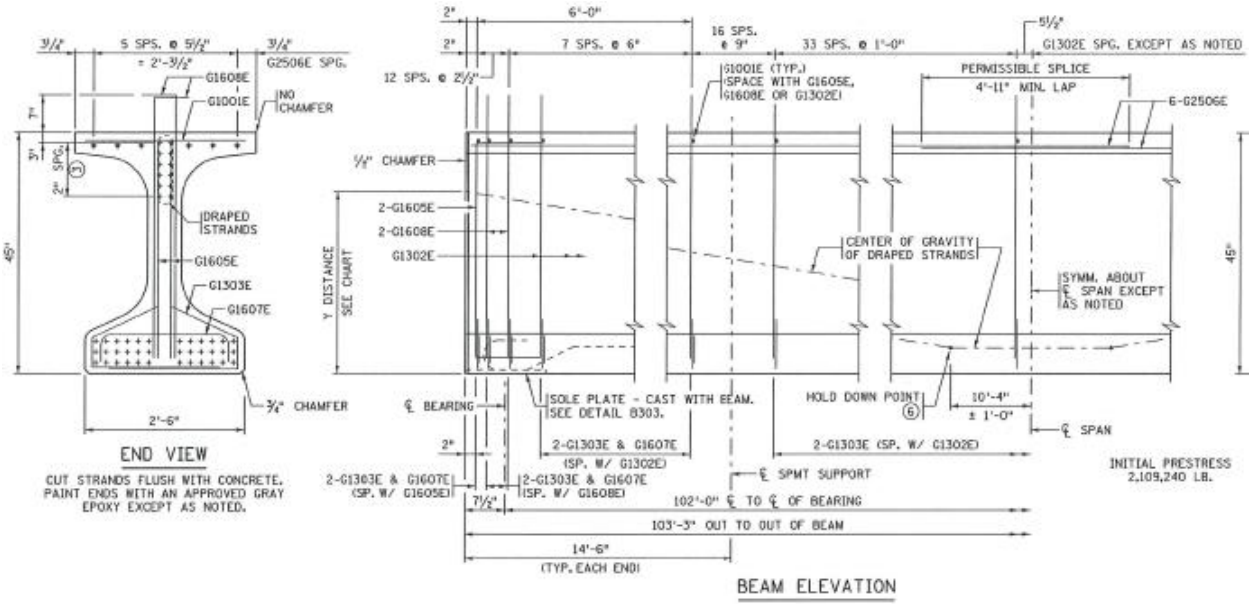


Figure 24. Diagram. End view and elevation plan details for concrete girders for bridge 62626 superstructure.

Figure 25. Photo. Setting the wooden support beams on the the concrete girders prior to placement of the wooden forms for the deck concrete.

Figure 26. Photo. Placing the wooden forms for the deck concrete.

Figure 27. Photo. Finished view of the wooden forms placed between the concrete girders to form the concrete bridge deck and the concrete haunches.

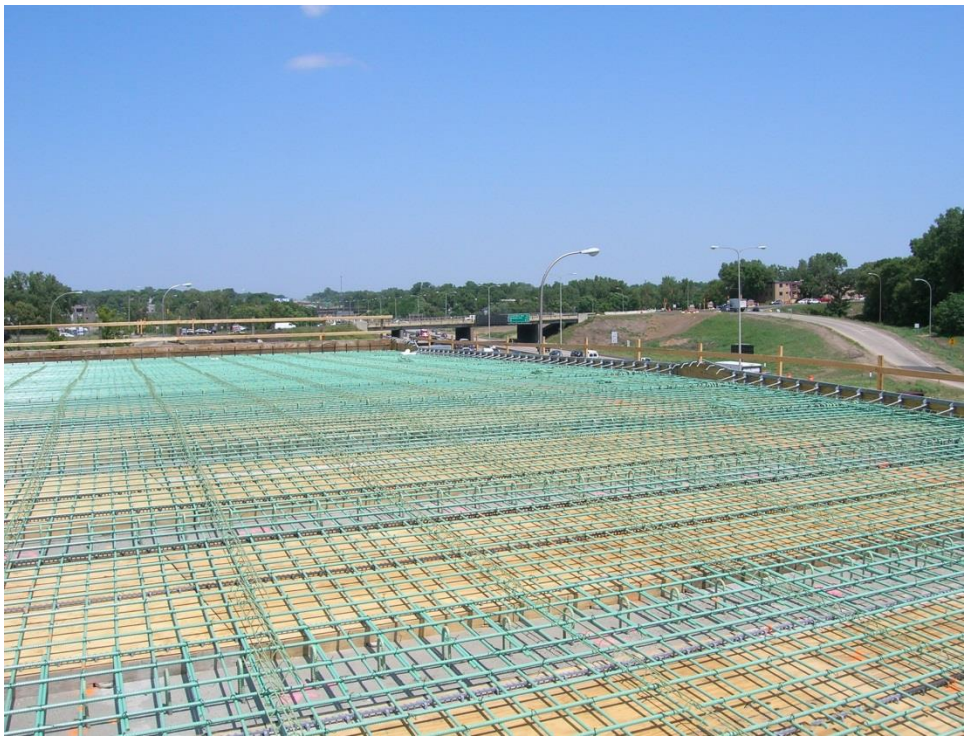


Figure 28. Photo. First layer of bridge deck reinforcing steel placed onto the concrete girders and wooden forms. Note the Maryland Ave. bridge 6513 in the background, which is yet to be demolished.

Figure 29. Photo. Placing the post-tensioning cables above the first layer of reinforcing steel.

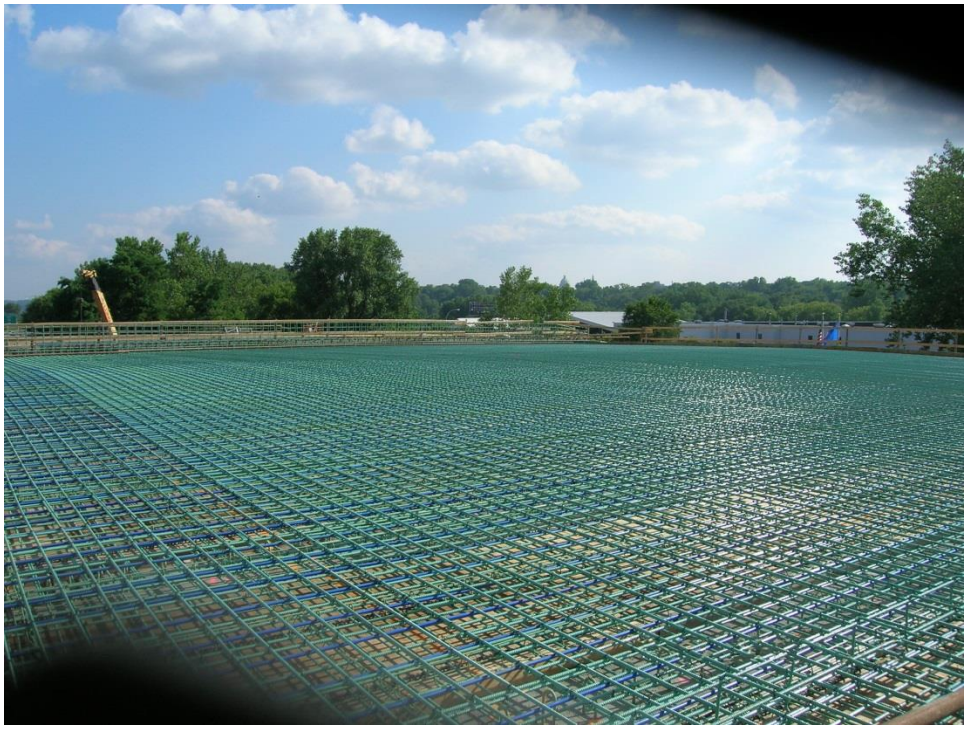


Figure 30. Photo. Surface of span 1 the new bridge deck after placement of both layers of reinforcing steel and post-tensioning cables prior to concrete placement.

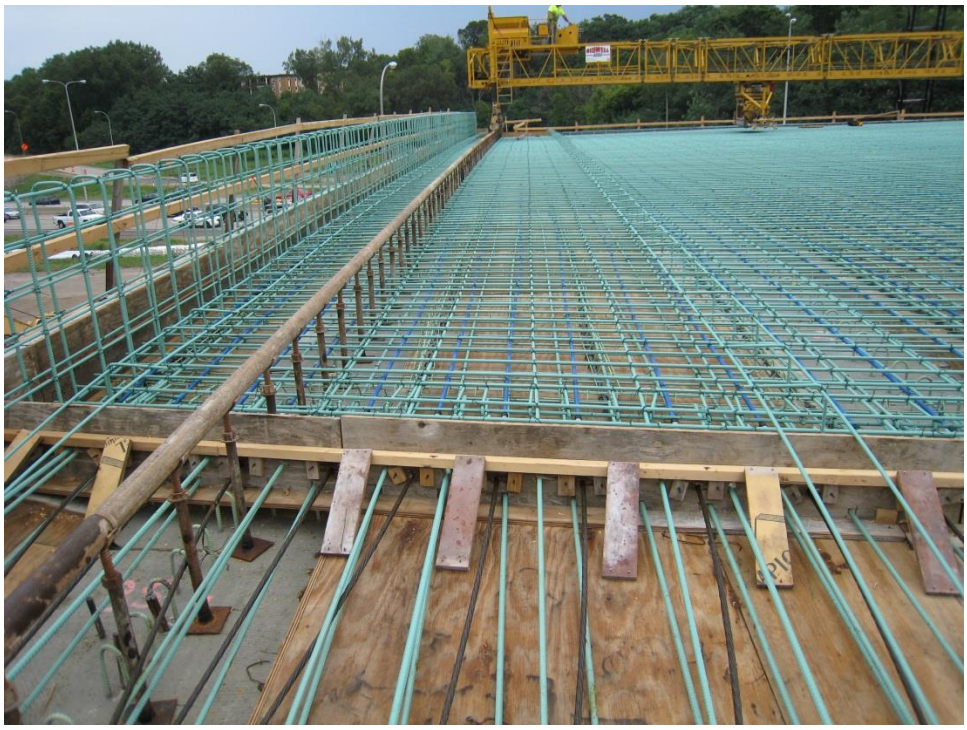


Figure 31. Photo. During paving of the bridge deck, the paver rolled over supported steel tubes.

Figure 32. Photo. The fiber-reinforced concrete was pumped from the roadway below on to the prepared bridge deck surface and the paving was done using a Terex® Bid-Well 4800 roller paver.

Figure 33. Photo. Close-up view of placing and paving the fiber-reinforced bridge deck concrete.


Figure 34. Photo. Finishing the bridge deck concrete surface from the finishing platform.

Figure 35. Photo. The concrete was cured by covering with wet burlap when fresh followed by polyethylene sheets after hardening to minimize water evaporation and shrinkage cracking. Note in the background that the Maryland Ave. bridge 6513 has now been demolished and concurrent substructure construction activities are taking place.

Figure 36. Photo. Finished and cured bridge deck surface after removal of the polyethylene sheets.

Figure 37. Photo. Stressing the post-tensioning cables to precompress the span prior to moving it using the SPMT.

Figure 38. Photo. Close-up view of stressing the post-tensioning cables.

Figure 39. Photo. Completed view of span 1 of the bridge superstructure after placement and curing of the bridge deck and curb concrete. Note the reinforcing steel that will be used to reinforce the closure pour between the two deck spans.

Demolition of Bridge 6513 and Substructure Construction

Concurrent with the superstructure construction, the existing Maryland Ave. bridge 6513 was demolished and the substructure for the Maryland Ave. bridge 62626 was constructed with little or no impact on I-35E traffic. Maryland Ave. was allowed to be closed between the I-35E ramps for a maximum of 60 days. Each additional day of closure was to be assessed a $10,000 penalty. During removal of bridge 6513, the contractor was allowed one weekend closure of mainline I-35E from 10:00 p.m. Friday to 5:00 a.m. Monday. The contractor closed northbound and southbound I-35E mainline at Maryland Ave. and diverted the mainline I-35E traffic through the I-35E/Maryland Ave. exit and entrance ramps. Figures 40 and 41 show the demolition of Maryland Ave. bridge 6513.

The substructure construction consisted of building the east and west abutments and the midspan pier. Figure 42 shows visual quality concept elevation views for the midspan pier and the end abutments. The construction activities included installing the cast-in-place (CIP) piles and reinforced footings for the midspan pier and the end abutments followed by installation of the crash walls, abutment walls, columns, and pier and abutment caps (figures 43 through 53). Portions of the I-35E shoulders were used during construction of the substructures, but the shoulder and traffic lane were separated using Jersey barriers. All three lanes in each direction remained open to traffic for the majority of the time, except when the contractor rented lanes for loading and unloading and safely perform the construction activities.

Figure 40. Photo. Demolishing Maryland Ave. bridge 6513.

Figure 41. Photo. Demolishing Maryland Ave. bridge 6513 as seen from I-35E. The bridge was demolished over a weekend closure of I-35E, while traffic was diverted through the Maryland Ave. off- and on-ramps.

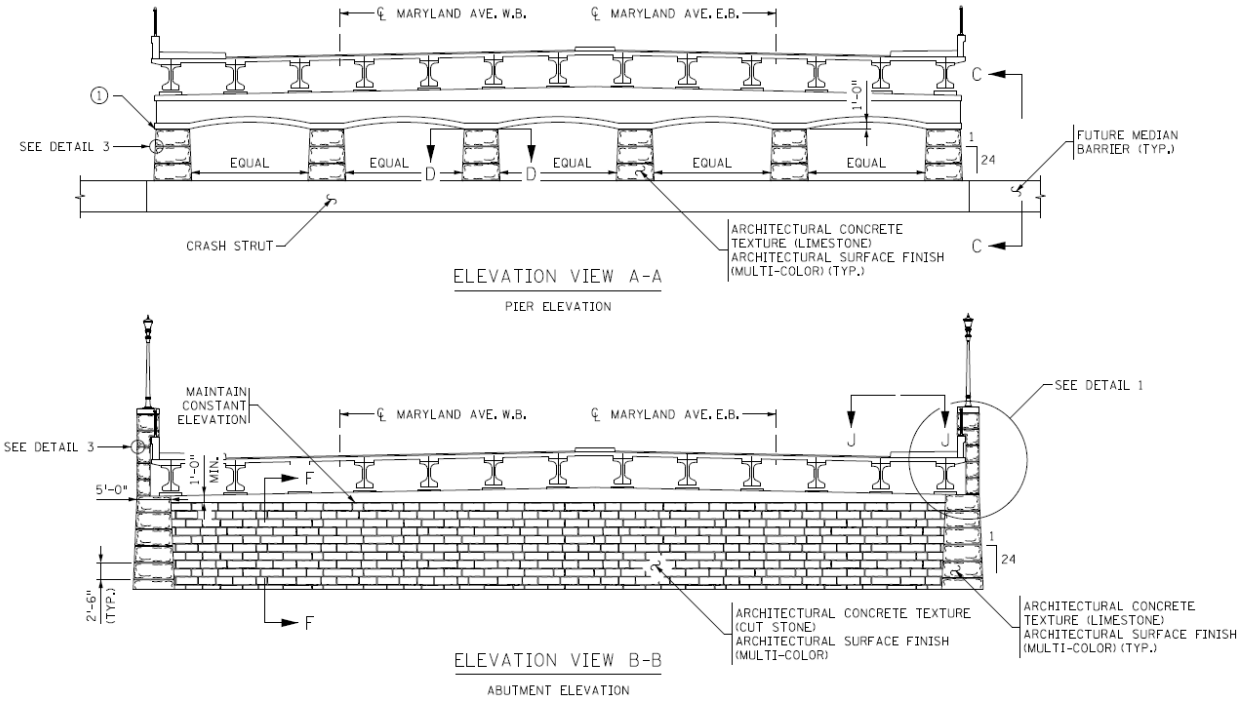


Figure 42. Diagram. Visual quality concept elevations views for the midspan piers and the end abutments.

Figure 43. Photo. Earthwork (foreground) and pile driving (background) in preparation for constructing the abutments and midspan pier. Note the open traffic lanes on I-35E.

Figure 44. Photo. Steel casing driven into the foundation for CIP concrete piles. Forty 12-inch-diameter CIP concrete piles (75 ft minimum length) were used for each abutment, while six to eight 12-inch-diameter CIP concrete piles (60 ft minimum length) were used for each of the six columns supporting the midspan pier.

Figure 45. Photo. Construction of the six 10-ft by 10-ft CIP columns (spaced 23 ft apart) supporting the midspan pier. Traffic lanes on I-35E were open to traffic except for the occasional closure of the inside lane for construction equipment and delivery.

Figure 46. Photo. Constructing the CIP crash wall and support columns for the midspan pier in the median of I-35E with lanes open to traffic.

Figure 47. Photo. Long-shot view of the construction of the abutments and midspan pier with traffic lanes open on I-35E. This view is from the top of the new bridge 62626 concurrently being constructed alongside the roadway.

Figure 48. Photo. Medium-shot view of the construction of the abutments and midspan pier with traffic lanes open on I-35E.

Figure 49. Photo. Close-up view of the construction of the midspan pier with traffic lanes open on I-35E.

Figure 50. Photo. Close-up view of the construction of the west abutment.

Figure 51. Photo. Erecting the reinforcing steel and forms for the construction of the CIP west abutment wall. Note the stamped texture on the forms for aesthetics of the inside wall face.

Figure 52. Photo. Long-shot view of the two abutments and the midspan pier after concrete placement.

Figure 53. Photo. Medium-shot view of the completed midspan pier in the foreground and the east abutment wall in the background after removal of the forms.

Prefabricated Components

Prefabricated components used in this project included the thirteen 130-ft-long reinforced girders for each of the two superstructure spans. In addition, a 16-ft by 12-ft box culvert bridge tunnel (No. 62X03) was constructed for a bicycle path that goes alongside I-35E and under Maryland Ave. using prefabricated sections, as shown in figures 54 through 57.

Use of EPS-Block Geofoam for Embankment Fill

Lightweight EPS-block geofoam (figure 58) was used for the embankment fill and covered with the native soil to minimize subsoil settlement and to reduce the amount of soil that would otherwise need to be excavated.

Limiting Closures Using Lane Rentals and Liquidated Damages

MnDOT limited closures on Maryland Ave., on- and off-ramps from Maryland Ave. to I-35E, and mainline I-35E by requiring the contractor to rent lanes and also assessing liquidated damages when the contractor would exceed the specified allowable closures. Tables 1 and 2 show the lane rental fees and allowable closures and the associated notes and liquidated damages.

Figure 54. Photo. Shipping the sections on flatbed trucks for the prefabricated elements of the box culvert bridge tunnel beneath Maryland Ave.

Figure 55. Photo. Placing the individual prefabricated sections for the box culvert bridge tunnel beneath Maryland Ave.

Figure 56. Photo. The north and south facades and the wingwalls for the box culvert bridge tunnel beneath Maryland Ave. were cast in place using wooden forms.

Figure 57. Photo. Close-up view of the box culvert bridge tunnel beneath Maryland Ave. before finishing the earthwork.

Figure 58. Photo. EPS-block geofoam was used for the west embankment fill to reduce bearing pressure on the subsoil to control settlement and minimize excavation.

Table 1. I-35E allowable lane closures and rental assessment rate.

Location/ Direction	Allowable Lane Closure Event	Assessment Rate (Per Closure Event)
NB I-35E	Sunday 10:00 p.m. to Monday 6:00 a.m. (2 lanes)	$1,000 per closure
	Sunday 8:00 p.m. to Monday 6:00 a.m. (1 lane)	$500 per closure
	Monday 6:00 a.m. to Monday 3:00 p.m. (1 lane)	$3,000 per closure
	Monday 10:00 p.m. to Tuesday 6:00 a.m. (2 lanes)	$1,000 per closure
	Monday 8:00 p.m. to Tuesday 6:00 a.m. (1 lane)	$500 per closure
	Tuesday 6:00 a.m. to Tuesday 3:00 p.m. (1 lane)	$3,000 per closure
	Tuesday 10:00 p.m. to Wednesday 6:00 a.m. (2 lanes)	$1,000 per closure
	Tuesday 8:00 p.m. to Wednesday 6:00 a.m. (1 lane)	$500 per closure
	Wednesday 6:00 a.m. to Wednesday 3:00 p.m. (1 lane)	$3,000 per closure
	Wednesday 10:00 p.m. to Thursday 6:00 a.m. (2 lanes)	$1,000 per closure
	Wednesday 8:00 p.m. to Thursday 6:00 a.m. (1 lane)	$500 per closure
	Thursday 6:00 a.m. to Thursday 3:00 p.m. (1 lane)	$3,000 per closure
	Thursday 10:00 p.m. to Friday 6:00 a.m. (2 lanes)	$1,000 per closure
	Thursday 8:00 p.m. to Friday 6:00 a.m. (1 lane)	$500 per closure
	Friday 6:00 a.m. to Friday 12:00 p.m. (1 lane)	$3,000 per closure
	Friday 10:00 p.m. to Saturday 8:00 a.m. (2 lanes)	$1,000 per closure
	Friday 8:00 p.m. to Saturday 8:00 a.m. (1 lane)	$500 per closure
	Saturday 8:00 a.m. to Saturday 11:59 p.m. (1 lane)	$500 per closure
	Sunday 12:00 a.m. to Sunday 9:00 a.m. (2 lanes)	$1,000 per closure
	Sunday 12:00 a.m. to Sunday 8:00 p.m. (1 lane)	$500 per closure
SB I-35E	Sunday 10:00 p.m. to Monday 5:00 a.m. (2 lanes)	$1,000 per closure
	Sunday 6:00 p.m. to Monday 6:00 a.m. (1 lane)	$500 per closure
	Monday 10:00 a.m. to Monday 2:00 p.m. (1 lane)	$3,000 per closure
	Monday 10:00 p.m. to Tuesday 5:00 a.m. (2 lanes)	$1,000 per closure
	Monday 6:00 p.m. to Tuesday 6:00 a.m. (1 lane)	$500 per closure
	Tuesday 10:00 a.m. to Tuesday 2:00 p.m. (1 lane)	$3,000 per closure
	Tuesday 10:00 p.m. to Wednesday 5:00 a.m. (2 lanes)	$1,000 per closure
	Tuesday 6:00 p.m. to Wednesday 6:00 a.m. (1 lane)	$500 per closure
	Wednesday 10:00 a.m. to Wednesday 2:00 p.m. (1 lane)	$3,000 per closure
	Wednesday 10:00 p.m. to Thursday 5:00 a.m. (2 lanes)	$1,000 per closure
	Wednesday 6:00 p.m. to Thursday 6:00 a.m. (1 lane)	$500 per closure
	Thursday 10:00 a.m. to Thursday 2:00 p.m. (1 lane)	$3,000 per closure
	Thursday 10:00 p.m. to Friday 5:00 a.m. (2 lanes)	$1,000 per closure
	Thursday 6:00 p.m. to Friday 6:00 a.m. (1 lane)	$500 per closure
	Friday 10:00 a.m. to Friday 12:00 p.m. (1 lane)	$3,000 per closure
	Friday 10:00 p.m. to Saturday 7:00 a.m. (2 lanes)	$1,000 per closure
	Friday 8:00 p.m. to Saturday 11:00 a.m. (1 lane)	$500 per closure
	Saturday 7:00 p.m. to Sunday 12:00 p.m. (1 lane)	$500 per closure

Table 1 notes:

(1) Northbound and southbound I-35E lane closures were counted as separate events. Each event, or any portion thereof, was assessed at the rate shown in table 1.

(2) No work was allowed within 6 feet from the edge line of traffic on I-35E.

(3) If the contractor was negligent in adhering to the established time schedules, the contractor was subject to an hourly charge assessed at a rate of $3,000 per hour for each hour or any portion thereof with which MnDOT determined the contractor had not complied.

Table 2. Allowable closures.

Segment Number	Segment/Direction	Restrictions	Maximum Closure Duration	Liquated Damages (per Day)
1	Northbound and southbound I-35E	(See Note 1)	(See Note 1)	(See Note 1)
2	Maryland Ave. between southbound and northbound I-35E ramps	(See Note 2)	60 Days	$10,000
3	Maryland Ave. between the western Project limits and southbound I-35E ramps	(See Notes 3, 4)	34 Days	$5,000
4	Maryland Ave. between northbound I-35E ramps and the eastern project limits	(See Note 3)	14 Days	$5,000
5	Northbound I-35E exit ramp to Maryland Ave.	(See Notes 3, 5)	14 Days	Assessed as part of Segment 4
6	Northbound I-35E entrance ramp from Maryland Ave.	(See Notes 3, 5)	14 Days	Assessed as part of Segment 4
7	Southbound I-35E exit ramp to Maryland Ave.	(See Notes 3, 6, 7)	34 Days	Assessed as part of Segment 3
8	Southbound I-35E entrance ramp from Maryland Ave.	(See Notes 3, 6, 7)	34 Days	Assessed as part of Segment 3

Table 2 notes:

(1) The contractor was allowed the following closures of I-35E:
   a. When the existing Maryland Ave. bridge was removed, the contractor was allowed one weekend closure from 10:00 p.m. Friday to 5:00 a.m. Monday of I-35E mainline. The contractor was required to close northbound and southbound I-35E mainline at Maryland Ave. and have mainline I-35E traffic traverse the I-35E/Maryland Ave. exit and entrance ramps. The contractor was also required to close access from the I-35E exit ramps to Maryland Ave. and from Maryland Ave. to the I-35E entrance ramps during the bridge removal. All Maryland Ave. traffic was required to be detoured as specified. The contractor was to provide four police officers for the duration of the closure.
   b. The contractor was allowed a closure of I-35E for a period of 12 consecutive hours sometime between 10:00 p.m. Friday to 5:00 a.m. Monday to move the new bridge to its final location using the SPMT. If the contractor required a second closure of I-35E to move the new bridge to its final location, the contractor was to be assessed $6,000 per hour for each hour I-35E would be closed prior to opening the roadway to traffic. A second closure could only occur between 10:00 p.m. Friday and 5:00 a.m. Monday. Both northbound and southbound I-35E were required to be closed when moving the new bridge to its final location. The contractor was required to detour traffic as specified. All northbound I-35E entrance ramps from I-94 to Maryland Ave. and all southbound I-35E entrance ramps from TH 36 to Maryland Ave. were required to be closed to traffic when moving the new bridge to its final location.

(2) The contractor was required to maintain the I-35E exit ramp right turns to Maryland Ave. and the right turns from Maryland Ave. to I-35E entrance ramps unless allowed otherwise in the specifications. Signal systems at the Maryland Ave./southbound I-35E ramps and Maryland Ave./northbound I-35E ramps were not required to be operational during the closure of Maryland Ave. between southbound I-35E ramps and the northbound I-35E ramps. Signal systems at the Maryland Ave./southbound I-35E ramps and Maryland Ave./northbound I-35E ramps were required to be operational when Maryland Ave. was open to traffic between the southbound and northbound I-35E ramps.

(3) Closure could only occur during the closure of Maryland Ave. between southbound and northbound I-35E ramps.

(4) A signal system at Maryland Ave./L'Orient St. was to be operational when Maryland Ave. west of L'Orient St. or east of L'Orient St. was open to traffic. If Maryland Ave. was closed on both sides of L'Orient St., the contractor was required to provide stop signs for L'Orient St. traffic. The contractor was required to close the eastbound left turn lane from Maryland Ave. to "Old" Maryland Ave. and direct traffic to the Jackson St./Maryland Ave. intersection.

(5) Closure could only occur during the closure of Maryland Ave. between I-35E and the eastern project limits.
(6) Closure could only occur during the closure of Maryland Ave. between I-35E and the western project limits.
(7) The contractor was required to provide temporary access to the MnDOT Maryland Ave. truck station directly from southbound I-35E. The temporary access was to be provided for the duration of the closure and was to be in the southwest quadrant of the I-35E/Maryland Ave. interchange. The contractor was to provide a paved taper and deceleration lane for the temporary access designed for at least a 55 mph design speed. Beyond the taper and deceleration lane, the temporary access was to be designed for at least a 30 mph design speed, and surfacing was to be Class 5 aggregate. The contractor was to provide an appropriate pavement and subbase thickness to handle the anticipated traffic volumes and loadings. The temporary access intersected and crossed the Gateway Trail. At the Gateway Trail, the contractor was to provide stop signs for traffic on the temporary access. The temporary access was to be designed for a WB-62 truck.
(8) If the contractor was negligent in adhering to the established maximum closure durations, the contractor was subject to liquidated damages assessed at the rate shown in table 2 for each day or any portion thereof with which MnDOT determined the contractor has not complied.

Placement of Maryland Ave. Bridge 62626 Using an SPMT

Both spans of the new Maryland Ave. bridge 62626 were moved from the falsework at the bridge staging area and placed successfully into position on Maryland Ave. within a limited closure of I-35E (specified as 12 hours before contractor penalties [actual closure was 15 hours]) on Saturday, August 18, 2012. To make such a rapid replacement possible, MnDOT used an SPMT for the first time in Minnesota. The SPMT greatly reduced construction time, minimized inconvenience to the traveling public, improved worker and motorist safety, and maintained a normal workweek traffic flow.

An SPMT is a computer-controlled platform vehicle with a large array of articulating wheels (figures 59 and 60). It is used for transporting objects such as bridges, buildings, heavy and oversized equipment, and other objects too large or too heavy for normal trucks. The SPMT deployed on this job was equipped with 2 sets of 18 axles, each with 8 independent, fully articulated, computer-controlled wheels (288 wheels total) and a hydraulic system capable of moving up and down within a vertical range of 48 inches. It was shipped to the job site on 30 flatbed trucks and assembled at the bridge staging area (figure 61). The SPMT was operated remotely by a single operator using a joystick control (figure 62). The operator was in constant radio communications with strategically positioned personnel who provided directions and feedback.

Although MnDOT decided early to use an SPMT to remove and replace the bridge, this project presented unique challenges. One of the most challenging factors was the weight and size of the superstructure, which consisted of two bridge spans (each span estimated at about 1,300 tons) to be moved and threaded into position during the limited closure period. Other challenges included elevation differences (approximately 3 ft) between the center pier and each of the abutments and poor soil support conditions. Because of the considerable length of the superstructure, the SPMT used both the northbound and southbound lanes of I-35E to transport the structure. One glitch was encountered in moving the first span. As the superstructure approached the west abutment and center pier, some of the wheels dug into the soft soil between the abutment and the roadway, resulting in some difficulty moving the SPMT. To prevent this from happening while placing the second span, steel plates were placed on top of the soil between the roadway and the eastern abutment. Figures 63 through 76 show various aspects of the move.

Many members of the public, as well as representatives from MnDOT and other Federal and State transportation agencies, witnessed the replacement process (figure 77). Local news outlets covered the proceedings at the construction site. I-35E reopened to traffic on Saturday night, 15 hours after closure.

Figure 59. Photo. An SPMT is a computer-controlled platform vehicle with a large array of articulating wheels on the bottom. The SPMT used for this project had a total of 288 wheels on 2 sets of 18 axles.

Figure 60. Photo. Close-up of the SMPT wheels. Each pair of wheels is full articulated and is capable of moving independently of the remaining wheels.

Figure 61. Photo. The SPMT was stripped down and shipped to the job site on a total of 30 flatbed trucks and reassembled at the job site for this project.

Figure 62. Photo. The SPMT movement was controlled by a single joystick operator who was in radio communications with strategically positioned personnel who provided directions and feedback.

Figure 63. Photo. The superstructure span was first lifted off the bearing pads on top of the falsework.

Figure 64. Photo. Strategically placed stringlines were used during lifting, moving, and placement of the spans to ensure that deflections and torsions of the span were within tolerance.

Figure 65. Photo. The falsework was removed after the bridge was fully supported by the SPMT to clear the path for the SPMT move.

Figure 66. Photo. The SPMT easily handled the grade difference between the bridge staging area and I-35E during the move to the final location. All movements measured using the stringlines were within specifications.

Figure 67. Photo. Moving the first span of Maryland Ave. bridge 62626 on I-35E using the SPMT.

Figure 68. Photo. Another view of moving the first span of Maryland Ave. bridge 62626 on I-35E using the SPMT.

Figure 69. Photo. The vertical and horizontal positions of all girders of the span were carefully monitored from the pier to ensure that it was lowered uniformly so as to not excessively stress the girders, deck, and pier columns, which could potentially cause cracking or other distresses.

Figure 70. Photo. The vertical and horizontal positions of all girders of the span were carefully monitored from the abutment to ensure that it was lowered uniformly so as to not excessively stress the girders, deck, and pier columns, which could potentially cause cracking or other distresses.

Figure 71. Photo. Another view of the girders before the span was carefully positioned on to the pre-positioned bearing plates on top of the abutment wall.

Figure 72. Photo. The girders of the first span resting on the bearing plates above the pier while still being supported by the SPMT.

Figure 73. Photo. Checking the final position of all girders before the SPMT released the first span load on to the pier and the abutment.

Figure 74. Photo. All girders of the first span resting on the bearing plates supported by the pier after removal of the SPMT support.

Figure 75. Photo. During placement of the first span, some of the SPMT wheels dug into the soft soil between the abutment and the roadway, resulting in some difficulty moving the SPMT.

Figure 76. Photo. The problem of the soft soils was resolved during the move of the second span by using 0.5-inch-thick steel plates above the soil to support the SPMT wheels.

Figure 77. Photo. Many members of the public, as well as representatives from MnDOT and other Federal and State transportation agencies, witnessed the replacement process.

Joints and Closures

The contractor proposed limiting the number of construction joints to improve the long-term durability by reducing the opportunities for water infiltration. The construction joints were limited to the 15-ft-wide closure pour at the pier and none at the abutments (figure 78). This was achieved by installing the end diaphragm and expansion joint device assembly with the deck placement in the bridge staging area (figures 78 and 79) rather than in-place after the bridge move. This approach also had the advantage of allowing the use of the standard MnDOT deck details and provided normal inspection access of the bottom of the deck at the pier and abutments.

To enhance the performance of the deck and barrier closure pour and joint, a specialized high-performance, low-permeability, low-shrinkage, fiber-reinforced concrete mix design was used. For the closure joints, reinforcement splices made using mechanical couplers in lieu of lap splices were used to ensure the high durability and continuity of the reinforcing. Figure 80 shows the forming and reinforcing of the end block at the abutment prior to concrete placement. Figure 81 shows the placement of the forms for the barrier closure pour after the deck closure pour at the pier between the two spans.

The Maryland Ave. bridge reopened to traffic on September 30, 2012, about 30 days later (figure 82) for a total closure (demolition to open to traffic) of 60 days.

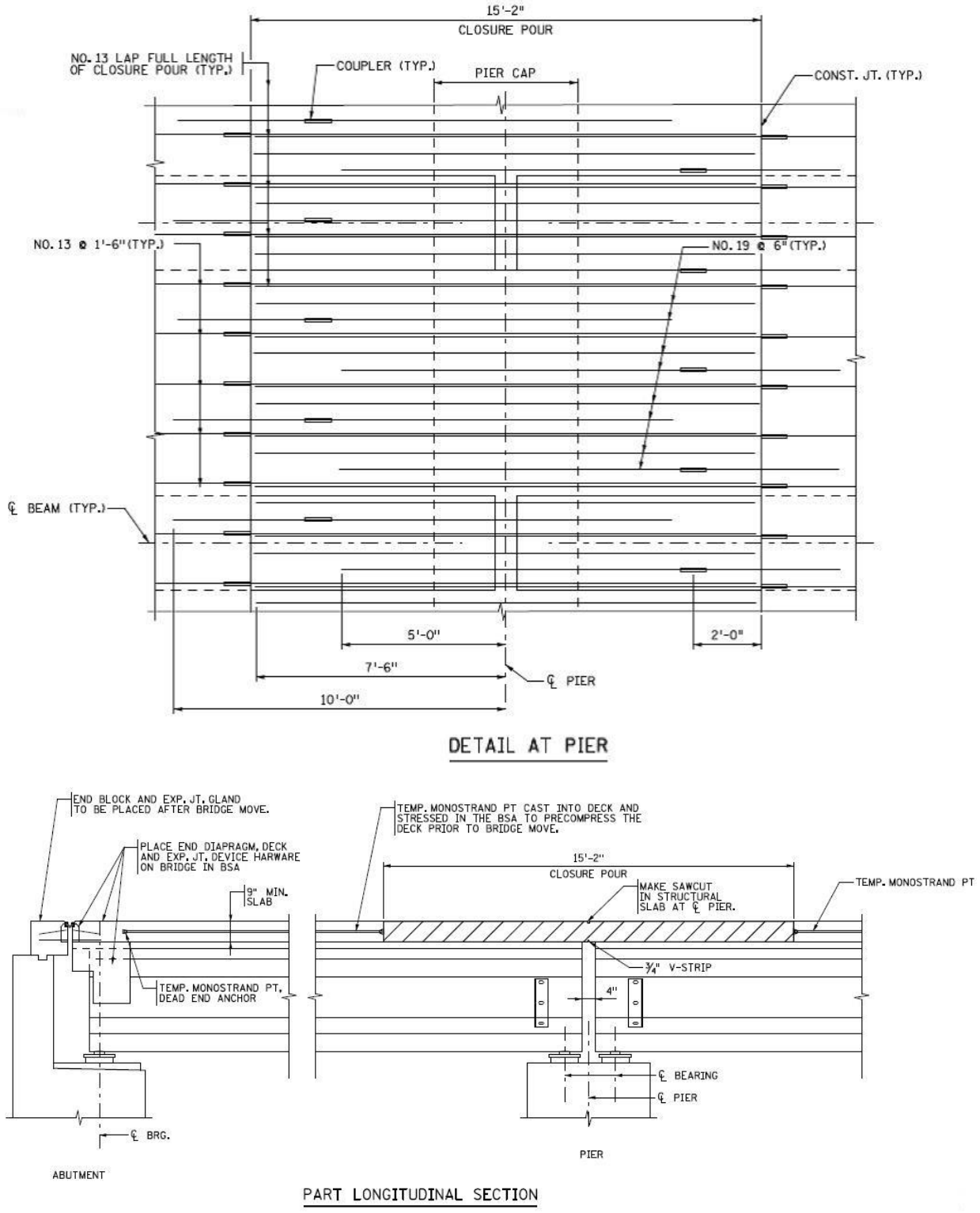


Figure 78. Diagram. Abutment joint details and details of the closure pour at the center pier between the two spans.

Figure 79. Photo. Forms and reinforcement for the end diaphragm and the expansion joint device hardware.

Figure 80. Photo. The end block and expansion joint gland were placed after the bridge was moved into place. This figure shows setting the reinforcing steel and forms for the abutment end block concrete.

Figure 81. Photo. Setting the reinforcing steel and forms for the closure pour of the barrier wall after the closure pour of the 15-ft transverse joint opening between the two spans.

Figure 82. Photo. View of the new Maryland Ave. bridge 62626 following completion of the project.

DATA ACQUISITION AND ANALYSIS

Data collection on the MnDOT HfL project consisted of acquiring and comparing data on safety, construction congestion, and user satisfaction before, during, and after construction. The primary objective of acquiring these types of data was to provide HfL with sufficient performance information to support the feasibility of the proposed innovations and to demonstrate that ABC technologies can be used to do the following:

- Achieve a safer work environment for the traveling public and workers.
- Reduce construction time and minimize traffic interruptions.
- Produce greater user satisfaction.

This section discusses how well the MnDOT project met the specific HfL performance goals related to these areas.

SAFETY

Worker Safety

The HfL performance goals for safety include meeting both worker and motorist safety goals during and after construction. This project included a HfL performance goal of achieving an incident rate for worker injuries to be less than 4.0 based on the OSHA 300 rate.

Because this was the first time MnDOT used the innovative approach to constructing the bridge superstructure, the contractor was required to submit a minimum five-page safety management plan outlining the processes and procedures for how this goal would be met, outline safety training requirements, describe how the contractor would monitor the rate during the construction season, and describe how the contractor would take corrective actions if the rate exceeded 4.0 at any time during the duration of the project. The safety management plan was also required to describe safety measures and procedures the contractor would implement to accommodate visitors to the site.

MnDOT expected the innovation used on this project would increase worker safety by constructing the superstructure on grade versus over traffic, thus eliminating the risk of falling during construction and eliminating cantilever temporary work bridges over traffic. During the construction of the Maryland Ave. bridge project, 0 worker injuries were reported, corresponding to an OSHA rate of 0.0, which means MnDOT exceeded the HfL goal for worker safety.

Motorist Safety

Traditional construction methods would require constructing the bridge superstructure over mainline I-35E traffic. The innovation moved the majority of this construction away from traffic, resulting in minimal impact on I-35E users. MnDOT expected this innovation would result in a work zone crash rate equal to or less than traditional construction by minimizing the need for temporary lane closures to set beams and perform other superstructure construction required with

traditional construction methods. Minimizing/eliminating lane closures was expected to reduce the risk of rear-end crashes that typically occur within these types of work zones. Constructing the superstructure away from traffic was also expected to minimizes the risk of items falling onto traffic during construction.

Safety Improvements

Between 2007 and 2009, there were a total of 366 crashes at this interchange. A total of 281 crashes occurred on I-35E compared with a total of 85 crashes on Maryland Ave. Most of these crashes involved property damage with no injuries, however, there were some injury crashes, as shown in table 3. The majority of these accidents were rear-end (62 percent), followed by sideswipe same direction (10 percent), left turns at the ramp termini (8 percent), ran off road (9 percent), others/unknown (10 percent), and head-on (1 percent).

Table 3. Historical crashes at I-35E/Maryland Ave. interchange between 2007 and 2009.

Crash Type	Number
Fatal	0
Injury – incapacitating injury	2
Injury – non-incapacitating injury	15
Injury – possible injury	75
Property damage – no apparent injury	274

MnDOT expects that accidents at this interchange will be reduced significantly due to improvements made to roadway geometrics, including turning movements and turn lane storage at the ramp termini and on Maryland Ave. MnDOT projects these improvements will result in fewer left turn accidents and rear-end accidents, thereby reducing the number of injury accidents.

CONSTRUCTION CONGESTION

The HfL program specifies performance goals for reducing both total construction duration by 50 percent and construction impacts on traffic.

Traditional methods would use a linear approach to constructing this bridge. The superstructure construction would not begin until after the piers and abutments were constructed. By constructing the superstructure in a staging area near the bridge, the substructure and superstructure construction were done simultaneously. After the substructures were complete, the superstructure was moved from a staging area using the SPMT to its final position over I-35E. This reduced overall project construction closure of Maryland Ave. from 4 months to approximately 2 months. This savings results in a 50 percent reduction in construction time impacts to users of Maryland Ave.

This innovation had an even more significant effect on I-35E users. Traditional construction would require many lane closures to construct the superstructure over traffic. MnDOT engineers anticipated that traditional construction would result in 12 days of off-peak lane closures. The innovation of this project significantly reduced this time to 3 days.

QUALITY

This project did not include any mainline, ramp, or roadway construction areas in which speeds reach 45 mph. In addition, due to the limited construction limits (short paving stretches), it would be difficult to enforce the HfL goal of IRI of 48 inches/mile due to the tie-in work to existing pavements at the project limits. The bridge deck was longitudinally planed (diamond ground) to achieve the desired roughness, as is MnDOT's standard practice on bridge decks within the Twin Cities metro area.

This project also was not evaluated for compliance with the HfL performance goal for tire-pavement noise. This project does not impact mainline I-35E, from which the majority of traffic noise is generated. The project does not include work on any roadway on which speeds reach 60 mph, the rate at which OBSI is typically measured.

Although this project does not include an IRI or tire-pavement noise performance goal, the use of an SPMT to construct the bridge superstructure offered many quality innovations that are expected to improve the durability and performance of this structure. The bridge superstructure was constructed away from traffic and other hazards, which allowed the workers to pay closer attention to the quality of the superstructure construction. Factors contributing to the quality included:

- **No reduced hours** – Because the superstructure was built off-line away from traffic, the contractor was not restricted to work windows dictated by traffic. This likely resulted in additional daytime construction and more optimal work windows for the contractor to improve quality.
- **Improved Material Quality** – Construction of the deck away from traffic reduced the risk of concrete mix segregation since the contractor could reduce concrete pumping distances compared to traditional methods.
- **No Staged Construction** – The full closure eliminated the need for staged construction. Quality is often reduced with staged construction due to vibrations encountered.

MnDOT also used 3Y33HP high performance concrete for the deck on the I-35E/Maryland Ave. interchange bridge. This mix has been utilized in locations throughout Minnesota to prolong the life of bridge decks. This mix has shown added benefits of low permeability and minimized deck cracking. Although MnDOT's special provision requires a minimum permeability of 1,500 coulombs or less at 56 days, test results on this mix have consistently shown closer to 1,000 coulombs or less, resulting in less chloride intrusion and slower deterioration. Other requirements for this mix include alkali silica reactivity (ASR) testing for fine aggregate, water/cement ratio not greater than 0.45, 6.5 percent air content plus 2.0 percent or minus 1.5 percent, concrete shrinkage not greater than 0.040 percent at 28 days, and anticipated strength of 4,300 psi at 28 days.

Using the SPMT for the bridge move also contributed to the improved quality of the superstructure construction. Since the bridge superstructure was expected to see different stresses during transport by the SPMT than while in service, the deck was designed (e.g. posttensioning) to accommodate these stresses and construction quality monitored closely. The contractor chose

to use fiber-reinforced concrete for paving the bridge deck and monitored the superstructure through the use of stringlines while it was being moved into position to make sure excessive deck cracking and twisting didn't take place.

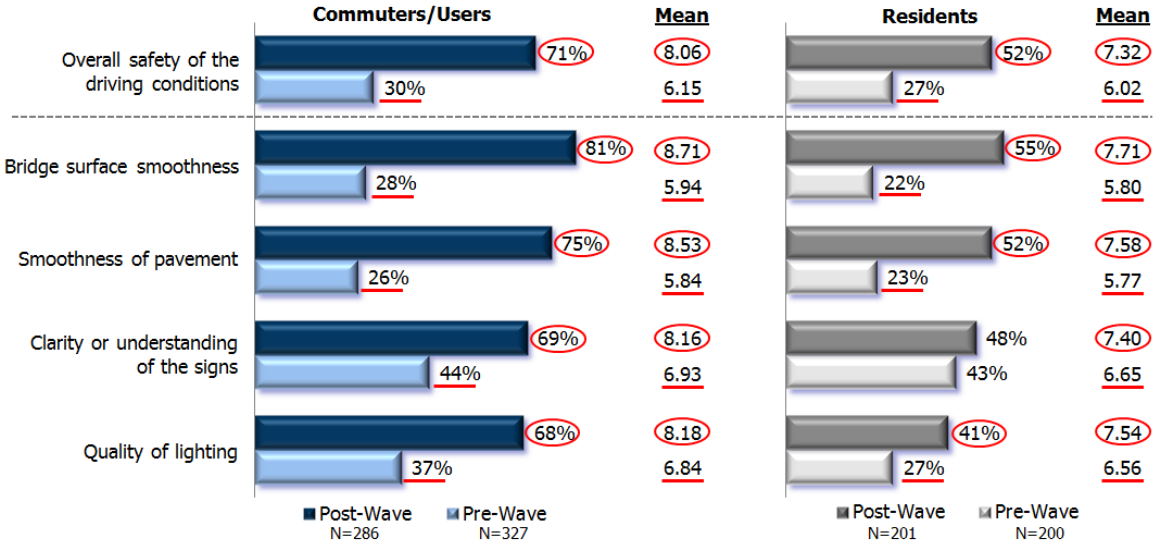
USER SATISFACTION

The user satisfaction survey for this project was conducted by The Deiringer Research Group, Inc. (www.thedrg.com). The Pre-Wave survey (Appendix A) included a total of 551 interviews, completed between April 25 and May 16, 2012. The Post-Wave survey (Appendix B) included a total of 525 interviews, completed between March 19 and April 2, 2013. A sample based on zip codes within a 10-mile radius around the I-35E corridor was purchased to conduct both waves. Respondent qualifications included:

- Between 18 and 75 years of age.
- Commuter/Users:
    - Travel on I-35E between Larpenteur Ave./Wheelock Parkway and Pennsylvania Ave. (either direction).
    - Personally travel along I-35E at least 3 to 4 times a week.
    - Have driven regularly on I-35E for 1 or more years.
- Area Residents:
    - Reside within a 5-mile radius of the I-35E construction corridor.
    - Have driven across the Maryland Ave. bridge within the past 2 years.
- No conflicting professional bias.

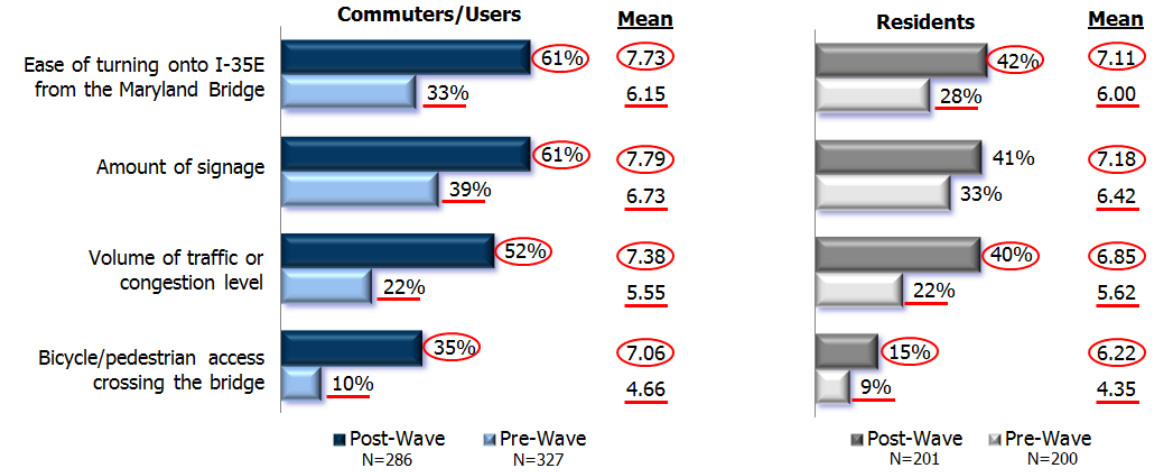
The results of the survey showed that Post-Wave satisfaction with the Maryland Ave. bridge increased across the board (figures 83 and 84). Both commuters and residents thought that safety and smoothness of the bridge and pavement surface had increased and that traffic congestion and ease of access to I-35E had improved.

While residents' satisfaction level with the clarity of signs remained constant (on a Top 3 List), their average rating increased significantly. Similarly, residents' satisfaction (Top 3 List) with the amount of signage on the bridge remained constant, while their average rating increased overall.



Q5. Now thinking about the roadway on the Maryland Avenue Bridge crossing over I-35E, please rate how satisfied you are with each of the following...
10 = Extremely Satisfied, 1 = Extremely Dissatisfied Circled data is significantly higher than the underlined data at the 95% confidence level.

Figure 83. Chart. Post-Wave vs. Pre-Wave results of survey (Top 3 List).



Q5. Now thinking about the roadway on the Maryland Avenue Bridge crossing over I-35E, please rate how satisfied you are with each of the following...
10 = Extremely Satisfied, 1 = Extremely Dissatisfied Circled data is significantly higher than the underlined data at the 95% confidence level.

Figure 84. Chart. Post-Wave vs. Pre-Wave results of survey (Top 3 List), continued.

ECONOMIC ANALYSIS

A key aspect of HfL demonstration projects is quantifying, as much as possible, the value of the innovations deployed. This entails comparing the benefits and costs associated with the innovative project delivery approach adopted on an HfL project with those from a more traditional delivery approach on a project of similar size and scope. The latter type of project is referred to as a baseline case and is an important component of the economic analysis.

For this economic analysis, MnDOT supplied most of the cost figures for the as-built project. The assumptions for the baseline case costs were determined from discussions with MnDOT and FHWA Minnesota Division staff and national literature.

CONSTRUCTION TIME

Through the use of innovative construction technology, MnDOT was able to dramatically reduce the impact of this project's construction on roadway users. The overall project construction closure of Maryland Ave. was reduced from 4 months to approximately 2 months, resulting in a 50 percent reduction in construction time impacts to users of Maryland Ave. This innovation also significantly reduced the impact felt by I-35E users. Traditional construction would require many lane closures to construct the superstructure over traffic. MnDOT engineers anticipated that traditional construction would result in 12 days of off-peak lane closures. The innovation of this project reduced this time to 3 days. Thus, MnDOT was able to reduce impact/inconvenience by 75 percent.

CONSTRUCTION COSTS

The Engineers' estimate for construction of this project was $16,032,612 and the bid was $14,546,184. The final costs for the project was $14,119,182, which was significantly below the Engineers' estimate and also below the low bid amount. MnDOT estimated that the innovative option using SPMT, while saving construction time, did incur $800,000 in additional costs as compared to the traditional alternative.

USER COSTS

Generally, three categories of user costs are used in an economic/life cycle cost analysis: vehicle operating costs, delay costs, and safety-related costs.

Construction Delay Costs

The delay associated with this project was primarily limited to the increased mileage caused by the detour due to the closure of Maryland Ave. For purposes of this analysis, the differences in delays on I-35E are considered negligible. While traditional construction would have required 12 days of off-peak lane restrictions, the innovation resulted in 3 days of off-peak lane restrictions plus a complete closure of I-35E between 5:30 a.m. and 10:35 p.m. (approximately 15 hours) during which the bridge was moved into place.

Maryland Ave. was closed for 2 months, and the traffic was detoured to alternate crossings over I-35E. Under traditional construction, Maryland Ave. would be closed for 4 months and the traffic would be detoured to alternate crossings over I-35E. The increase in travel distance due to the detours was approximately 1.6 miles, with a corresponding increase in travel time of 7 minutes, 30 seconds. Given the volume of traffic diverted (assuming a 100 percent diversion of 23,400 vehicles per day, which is the average of Maryland Ave. traffic east of I-35E and west of I-35E, with 10 percent commercial trucks), the resulting delay was calculated to be 2,925 hours per day. From the mileage perspective, the 1.6-mile detour for a volume of 23,400 vehicles per day indicates a mileage impact of 37,440 vehicle-miles per day.

MnDOT estimates delay costs of $15.60 per hour for automobiles and $26.90 per hour for commercial trucks. This figure includes delay time, vehicle occupancy, and lost hourly wages for automobiles and commercial vehicles. Assuming that traditional construction would have impacted traffic for an additional 60 days, this results in a user delay cost differential of $2,900,000, as calculated below:

[21,060 passenger cars/day × 15.60 delay cost/hour + 2,340 commercial trucks/day × 26.90 delay costs/hour] × (7.5/60) hours delay × 60 days = $2,900,000.

Safety Costs

The safety standards for the bridge would be the same whether the bridge was constructed using traditional or innovative methods. As such, the crash- and safety-related costs between the as-constructed case and baseline cases are expected to be identical.

The innovative construction also reduced traffic impacts to I-35E to only a few days. Moving the superstructure into place occurred on a weekend with a full closure, thus minimizing the need for temporary lane closures to set beams and perform other superstructure construction required with traditional construction methods and consequently reducing the risk of rear-end crashes that typically occur within these types of work zones. However, because of the relatively short timeframe of impact on I-35E (12 days vs. 3 days), the monetary value of the safety benefits is expected to be small and not included in the analysis.

Cost Summary

Construction costs for the MnDOT Maryland Ave. bridge project totaled about $14,119,182, which resulted in an increase of $800,000 over the conventional alternative. However, a savings of $2,900,000 in road user cost was estimated from the reduction of Maryland Ave. closure days from 4 months to 2 months. While not directly recouped by the agency, this indicates an estimated savings of about $2,100,000 using ABC technology.

Furthermore, it is believed that some of the additional cost of the ABC alternative was due to the unfamiliarity with the technology by the construction community, indicating that future projects could result in even more savings.

TECHNOLOGY TRANSFER

No showcase was held for this project. However, to promote further interest and to encourage implementation of the ABC technology used in this project, MnDOT organized a formal site visit by MnDOT staff during the bridge move (figures 85 and 86).

Figure 85. Photo. Safety briefing in preparation for visit to the job site.

Figure 86. Photo. MnDOT staff observing the moving of the Maryland Ave. bridge using the SPMT.

REFERENCES

1. *Manual on Use of Self-Propelled Modular Transporters to Remove and Replace Bridges*, Federal Highway Administration, Washington, DC, (accessed October 7, 2014), http://www.fhwa.dot.gov/bridge/pubs/07022/chap00.cfm.

APPENDIX A: PRECONSTRUCTION USER SATISFACTION SURVEY

Appendix A includes the Pre-Wave user satistfaction survey plans and questionnaire prepared for the Maryland Ave. bridge project by DRG.

Questionnaire

MnDOT I-35E Corridor Study

Prepared For:

MnDOT

Prepared By:

Information to insights...Launching you forward

200 Bishops Way
Brookfield, WI 53005

April 17, 2012
Project Tracking Number: 6981
Version: 2

Sample: The DRG will purchase a sample list based on the qualifiers for this survey. The calling sample will be proportional to the population.

Respondent: Respondents will be adult residents in Minnesota, falling into one of the following two groups:

I-35E users

- To qualify, this group of respondents must:
  - Drive on I-35E during morning peak periods 3-4 times per week
  - Have driven I-35E regularly for 2+ years
- We will recruit for a mix of general users and a minimum of 50 bus/carpoolers

Residents living in select zip codes near I-35E

Quotas: We will complete 400 interviews with I-35E users and 200 interviews with residents living near I-35E. Demographically, MnDOT anticipates a random distribution from the RDD sample.

Quotas	
Segment	**# of Interviews**
I-35E Users (General)	400
Bus/Carpoolers	50
Residents (Cross over I-35E on Maryland Bridge)	200
Total Interviews	**600**

Survey Target Length: 12 Minutes

Incidence: Taking into consideration the current respondent qualifiers, quotas and list source, and actual incidence of the past wave of research, The DRG is providing costs based on a qualifying incidence of 20% for I-35E users and 70% for residents living within a five mile radius of the I-35E corridor (Maryland Ave. Bridge).

Incidence is derived by taking the total number of qualified respondents and dividing by the total number who are qualified plus the total number who are not qualified for the survey. All incidence numbers are derived from respondents spoken to who are past the qualification point. Dispositions such as disconnected phones, initial refusals, etc. are never considered in incidence calculations.

Introduction

Hello, my name is _____, and I am calling on behalf of **MnDOT [pronounced Minndot]**. Today/Tonight, I am conducting research to obtain your opinions regarding upcoming highway construction projects. I am not trying to sell anything. I'm only interested in your opinions and traveling experiences.

Confidentiality Statement

MnDOT is committed to protecting the identity of those responding to their surveys. Please be assured that your personal information will not ever be shared with MnDOT or any 3rd party. The only thing about you that is kept on anyone's record is your zip code.

READ IF ASKED:

- Re-emphasize this is a survey, not a sales call.
- Responses are completely anonymous.
- Depending on your responses, the survey will take about 10 to 12 minutes to complete.

If the respondent states they are on the state's do-not-call list and we should not be calling them, we should respond with:

"That law pertains to telemarketers. We are not selling anything. We are a survey research firm gathering opinions so that agencies can better understand your opinions.

This call may be monitored for quality and training purposes.

Screener Questions

(IF A RESPONDENT <u>REFUSES</u> TO ANSWER QUESTIONS DURING A SCREENER – SHOULD CODE AS AN INITIAL REFUSAL)

S1. What is the zip code in which you reside? _____

98 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[S1 MUST MATCH LIST OF ZIPCODES FROM PURCHASED SAMPLE – EITHER SAMPLE 1 RESIDENTS OR SAMPLE 2 COMMUTERS]

S2. Do you or does anyone in your household work for: **(READ LIST, ENTER ALL THAT APPLY)**

1 The Minnesota Department of Transportation
2 A Bus company
3 A marketing research firm
4 A newspaper, radio or TV station
5 The Metropolitan Council, or
6 City or county public works department
9 None of the above **[CONTINUE]**

[IF S2 = ANY 1-6, THANK AND TERMINATE, ELSE CONTINUE]

S3. Have you participated in any research survey sponsored by MnDOT in the past 12 months?

1 Yes **[THANK AND TERMINATE]**
2 No **[CONTINUE]**

S4. In what year were you born? _____

9 Refused **(THANK AND TERMINATE)**

[IF S4 >1937 or < 1994, THANK AND TERMINATE, ELSE CONTINUE]

S5. Do you regularly travel on I-35E in either direction between Larpenteur Ave./ Wheelock Parkway and Pennsylvania Ave**.** between 5:30 am and 9 am?

1 Yes
2 No
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[IF S5 = 2, SKIP TO S10, ELSE CONTINUE]

S6. Which direction do you travel using I-35E between 5:30 am and 9 am?

1 Northbound away from the downtown St. Paul area
2 Southbound towards the direction of downtown St. Paul
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

S7. For how long have you driven on I-35E?

1 Less than one year **(THANK AND TERMINATE)**
2 1-2 years **(THANK AND TERMINATE)**
3 2-3 years
4 4 years or more
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

S8. How frequently, on average, do you personally travel on I-35E between 5:30 am and 9 am?

1 1 time a week **(THANK AND TERMINATE)**
2 2 times a week **(THANK AND TERMINATE)**
3 3-4 times a week
4 5 or more times a week
9 (DO NOT READ) Refused **(THANK AND TERMINATE)**

S9. When traveling on I-35E, do you **typically**: **(READ LIST, ENTER ALL THAT APPLY)**

1 Drive alone
2 Carpool
3 Ride the bus

[STRIVE FOR S9 2 OR 3 N = 50]

S10. Have you traveled across the Maryland Bridge, that is, on the bridge itself, within the past two years?

1 Yes
2 No
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[IF S5 = 2 AND S10 = 2, THANK AND TERMINATE, ELSE CONTINUE]

SET QUOTAS FOR:
[IF S5 = 1 AND S7 = 3-4 AND S8 = 3-4] **COMMUTERS (N=400)**
[IF S5 = 2 AND S10 = 1] **RESIDENTS (N=200)**

General Use of I-35E Freeway lanes

For this first set of questions I would like you to think about your travel on I-35E during typical (or normal) weather conditions…

1. For which of the following purposes do you use the I-35E? **(READ LIST. ENTER ALL THAT APPLY.)**

   1 Work trips (Commuting)
   2 School trips
   3 Personal business (Shoppingorerrands)
   4 Work appointments
   5 Recreational
   6 Medical
   7 Other (please specify _____)

2. Thinking of all the occasions you have for using the I-35E lanes, approximately how many one-way trips do you take per week? **(READ LIST. IF UNSURE, ASK RESPONDENT TO GIVE THEIR BEST ESTIMATE.)**

   1 1 trip per week
   2 2 trips per week
   3 3 trips per week
   4 4 trips per week
   5 5 trips per week
   6 6 trips per week
   7 More than 6 trips per week
   8 **(DO NOT READ)** None

Satisfaction with Roadway and Travel Conditions

Next I would like to ask a few questions regarding your satisfaction with the roadway and travel conditions on I-35E in either direction between Larpenteur Ave./Wheelock and Pennsylvania Ave.

3. Using a scale from "1" to "10" where "10" means Extremely Satisfied and "1" means Extremely Dissatisfied, how satisfied are you overall with the roadways along I-35E between Larpenteur Ave. and Pennsylvania Ave., in either direction?

Extremely Dissatisfied									Extremely Satisfied	[DON'T OFFER]
1	2	3	4	5	6	7	8	9	10	Don't Know

4. Still thinking about the same section of roadway on I-35E on the east side of St. Paul, , please rate how satisfied you are with each of the following. Using a scale from "1" to "10" where "10" means Extremely Satisfied and "1" means Extremely Dissatisfied, how satisfied are you with…? **(READ AND ROTATE LIST).**

Extremely Dissatisfied									Extremely Satisfied	[DON'T OFFER]
1	2	3	4	5	6	7	8	9	10	Don't Know

a. The pavement smoothness Your average travel time
b. The volume of traffic or congestion levels
c. The ease of merging onto the freeway
d. The amount of signage
e. The clarity or understandability of the signs
f. The quality of the lighting
g. The overall safety of the driving conditions
h. The smoothness of the pavement

Satisfaction with Maryland Bridge Travel Conditions

5. Now thinking about the roadway on the Maryland Bridge crossing over I-35E, please rate how satisfied you are with each of the following. Using a scale from "1" to "10" where "10" means Extremely Satisfied and "1" means Extremely Dissatisfied, how satisfied are you with…? **(READ AND ROTATE LIST).**

Extremely Dissatisfied									Extremely Satisfied	[DON'T OFFER]
2	2	3	4	5	6	7	8	9	10	Don't Know

a. The bridge surface smoothness
b. The volume of traffic or congestion levels
c. The ease of turning onto I-35E from the Maryland Bridge
d. The amount of signage
e. The clarity or understandability of the signs
f. The quality of the lighting
g. The smoothness of the pavement
h. Overall safety of the driving conditions
i. The current bicycle and or pedestrian access crossing the bridge

Awareness of Upcoming Construction Projects

Next I would like to ask you some questions regarding upcoming construction projects.

6. What upcoming freeway construction projects, if any, are you aware of? **(DO NOT READ LIST, ENTER ALL THAT APPLY.)**

1 Reonstruction of the Cayuga bridge
2 Reconstruction of the Maryland bridge
3 Construction of I-35E MnPass Express lanes
4 General roadway reconstruction along I-35E
5 Other (Please specify highway name and traffic direction): _____
6 None

[ASK Q7 FOR ANY RESPONSES NOT MENTIONED IN Q6. IF Q6 = "5" OR "6", ASK Q7 READING ALL CODES 1-3, IF Q6 = 1-4, SKIP TO Q8.]

7. Which of the following upcoming freeway construction projects, if any, are you aware of? **(ROTATE LIST, READ LIST, ENTER ALL THAT APPLY.)**

1 Reconstruction of the Cayuga bridge
2 Reconstruction of the Maryland bridge
3 Possible construction of I-35E MnPass Express lanes
4 **(DO NOT READ)** None

[ASK Q8 ONLY FOR CODES ENTERED IN Q6 1-4 AND Q7 1-3]

8. What have you specifically heard about the following upcoming freeway construction projects? **(RECORD VERBATIM RESPONSE. PROBE AND CLARIFY.)**

1 Reconstruction of the Cayuga bridge: _____
2 Reconstruction of the Maryland bridge: _____
3 Possible construction of I-35E MnPass Express lanes: _____
4 General roadway reconstruction along I-35E between Larpenteur Ave. and Pennsylvania Ave.: _____

9. Are you aware that the Maryland Bridge reconstruction will be different than other construction efforts?

1 Yes
2 No
9 Not sure / Don't Know

9b. Using a scale of 1 – 10 with "1" meaing you strongly disagree and "10" meaning you strongly agree, how would you rate MnDOT on the following statements:

MnDOT is innovative in their construction plans and programs (1 -10)
I feel well informed about upcoming construction projects and plans (1-10)
I know how to get the information I need about upcoming construction projects and plans (1-10)

[AUTOFILL RESPONSES TO Q6 AND Q7 IN Q10]

10. How <u>did</u> you learn about the following upcoming freeway construction projects? **(DO NOT READ, ENTER ALL THAT APPLY.)**

1 Public service announcements on local television stations
2 Announcements on local television newscasts (morning, lunch hour and/or evening)

3 Public service announcements on local radio stations
4 Signage along the affected stretch of freeway
5 Direct mail communications
6 Postings on the MnDOT (MN Department of Transportation) website
7 Newspapers (Star Tribune)
8 511 traveler information – website
9 511 traveler information -- phone number
10 Personal experience from traveling the freeway
11 Electronic overhead signage (along freeway)
12 Social media (Facebook, Twitter, etc.)
13 Regular email updates providing general construction information with links to other relevant transportation updates
14 Other (please specify) _____
98 **(DO NOT READ)** Don't know

11. How would you prefer to receive communications regarding upcoming freeway construction projects? **(ROTATE LIST, READ LIST. ENTER ALL THAT APPLY.)**

1 Public service announcements on local television stations
2 Announcements on local television newscasts (morning, lunch hour and evening)
3 Public service announcements on local radio stations
4 Signage along the affected stretch of freeway
5 Direct mail communications
6 Postings on the MnDOT (MN Department of Transportation) website
7 Newspapers (Star Tribune)
8 511 (Freeway travel information)
9 Electronic overhead signage (along freeway)
10 Social media (Facebook, Twitter, etc.)
11 Regular email updates providing general construction information with links to other relevant transportation updates
12 Other (please specify _____)

12. What specific types of information would you find most helpful regarding upcoming freeway construction projects? **(DO NOT READ LIST. ENTER ALL THAT APPLY.)**

1 Starting date for the construction project
2 Estimated ending date for the construction project
3 Specific stretch of freeway being affected by the construction project
4 Number of lane reductions anticipated during the construction project
5 Specific roadways to be designated as detour routes
6 Projected timing (day vs. night) for lane reductions
7 Projected timing for closure of specific sections of freeway and/or freeway ramps during construction
8 Innovative construction plans, new bridge innovation
8 Other (please specify _____)

Preference of Method for Completing Construction

Now I would like to ask you a few questions upcoming freeway construction projects.

13. In your opinion, what is your greatest concern or complaint regarding freeway construction projects? **(RECORD VERBATIM RESPONSE. PROBE AND CLARIFY.)**

_____

_____

_____

[IF S5 = 1 (COMMUTERS), CONTINUE, ELSE SKIP TO Q15]

14. Thinking of those times when freeway construction is causing longer travel delays, how do you adjust your travel if at all? Would you say you… **(READ LIST. ENTER ALL THAT APPLY.)**

1 Change the time you travel by leaving earlier or later
2 Change your travel route as a result of travel information recommendations
3 Change your travel route based on your own experience
4 Eliminate a trip, when possible
5 Change the way you travel (carpool, take the bus, etc.)
6 **(DO NOT READ)** Make no changes to the way you travel
7 Other (please specify): _____

15. Which one of the following construction scenarios would you prefer? **(READ LIST. ENTER ONLY ONE RESPONSE. REPEAT IF NECESSARY.)**

1 Temporary shut-down of the affected section of freeway during overnight hours and/or during the weekend in order to shorten the overall construction timeframe, while continuing to allow travel during peak driving times
2 Continuous access to the affected section of freeway during the entire construction period, minimizing detour traffic to surrounding roadways, but lengthening the overall construction timeframe
3 **(DO NOT READ)** Other (please specify): _____

Awareness of MnPass Express

My next few questions have to do with MnPass Express lanes.

16. Are you familiar with or have heard of MnPass Express lanes?

1 Yes
2 No
9 **(DO NOT READ)** Don't know

[IF Q16=2 OR 99, READ FOLLOWING DESCRIPTION, ELSE CONTINUE.] READ FOR EVERYONE – you could start with "just to make sure when we're saying MnPASS Express lanes we're referring to the following…"

A MnPASS Express lane is designed for solo drivers (those driving alone) to be able to use HOV (High Occupancy Vehicle lanes) those lanes traditionally reserved for carpoolers, bus riders or motorcyles. MnPASS Express lanes would also allow solo drivers to pay a modest electronic toll for a time predictable trip during congested, peak periods. Its purpose is to maintain traffic flow and alleviate congestion providing a more convenient and timely trip for solo drivers.

17. To the best of your knowledge, which metro freeways currently have MnPass Express lanes? **(DO NOT READ LIST, ENTER ALL THAT APPLY.)**

1 I-35W
2 I-35E
3 Highway 394
4 Other (Please specify): _____
98 **(DO NOT READ)** None of the above
99 **(DO NOT READ)** Don't know of any

[ASK Q18 FOR ANY RESPONSES NOT MENTIONED IN Q17. IF Q17 = "98" OR "99", ASK Q18 READING ALL CODES 1-2.]

18. Which of the following metro area MnPass Express lanes, if any, are you aware of? **(ROTATE LIST, READ LIST, ENTER ALL THAT APPLY.)**

1 I-35W
2 Highway 394
9 **(DO NOT READ)** None of the above

19. Whether as a carpooler, bus rider, motorcycle or as a solo driver paying a modest fee, How likely would you be to use the MnPass Express lane <u>on I-35E</u> if it were to be made available -- during the peak periods (weekday mornings and afternoons)? Would you say your likelihood to use a MnPASS Express lane is… **(READ LIST. ENTER ONLY ONE.)**

Very Likely
Somewhat likely
Not very likely or
Not at all Likely to use the MnPASS lane?
Don't

19b. If Very or somewhat likely ask:
Would you likely use the MnPASS lane as a:
Solo driver – paying a modest fee to use this lane
Bus rider along 35E (no fee to use the lane)
Carpooler (no fee to use the lane)
Motorcylce (no fee to use the lane)

Demographic Questions

The next few questions are for classification purposes only.

D1. **(RECORD GENDER)**:

1 Male
2 Female

D2. How long have you lived at your current residence?

_____ **(ENTER WHOLE NUMBER)**

D3. What is the highest level of education you have completed? **(IF NECESSARY, READ CODES 1-6)**

1 Less than high school
2 High school graduate
3 Some college/Technical/Vocational school
4 4 Year degree college graduate
5 Post-graduate degree (e.g., Masters degree)
6 Doctoral degree (e.g., Ph.D., MD, DDS, etc.)
8 Don't know
9 Refused

D4. Are you of Hispanic or Latino origin?

1 Yes
2 No

[IF D4 = 2, CONTINUE, ELSE SKIP TO D5]

D4.1 How would you describe yourself in terms of your race? **(IF NECESSARY, READ CODES 1-4)**

1 African American/Black
2 American Indian or Alaskan Native
3 Asian
4 White or Caucasian
5 Other
98 Don't know
99 Refused

D5. I am going to read several income groups. In 2011, what was your household's total annual income (from all sources) before taxes or other deductions from pay? Note: If your household doesn't share income, please report your personal income only.

Please stop me when I reach the group that includes your total annual household income before taxes.

(READ CODES 1-10)

1 Less than $10,000
2 $10,000 to less than….$25,000
3 $25,000 to less than (etc.)$35,000
4 $35,000 to $50,000
5 $50,000 to $75,000
6 $75,000 to $100,000
7 $100,000 to $150,000
8 $150,000 to $200,000
9 $200,000 to $250,000
10 $250,000 or more
98 **(DO NOT READ)** Don't know
99 **(DO NOT READ)** Prefer not to answer

D6. How many working automobiles do you have available for your use?

_____ Automobiles
Refused = 99

D.7 Have you personally used an outdoor bicycle within the past two years?

1 Yes
2 No

D8. For validation purposes only, what is your first name?

_____

D9. Would you be interested and willing to participate in future transportation surveys on behalf of MnDOT?

1 Yes **(CONTINUE)**
2 No **(THANK AND TERMINATE)**

[IF D9 = 1, VERIFY FULL NAME, PHONE NUMBER AND EMAIL ADDRESS)

Full name: _____
Phone number: _____
Email address: _____

APPENDIX B: POSTCONSTRUCTION USER SATISFACTION SURVEY

Appendix B includes the Post-Wave user satistfaction survey plans and questionnaire prepared for the Maryland Ave. bridge project by DRG. Changes between the Pre-Wave and Post-Wave survey are highlighted in this appendix.

Questionnaire

MnDOT I-35E Corridor Study Post-Wave

Prepared For:

MnDOT

Prepared By:

Information to insights...Launching you forward

200 Bishops Way
Brookfield, WI 53005

March 12, 2013
Project Tracking Number: 7153
Version: 2

gather create launch

Sample: The DRG will purchase a sample list based on the qualifiers for this survey. The calling sample will be proportional to the population.

Respondent: Respondents will be adult residents in Minnesota, falling into one of the following two groups:

I-35E users

- To qualify, this group of respondents must:
  - Drive on I-35E during morning peak periods 3-4 times per week
  - Have driven I-35E regularly for 2+ years
- We will recruit for a mix of general users and a minimum of 50 bus/carpoolers

Residents living in select zip codes near I-35E

Quotas: We will complete 400 interviews with I-35E users and 200 interviews with residents living near I-35E. Demographically, MnDOT anticipates a random distribution from the RDD sample.

Quotas	
Segment	**# of Interviews**
I-35E Users (General)	400
Bus/Carpoolers	50
Residents (Cross over I-35E on Maryland Bridge)	200
Total Interviews	**600**

Survey Target Length: 12 Minutes

Incidence: Taking into consideration the current respondent qualifiers, quotas and list source, and actual incidence of the past wave of research, The DRG is providing costs based on a qualifying incidence of 20% for I-35E users and 70% for residents living within a five mile radius of the I-35E corridor (Maryland Ave. Bridge).

Incidence is derived by taking the total number of qualified respondents and dividing by the total number who are qualified plus the total number who are not qualified for the survey. All incidence numbers are derived from respondents spoken to who are past the qualification point. Dispositions such as disconnected phones, initial refusals, etc. are never considered in incidence calculations.

Introduction

Hello, my name is _____, and I am calling on behalf of **MnDOT [pronounced Minndot]**. Today/Tonight, I am conducting research to obtain your opinions regarding recently completed or upcoming highway construction projects. I am not trying to sell anything. I'm only interested in your opinions and traveling experiences. May I speak to someone 18 or older?

Confidentiality Statement

MnDOT is committed to protecting the identity of those responding to their surveys. Please be assured that your personal information will not ever be shared with MnDOT or any 3rd party. The only thing about you that is kept on anyone's record is your zip code.

READ IF ASKED:

- Re-emphasize this is a survey, not a sales call.
- Responses are completely anonymous.
- Depending on your responses, the survey will take about 10 to 12 minutes to complete.

If the respondent states they are on the state's do-not-call list and we should not be calling them, we should respond with:

"That law pertains to telemarketers. We are not selling anything. We are a survey research firm gathering opinions so that agencies can better understand your opinions.

If respondent states they have completed a survey like this in the past, we should respond with:

"You may have completed a similar survey in early summer 2012, but we're also interested in your current opinions."

This call may be monitored for quality and training purposes.

Screener Questions

(IF A RESPONDENT <u>REFUSES</u> TO ANSWER QUESTIONS DURING A SCREENER – SHOULD CODE AS AN INITIAL REFUSAL)

S1. What is the zip code in which you reside? _____

99 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[S1 MUST MATCH LIST OF ZIP CODES FROM PURCHASED SAMPLE]

S2. Do you or does anyone in your household work for: **(READ LIST, ENTER ALL THAT APPLY)**

1 The Minnesota Department of Transportation
2 A Bus company
3 A marketing research firm
4 A newspaper, radio or TV station
5 The Metropolitan Council, or
6 City or county public works department
9 None of the above **[CONTINUE]**

[IF S2 = ANY 1-6, THANK AND TERMINATE, ELSE CONTINUE]

DELETE S3

~~S3. Have you participated in any research survey sponsored by MnDOT in the past 12 months?~~

~~1 Yes **[THANK AND TERMINATE]**~~
~~2 No **[CONTINUE]**~~

S4. In what year were you born? _____

9 Refused **(THANK AND TERMINATE)**

[IF S4 <1937 or > 1994, THANK AND TERMINATE, ELSE CONTINUE]

S5. Do you ever travel on I-35E in either direction between Larpenteur Ave./ Wheelock Parkway and Pennsylvania Ave**.**?

1 Yes
2 No
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[IF S5 = 2, SKIP TO S10, ELSE CONTINUE]

S5a. Do you typically travel on I-35E in either direction between Larpenteur Ave./ Wheelock Parkway and Pennsylvania Ave**. between 5:30 am and 9 am**?

1 Yes
2 No
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[IF S5a = 2, SKIP TO S7, ELSE CONTINUE]

S6. Which direction do you typically travel using I-35E between 5:30 am and 9 am? **(READ LIST.)**

1 Northbound away from the downtown St. Paul area
2 Southbound towards the direction of downtown St. Paul
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

S7. For how long have you driven on I-35E? **(READ LIST.)**

1 Less than one year **(THANK AND TERMINATE)**
2 1-2 years
3 2-3 years
4 4 years or more
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

S8. How frequently, on average, do you personally travel on I-35E? **(READ LIST.)**

1 1 time a week or less **(THANK AND TERMINATE)**
2 2 times a week **(THANK AND TERMINATE)**
3 3-4 times a week
4 5 or more times a week
9 (DO NOT READ) Refused **(THANK AND TERMINATE)**

[IF S7 = 1 or 9 or S8 = 1-2 or 9 THANK AND TERMINATE, ELSE CONTINUE]

S9. When traveling on I-35E, do you **typically**: **(READ LIST, ENTER ALL THAT APPLY)**

1 Drive alone
2 Carpool
3 Ride the bus
9 **(DO NOT READ)** Refused

[STRIVE FOR S9 2 OR 3 N = 50]

S10. Have you traveled across the Maryland Bridge, that is, on the bridge itself, within the past two years?

1 Yes
2 No
9 **(DO NOT READ)** Refused **(THANK AND TERMINATE)**

[IF S5 = 2 AND S10 = 2, THANK AND TERMINATE, ELSE CONTINUE]

SET QUOTAS FOR:
[IF S8 = 3 or 4 = I-35E USERS (N=400)
[IF S5 = 2 = RESIDENTS/BRIDGE USERS (N=200)

General Use of I-35E Freeway lanes

For this first set of questions I would like you to think about your travel on I-35E during typical (or normal) weather conditions…

12. For which of the following purposes do you use the I-35E? **(READ LIST. ENTER ALL THAT APPLY.)**

[INTERVIEWER NOTE: I HAVE A SHORT LIST TO READ TO YOU, PLEASE TELL ME YES OR NO AFTER EACH.]

1 Work trips (Commuting)
2 School trips
3 Personal business (Shopping and/or errands)
4 Work appointments
5 Recreational
6 Medical
7 Other (please specify _____)

Deleted Q2 in Pre-Wave

Satisfaction with Roadway and Travel Conditions

Next I would like to ask a few questions regarding your satisfaction with the roadway and travel conditions on I-35E in either direction between Larpenteur Ave./ Wheelock Parkway and Pennsylvania Ave. Please exclude any impact related to winter weather conditions you may have experienced when thinking about your satisfaction levels.

3. Using a scale from "1" to "10" where "10" means Extremely Satisfied and "1" means Extremely Dissatisfied, how satisfied are you overall with the roadways along I-35E between Larpenteur Ave. and Pennsylvania Ave., in either direction?

Extremely Dissatisfied								Extremely Satisfied	[DON'T OFFER]
2	2	3	4	5	6	7	8	9	10	Don't Know

4. Still thinking about the **same section** of roadway on I-35E on the east side of St. Paul, please rate how satisfied you are with each of the following. Using a scale from "1" to "10" where "10" means Extremely Satisfied and "1" means Extremely Dissatisfied, how satisfied are you with…? **(READ AND ROTATE LIST).**

Extremely Dissatisfied								Extremely Satisfied	[DON'T OFFER]
5	2	3	4	5	6	7	8	9	10	Don't Know

i. The pavement smoothness
j. Your average travel time
k. The volume of traffic or congestion levels
l. The ease of merging onto the freeway
m. The amount of signage
n. The clarity or understandability of the signs
o. The quality of the lighting
p. The overall safety of the driving conditions

Satisfaction with Maryland Bridge Travel Conditions

[IF S5 = 1 AND S10 = 2, SKIP TO Q6, ELSE CONTINUE]

5. Now thinking about the roadway on the Maryland Bridge crossing over I-35E, please rate how satisfied you are with each of the following. Using a scale from "1" to "10" where "10" means Extremely Satisfied and "1" means Extremely Dissatisfied, how satisfied are you with…? **(READ AND ROTATE LIST).**

Extremely Dissatisfied									Extremely Satisfied	[DON'T OFFER]
1	2	3	4	5	6	7	8	9	10	Don't Know

a. The bridge surface smoothness
b. The volume of traffic or congestion levels
c. The ease of turning onto I-35E from the Maryland Bridge
d. The amount of signage
e. The clarity or understandability of the signs
f. The quality of the lighting
g. The smoothness of the pavement
h. Overall safety of the driving conditions
i. The current bicycle and or pedestrian access crossing the bridge

Awareness of Recently Completed or Upcoming Construction Projects

Next I would like to ask you some questions regarding upcoming construction projects.

6. What recently completed or upcoming freeway construction projects, if any, are you aware of? **(DO NOT READ LIST, ENTER ALL THAT APPLY.)**

9 Reconstruction of the Cayuga bridge (I35E from Maryland to University)
10 Reconstruction of the Maryland bridge
11 ~~Possible~~ Construction of I-35E MnPass Express lanes
12 General roadway reconstruction along I-35E
13 Reconstruction of I-694, Highway 10/Snelling Ave.
14 Hwy 36 & English St.
15 Other (Please specify highway name and traffic direction): _____
16 None

[ASK Q7 FOR ANY RESPONSES NOT MENTIONED IN Q6. IF Q6 = "6" OR "7", ASK Q7 READING ALL CODES 1-4, IF Q6 = 1-5, SKIP TO Q8.]

7. Which of the following recently completed or upcoming freeway construction projects, if any, are you aware of? **(ROTATE LIST, READ LIST, ENTER ALL THAT APPLY.)**

1 Reconstruction of the Cayuga bridge (I35E from Maryland to University)
2 Reconstruction of the Maryland bridge
3 ~~Possible~~ Construction of I-35E MnPass Express lanes
4 Reconstruction of I-694, Highway 10/Snelling Ave.
5 Hwy 36 & English St.
6 **(DO NOT READ)** None

[ASK Q8 ONLY FOR CODES ENTERED IN Q6 1-6 AND Q7 1-5]

8. What have you specifically heard about the **[INSERT CODES FROM Q6 AND Q7]**? **(DO NOT READ LIST, ENTER ALL THAT APPLY. IF RESPONSE DOES NOT SPECIFICALLY MATCH LISTED CODES, RECORD VERBATIM FOR OTHER.)**

1 General awareness, no specifics
2 Read in the newspaper (Specify which newspaper): _____
   a. St. Paul Pioneer Press
   b. Star Tribune
   c. East Side Review
3 The Maryland bridge will be constructed offsite
4 Reconstruction due to PM congestion
5 Bridge(s) are being replaced/rebuilt
6 It may become a toll portion of the freeway
7 Have seen something along roadways (Specify): _____
   a. Signs/signage
   b. Equipment/trucks
8 Entrance/Exit ramps will be easier to access
9 Construction will take a while
10 Construction will make it safer
11 Closed or blocked
12 Adding lanes/repaving
13 Built on side of freeway, moved into place
14 Innovative
15 Moved bridge down freeway
16 Saw video of bridge being put into place
17 Watched bridge get rolled into place (from side of the road)
18 Other (Specify): _____
9 **(DO NOT READ)** Not sure / Don't Know

9. ~~Are~~ Were you aware that the Maryland Bridge reconstruction ~~will be~~ was different than other construction efforts?

3 Yes
4 No
10 **(DO NOT READ)** Not sure / Don't Know

10. Using a scale of 1 – 10 where "1" means "Strongly Disagree" and "10" means "Strongly Agree", how would you rate MnDOT on the following statements? **(READ AND ROTATE LIST).**

Strongly Disagree									Strongly Agree	[DON'T OFFER]
1	2	3	4	5	6	7	8	9	10	Don't Know

a. MnDOT is innovative in their construction plans and programs
b. I feel well informed about upcoming construction projects and plans
c. I know how to get the information I need about upcoming construction projects and plans

11. How did you learn about the recently completed ~~upcoming~~ freeway construction projects this past construction period? **(DO NOT READ, ENTER ALL THAT APPLY.)**

15 Public service announcements on local television stations
16 Announcements on local television newscasts (morning, lunch hour and/or evening)
17 Public service announcements on local radio stations
18 Signage along the affected stretch of freeway
19 Direct mail communications
20 Postings on the MnDOT (MN Department of Transportation) website
21 Newspapers (Star Tribune)
22 511 traveler information – website
23 511 traveler information -- phone number
24 Personal experience from traveling the freeway
25 Electronic overhead signage (along freeway)
26 Facebook
27 Twitter
28 Regular email updates providing general construction information with links to other relevant transportation updates
29 Videos
30 News stories
31 Other (Specify): _____
98 **(DO NOT READ)** Don't know

DELETE Q12 & Q13

12. How would you prefer to receive communications regarding upcoming freeway construction projects? **(DO NOT READ LIST. ENTER ALL THAT APPLY.)**

13 Public service announcements on local television stations
14 Announcements on local television newscasts (morning, lunch hour and evening)
15 Public service announcements on local radio stations
16 Signage along the affected stretch of freeway
17 Direct mail communications
18 Postings on the MnDOT (MN Department of Transportation) website
19 Newspapers (Star Tribune)
20 511 traveler information – website
21 511 traveler information -- phone number
22 Electronic overhead signage (along freeway)
23 Social media (Facebook, Twitter, etc.)
24 Regular email updates providing general construction information with links to other relevant transportation updates
25 **(DO NOT READ)** Other (Specify): _____
9 **(DO NOT READ)** Don't know

13. What specific types of information would you find most helpful regarding upcoming freeway construction projects? **(DO NOT READ LIST. ENTER ALL THAT APPLY.)**

1 Starting date for the construction project
2 Estimated ending date for the construction project
3 Specific stretch of freeway being affected by the construction project
4 Number of lane reductions anticipated during the construction project
5 Specific roadways to be designated as detour routes
6 Projected timing (day vs. night) for lane reductions
7 Projected timing for closure of specific sections of freeway and/or freeway ramps during construction
8 Innovative construction plans, new bridge innovation
9 Other (Specify): _____

Preference of Method for Completing Construction

Now I would like to ask you a few questions regarding recently completed ~~upcoming~~ freeway construction projects.

14.1 ~~In your opinion, what is your greatest concern or complaint regarding freeway construction projects?~~ Thinking about this most recent construction period, what is most memorable to you about traveling along I-35E in either direction between Larpenteur Ave./ Wheelock Parkway and Pennsylvania Ave? **(RECORD VERBATIM RESPONSE.)**

_____

_____

_____

[IF S5 = 1 (COMMUTERS), CONTINE, ELSE SKIP TO Q16]

15. Thinking of those times when freeway construction ~~is causing~~ caused longer travel delays through this area, how ~~do~~ did you adjust your travel if at all? Would you say you… **(READ LIST. ROTATE LIST. ENTER ALL THAT APPLY.)**

8 Changed the time you traveled by leaving earlier or later
9 Changed your travel route as a result of travel information recommendations
10 Changed your travel route based on your own experience
11 Eliminated a trip, when possible
12 Changed the way you traveled (carpool, take the bus, etc.)
13 **(DO NOT READ)** Made no changes to the way you traveled
14 Other (please specify): _____

DELETE Q16

~~16. Which one of the following construction scenarios would you prefer? **(READ LIST. ROTATE LIST. ENTER ONLY ONE RESPONSE. REPEAT IF NECESSARY.)**~~

~~**[INTERVIEWER NOTE: AFTER READING CODES, IF NECESSARY READ THESE SHORTER VERSIONS TO MAKE IT EASIER TO UNDERSTAND:**~~

~~**1=A TEMPORARY SHUT-DOWN DURING OVERNIGHT HOURS AND/OR DURING THE WEEKEND TO SHORTEN CONSTRUCTION TIMEFRAME.**~~

~~**2=CONTINUOUS ACCESS, WHICH MAY LENGTHEN CONTRUCTION TIMEFRAME.]**~~

~~4 Temporary shut-down of the affected section of freeway during overnight hours and/or during the weekend in order to shorten the overall construction timeframe, while continuing to allow travel during peak driving times~~
~~5 Continuous access to the affected section of freeway during the entire construction period, minimizing detour traffic to surrounding roadways, but lengthening the overall construction timeframe~~
~~6 **(DO NOT READ)** Other (please specify): _____~~

Awareness of MnPass Express

My next few questions have to do with MnPass Express lanes.

17. Are you familiar with or have heard of MnPass Express lanes?

    1 Yes
    2 No
    9 **(DO NOT READ)** Don't know

READ FOLLOWING:

Just to be clear, when we're saying MnPASS Express lanes, we're referring to the following: The purpose of a MnPASS Express lane is to provide a congestion-free option for buses, carpoolers and solo drivers during peak rush hour periods. During peak periods, buses and carpoolers (two or more passengers) can use a MnPASS Express lane for free, while solo drivers can choose to use a MnPASS Express lane for a small fee.

18. To the best of your knowledge, which metro freeways currently have MnPass Express lanes? **(DO NOT READ LIST, ENTER ALL THAT APPLY.)**

    5 I-35W
    6 I-35E
    7 Highway 394
    8 Other (Specify): _____
    98 **(DO NOT READ)** None of the above
    99 **(DO NOT READ)** Don't know of any

[ASK Q19 FOR ANY RESPONSES NOT MENTIONED IN Q18. IF Q18 = "98" OR "99", ASK Q19 READING ALL CODES 1-2.]

19. Which of the following metro area MnPass Express lanes, if any, are you aware of? **(ROTATE LIST, READ LIST, ENTER ALL THAT APPLY.)**

    3 I-35W
    4 Highway 394
    10 **(DO NOT READ)** None of the above

20. Whether as a carpooler, bus rider, motorcycle or as a solo driver paying a modest fee, how likely would you be to use the MnPass Express lane on I-35E if it were to be made available -- during the peak periods weekday mornings and afternoons? Would you say your likelihood to use a MnPASS Express lane is… **(READ LIST. ENTER ONLY ONE.)**

4 Very Likely
3 Somewhat likely
2 Not very likely or
1 Not at all Likely to use the MnPASS lane?
9 (DO NOT READ) Unsure

[IF Q20 = 4-3, ASK Q20b, ELSE CONTINUE TO DEMOGRAPHICS.]

20b. Would you likely use the MnPASS lane as a… **(ROTATE LIST, READ LIST, ENTER ONLY ONE.)**

1 Solo driver – paying a modest fee to use this lane
2 Bus rider along 35E (no fee to use the lane)
3 Carpooler (no fee to use the lane)
4 Motorcycle (no fee to use the lane)
9 (DO NOT READ) Unsure

Demographic Questions

The next few questions are for classification purposes only.

D1. **(RECORD GENDER)**:

1 Male
2 Female

Deleted D2 & D3 in Pre-Wave

D4. Are you of Hispanic or Latino origin?

1 Yes
2 No

[IF D4 = 2, CONTINUE, ELSE SKIP TO D6]

D4.1 How would you describe yourself in terms of your race? **(IF NECESSARY, READ CODES 1-4)**

1 African American/Black
2 American Indian or Alaskan Native
3 Asian
4 White or Caucasian
5 Other
98 Don't know
99 Refused

Deleted D5 in Pre-Wave

D6. How many working automobiles do you have available for your use?

_____ Automobiles
Refused = 99

D7. Have you personally used an outdoor bicycle within the past two years?

1 Yes
2 No

D8. For validation purposes only, what is your first name?

_____

D9. Would you be interested and willing to participate in future transportation surveys on behalf of MnDOT?

1 Yes **(CONTINUE)**
2 No **(THANK AND TERMINATE)**

[IF D9 = 1, VERIFY FULL NAME, PHONE NUMBER AND EMAIL ADDRESS)

Full name: _____
Phone number: _____
Email address: _____

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