HARD SHOULDER RUNNING PILOT PROJECT (SMARTLANE)

The I-670 corridor in Columbus, Ohio, serves as the major artery connecting downtown to the John Glenn International Airport. To combat congestion on this crucial roadway, Burgess & Niple (B&N) led an eight-consultant team to design an Active Traffic Management Strategy called Hard Shoulder Running (HSR). HSR is the temporary use of the shoulder to provide an additional lane of capacity during peak travel hours.

This approach is significantly less expensive than other options, such as traditional road widening, because it uses the existing roadway infrastructure and typically requires fewer impacts to overhead bridges, interchange ramps and signs. The versatile solution also provides the Ohio Department of Transportation (ODOT) with a dynamic system that will allow them to respond to various traffic challenges as they arise.

Innovation & Unique Features

First HSR Application in Ohio

At the time of design, there were only 12 active HSR corridors in the United States, which added to the complexity of the design process. Opened to traffic on October 23, 2019, this is the 14th active HSR corridor in the country and the first in Ohio.

Intelligent Transportation Systems (ITS)

The “SmartLane” brand was a perfect fit for this project with the use of ITS to create a dynamic lane and communicate with drivers. Using 11 Dynamic Messaging Signs (DMS), these communications can include lane closures, speed limits and any emergent information. Operators monitor traffic conditions remotely from the Traffic Management Center (TMC). Using 46 closed-circuit television (CCTV) cameras, they get a complete picture of the corridor at any time. With this information, they close or open the shoulder as an additional lane to optimize traffic flow.

The DMS also display the variable speed limit (VSL). Although Ohio has been utilizing VSLs in work zones for years, this corridor is only the second instance of a permanent VSL in the state. VSLs are used to harmonize speeds to eliminate start-stop traffic operations, which improves capacity and safety. The operators at the TMC use the CCTVs to visually assess the corridor in real-time, determine the appropriate speed limit based on congestion and operating speeds, and then communicate the appropriate speed limit using the DMS. They can adjust the number of available lanes, speed or message to ensure that the corridor is safe and efficient for drivers.

Complexity

Innovation & Technology

This first-of-its-kind project in the state of Ohio presented challenges to the B&N team. One was legislation. In 2017, at the time when the project design plans were being completed, Governor Kasich requested the passage of special legislation to permit the permanent VSLs in this corridor. The legislation included allocating funds to study the effects of different speed limits within the corridor. The law took effect in 2018, allowing the SmartLane project to move forward.

This project requires a change in driver behavior. Before, drivers would refer to permanent signs, located near the ground on the right side of the road, to know the speed limit. Now, they must look up to the DMS to see the current speed limit. To address this necessary change in driver behavior, the design team met with the stakeholders and ODOT to develop a unified message for the public, complete with examples, drive-through simulation videos, and scenario workshops.

At the time of design, there was not an abundance of HSR data or lessons learned. B&N reached out to several DOTs who had implemented HSR on their system for a list of best practices. Most of those agencies admitted a lack of public outreach on their projects. This meant that the design team had to develop their own strategy to clearly communicate their ideas to ensure that all stakeholders and the client understood the solutions.

Interchange Modifications & Bridge Rehabilitation

The analysis clearly showed that SmartLane would relieve congestion within the I-670 corridor. However, to achieve maximum benefit, it was critical that the SmartLane extend beyond the point where the additional lane of capacity was needed to avoid shifting congestion to another spot on the corridor. For this project, that meant a modification was needed to the I-270 interchange where I-670 eastbound terminates to eliminate problematic weaving movements. This was resolved by braiding critical ramps in the interchange to help improve traffic flow and safety performance. The project also added a lane through the center of the interchange as the extension of SmartLane. With this addition, drivers in SmartLane will not be forced to merge into the “general purpose” lane, and traffic can continue to flow freely into the interchange.

To support the ODOT maintenance needs, ODOT and B&N developed a strategy in partnership with the City of Columbus to rehabilitate many of the mainline and overhead city street bridges along the I-670 corridor. These improvements included two new structures, one full superstructure replacement, new bridge decks, new pressure relief joints, semi-integral abutment retrofits and part-width staged construction to accommodate MOT. The rehabilitation efforts required extensive coordination with the City of Columbus to develop a temporary traffic control scheme during construction to maintain access.

Stakeholders

Stakeholders for this project included several government agencies, including the Mid-Ohio Regional Planning Commission (MORPC), City of Columbus, the John Glenn International airport, public safety, first-responders and the Federal Highway Administration (FHWA). Coordination with the City of Columbus Division of Power was needed to identify the power sources, power the ITS and develop the temporary ITS alignment used to carry 911 dispatch calls.

B&N had to meet directly with those who routinely used the shoulder, such as emergency services and the Central Ohio Transit Authority (COTA). COTA’s buses were formerly permitted to use the left (median) shoulder on I-670 when speeds dropped below 35 miles per hour. SmartLane eliminated this option for the COTA bus. However, as mitigation to their loss, B&N was able to create a solution that is expected to prevent speeds from dropping below 35 miles per hour, allowing the buses to use the general purpose lanes without needing to use the shoulders.

Compressed Schedule

Within ODOT’s nine-month project development schedule, the firm completed a Value Engineering workshop that identified $10 million in construction cost savings for the project. B&N also managed complex stakeholder communications, including public meetings and targeted stakeholder meetings, as well as public outreach and education. Finally, B&N utilized interactive strategies such as hands-on workshops and in-person traffic modeling demonstrations to coordinate with FHWA to obtain the Systems Engineering Analysis (SEA) and Design Exception approvals concurrently with the design and keep the project on schedule.

Aesthetics & Sustainable Features

An Attention-Grabbing Result

Throughout SmartLane, there are nine 110,000-pound, billboard-sized gantries that house the DMS and display the speed limit, current lane openings and any emergency messages. These large, bright structures make it easy for a driver to see all relevant information from a distance at any time of day. Other aesthetic treatments were incorporated in this project, including form liners on bridge piers and facia on the noise walls, designed to enhance the projects' aesthetic appeal.

Sustainability

In addition to improving traffic flow, SmartLane has a positive impact on the environment. Reduced congestion means fewer vehicles idling on the freeway. A reduction in vehicle delays decreases noise and air pollution and fuel consumption significantly by reducing the time spent idling. Also, the project's narrow footprint, use of existing infrastructure and staying within the existing right-of-way prevented impacts to the surrounding nature.

Benefit to the Public

Safety & Communications

The numerous cameras along the corridor allow the decision to open or close the shoulder to reside in the TMC where it is communicated to drivers using the DMS. For example, if there is an accident in the in the SmartLane, the TMC can close it to the public, allowing emergency vehicles direct access. The TMC can also elect to close one or more of the general purpose travel lanes if the accident is along the right or left side of the road to help prevent vehicles and occupants involved in the crashfrom being struck by oncoming traffic. To maintain safety and awareness during this process, the TMC can communicate these messages to the public using the DMS.

A Reliable Commute

Located on the heavily-traveled I-670 corridor near John Glenn International Airport, SmartLane creates a more reliable commute for those working in Columbus, as well as those traveling from out of state. This reliability allows drivers to accurately plan activities around their commute times. SmartLane can also be used during off-peak times for special events, such as an Ohio State University football game or festival in downtown Columbus, that have specific ending times. This gives ODOT flexibility on how to best apply this new technology given various road conditions.

In a statement about the SmartLane project, former ODOT Director Jerry Wray noted, "This project is a smart investment for Ohio. By re-purposing the shoulder, which already exists, and investing in state-of-the-art technology, we are able to decrease congestion in this corridor without the high costs and long timelines associated with highway widening...Ultimately, we believe the combination of the extra travel lane and the reduced speed limits will allow for a more reliable commute for travelers along that route."

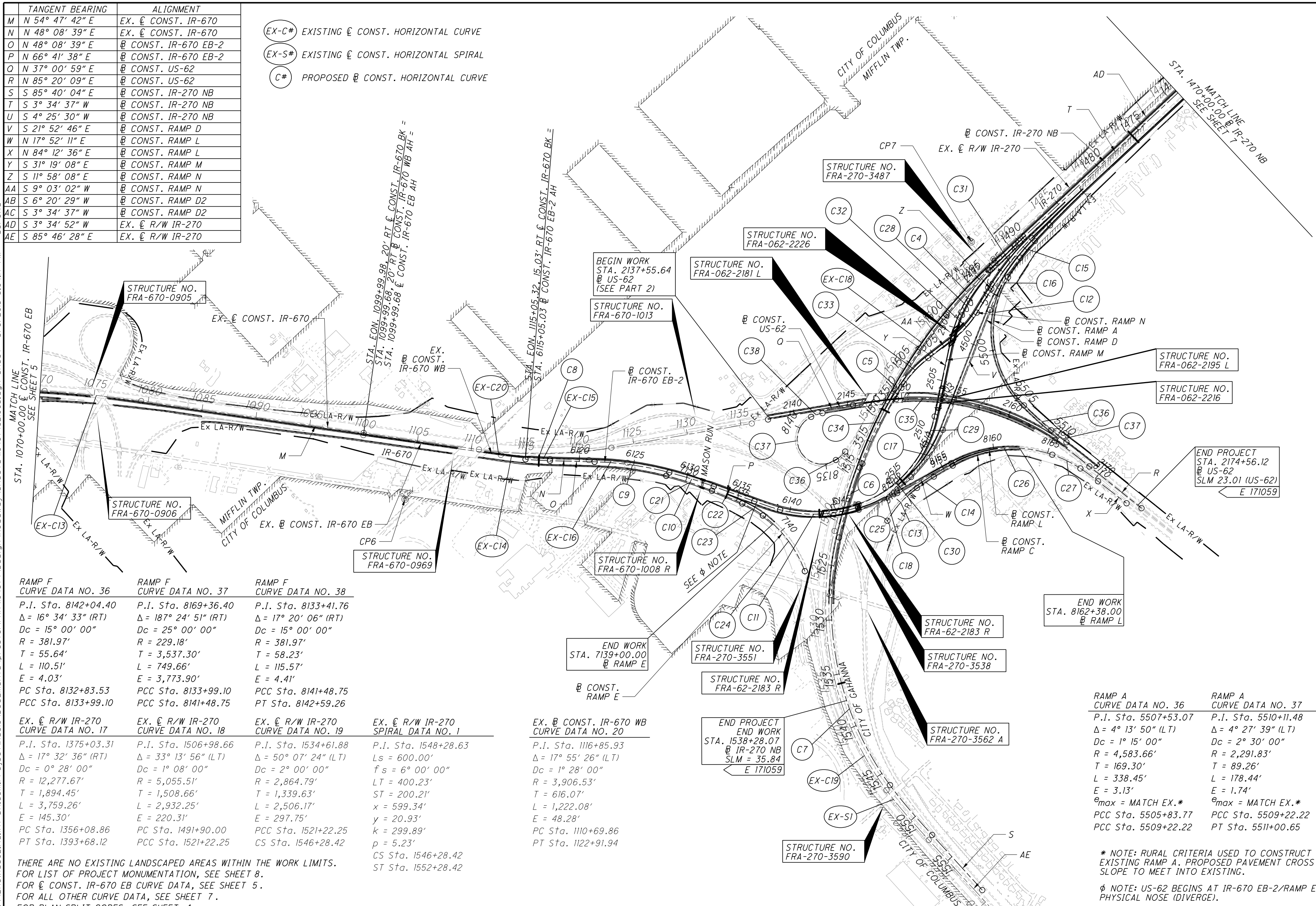
Project Information

Project Design Cost: $6,325,375
Construction Cost: $51,000,000


SPEED LIMIT 45
SPEED LIMIT 45

	TANGENT BEARING	ALIGNMENT
M	N 54° 47' 42" E	EX. ℄ CONST. IR-670
N	N 48° 08' 39" E	EX. ℄ CONST. IR-670
O	N 48° 08' 39" E	℄ CONST. IR-670 EB-2
P	N 66° 41' 38" E	℄ CONST. IR-670 EB-2
Q	N 37° 00' 59" E	℄ CONST. US-62
R	N 85° 20' 09" E	℄ CONST. US-62
S	S 85° 40' 04" E	℄ CONST. IR-270 NB
T	S 3° 34' 37" W	℄ CONST. IR-270 NB
U	S 4° 25' 30" W	℄ CONST. IR-270 NB
V	S 21° 52' 46" E	℄ CONST. RAMP D
W	N 17° 52' 11" E	℄ CONST. RAMP L
X	N 84° 12' 36" E	℄ CONST. RAMP L
Y	S 31° 19' 08" E	℄ CONST. RAMP M
Z	S 11° 58' 08" E	℄ CONST. RAMP N
AA	S 9° 03' 02" W	℄ CONST. RAMP N
AB	S 6° 20' 29" W	℄ CONST. RAMP D2
AC	S 3° 34' 37" W	℄ CONST. RAMP D2
AD	S 3° 34' 52" W	EX. ℄ R/W IR-270
AE	S 85° 46' 28" E	EX. ℄ R/W IR-270

(EX-C#) EXISTING ℄ CONST. HORIZONTAL CURVE
(EX-S#) EXISTING ℄ CONST. HORIZONTAL SPIRAL
(C#) PROPOSED ℄ CONST. HORIZONTAL CURVE



RAMP F CURVE DATA NO. 36
P.I. Sta. 8142+04.40
Δ = 16° 34' 33" (RT)
Dc = 15° 00' 00"
R = 381.97'
T = 55.64'
L = 110.51'
E = 4.03'
PC Sta. 8132+83.53
PCC Sta. 8133+99.10

RAMP F CURVE DATA NO. 37
P.I. Sta. 8169+36.40
Δ = 187° 24' 51" (RT)
Dc = 25° 00' 00"
R = 229.18'
T = 3,537.30'
L = 749.66'
E = 3,773.90'
PCC Sta. 8133+99.10
PCC Sta. 8141+48.75

RAMP F CURVE DATA NO. 38
P.I. Sta. 8133+41.76
Δ = 17° 20' 06" (RT)
Dc = 15° 00' 00"
R = 381.97'
T = 58.23'
L = 115.57'
E = 4.41'
PCC Sta. 8141+48.75
PT Sta. 8142+59.26

EX. ℄ R/W IR-270 CURVE DATA NO. 17
P.I. Sta. 1375+03.31
Δ = 17° 32' 36" (RT)
Dc = 0° 28' 00"
R = 12,277.67'
T = 1,894.45'
L = 3,759.26'
E = 145.30'
PC Sta. 1356+08.86
PT Sta. 1393+68.12

EX. ℄ R/W IR-270 CURVE DATA NO. 18
P.I. Sta. 1506+98.66
Δ = 33° 13' 56" (LT)
Dc = 1° 08' 00"
R = 5,055.51'
T = 1,508.66'
L = 2,932.25'
E = 220.31'
PC Sta. 1491+90.00
PCC Sta. 1521+22.25

EX. ℄ R/W IR-270 CURVE DATA NO. 19
P.I. Sta. 1534+61.88
Δ = 50° 07' 24" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
T = 1,339.63'
L = 2,506.17'
E = 297.75'
PCC Sta. 1521+22.25
CS Sta. 1546+28.42

EX. ℄ R/W IR-270 SPIRAL DATA NO. 1
P.I. Sta. 1548+28.63
Ls = 600.00'
f s = 6° 00' 00"
LT = 400.23'
ST = 200.21'
x = 599.34'
y = 20.93'
k = 299.89'
p = 5.23'
CS Sta. 1546+28.42
ST Sta. 1552+28.42

EX. ℄ CONST. IR-670 WB CURVE DATA NO. 20
P.I. Sta. 1116+85.93
Δ = 17° 55' 26" (LT)
Dc = 1° 28' 00"
R = 3,906.53'
T = 616.07'
L = 1,222.08'
E = 48.28'
PC Sta. 1110+69.86
PT Sta. 1122+91.94

RAMP A CURVE DATA NO. 36
P.I. Sta. 5507+53.07
Δ = 4° 13' 50" (LT)
Dc = 1° 15' 00"
R = 4,583.66'
T = 169.30'
L = 338.45'
E = 3.13'
e_{max} = MATCH EX.*
PCC Sta. 5505+83.77
PCC Sta. 5509+22.22

RAMP A CURVE DATA NO. 37
P.I. Sta. 5510+11.48
Δ = 4° 27' 39" (LT)
Dc = 2° 30' 00"
R = 2,291.83'
T = 89.26'
L = 178.44'
E = 1.74'
e_{max} = MATCH EX.*
PCC Sta. 5509+22.22
PT Sta. 5511+00.65

THERE ARE NO EXISTING LANDSCAPED AREAS WITHIN THE WORK LIMITS.
FOR LIST OF PROJECT MONUMENTATION, SEE SHEET 8.
FOR ℄ CONST. IR-670 EB CURVE DATA, SEE SHEET 5.
FOR ALL OTHER CURVE DATA, SEE SHEET 7.
FOR PLAN SPLIT CODES, SEE SHEET 4.

* NOTE: RURAL CRITERIA USED TO CONSTRUCT EXISTING RAMP A. PROPOSED PAVEMENT CROSS SLOPE TO MEET INTO EXISTING.

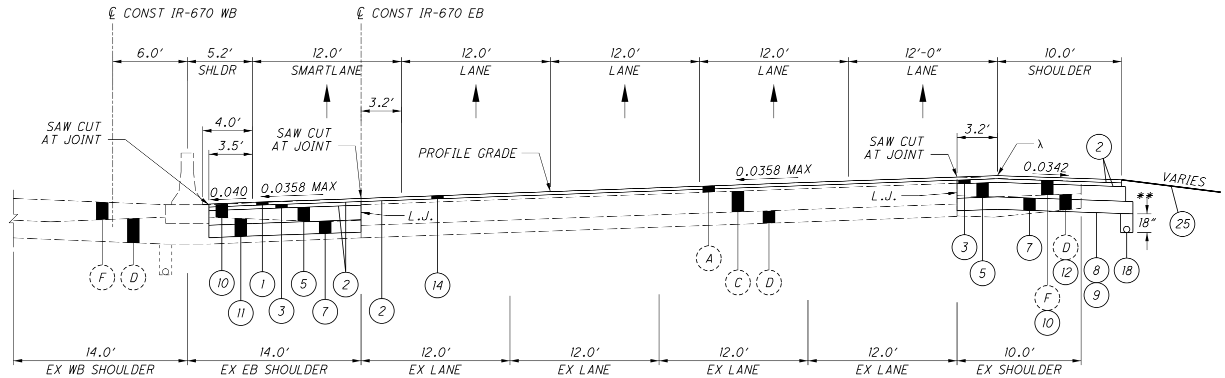
ϕ NOTE: US-62 BEGINS AT IR-670 EB-2/RAMP E PHYSICAL NOSE (DIVERGE).

0 200 400 800 HORIZONTAL SCALE IN FEET

CALCULATED NRS CHECKED MRT

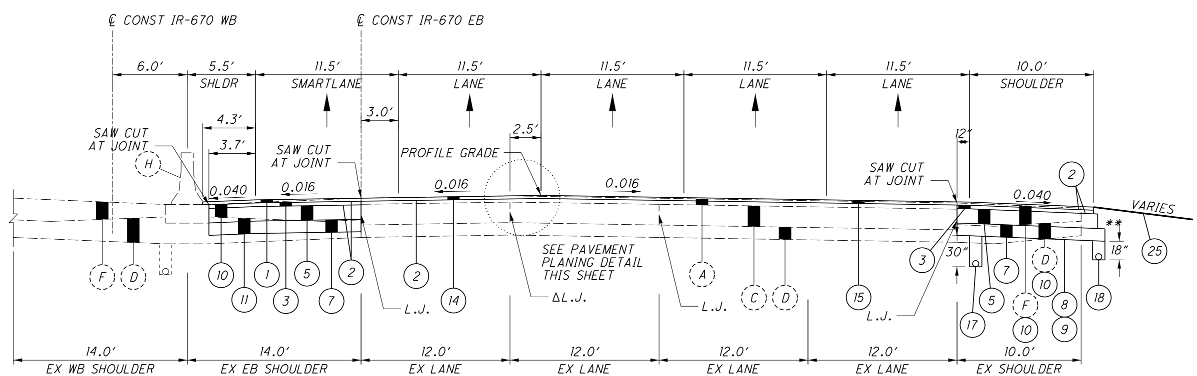
SCHEMATIC PLAN

FRA-670-5.03 EB



NORMAL SECTION - IR-670 EB

SECTION APPLIES:
STA. 1112+50.00 TO STA. 1115+05.32

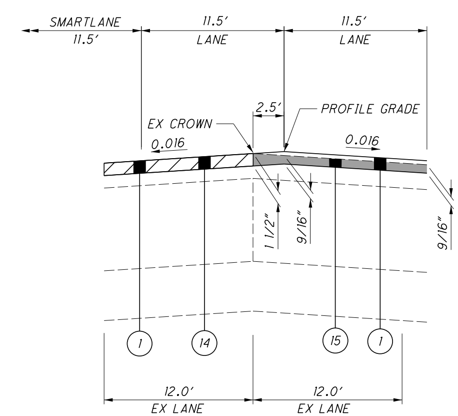


NORMAL SECTION - IR-670 EB

SECTION APPLIES:
(EON STA. 1099+99.98 BK = 1099+99.68 AH)
STA. 1099+98.68 TO STA. 1108+80.82
STA. 1111+23.19 TO STA. 1112+50.00

APPROACH SLAB SECTION - IR-670

APPROACH SLAB AND BRIDGE LIMITS:
STA. 1108+80.82 TO STA. 1111+23.19
NO PAVEMENT WORK.
FOR REHAB WORK, SEE BRIDGE PLANS.
FOR CROWN TRANSITION AT APPROACH SLAB SEE SHEET 769



NORMAL SECTION PAVEMENT PLANING DETAIL

SECTION APPLIES:
STA. 252+03.06 TO STA. 256+99.39
STA. 1039+05.27 TO STA. 1074+52.22
STA. 1076+08.20 TO STA. 1085+03.79
STA. 1099+98.68 TO STA. 1108+70.71
STA. 1111+13.04 TO STA. 1112+50.00

λ 7.00% MAX BREAK

** FOR TYPICAL ASPHALT EDGE COURSE DETAIL, SEE SHEET 17

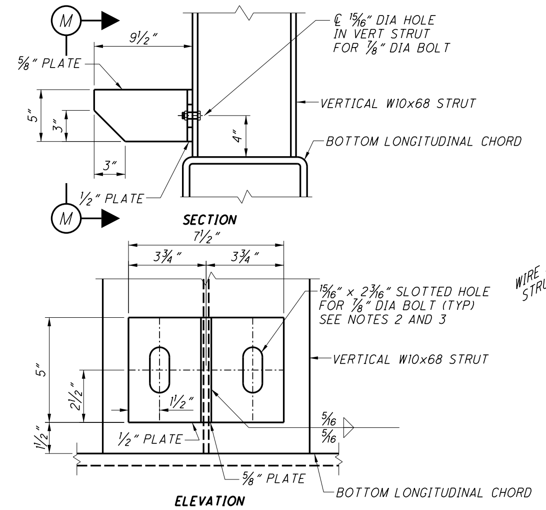
FOR PAVEMENT LEGEND, SEE SHEET 10

FOR PLAN ABBREVIATIONS, SEE GENERAL NOTES

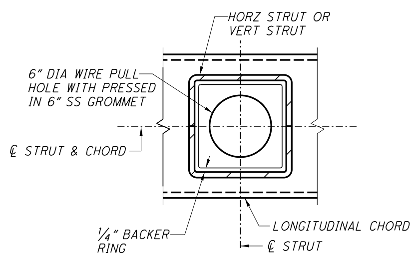
ΔL.J. = LONGITUDINAL JOINTS WITHOUT TIE BARS OR HOOK BOLTS (EXISTING)

TYPICAL SECTIONS - IR-670

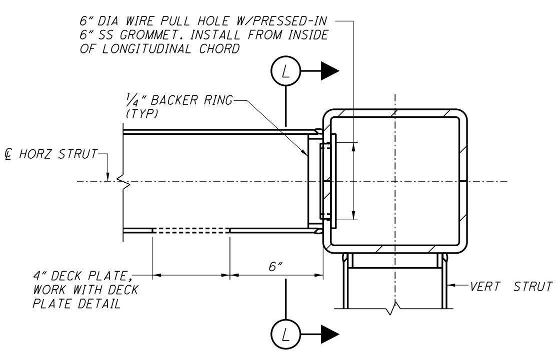
FRA-670-5.03 EB



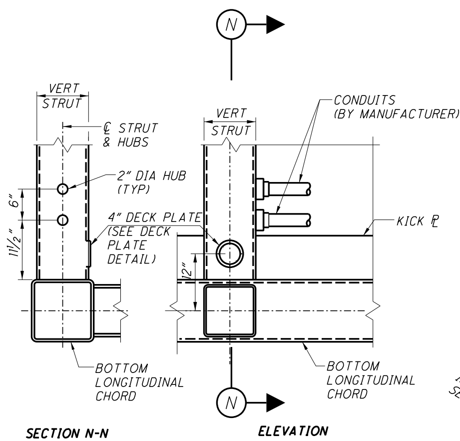
LEDGER SHELF DETAIL
NOT TO SCALE



SECTION L-L



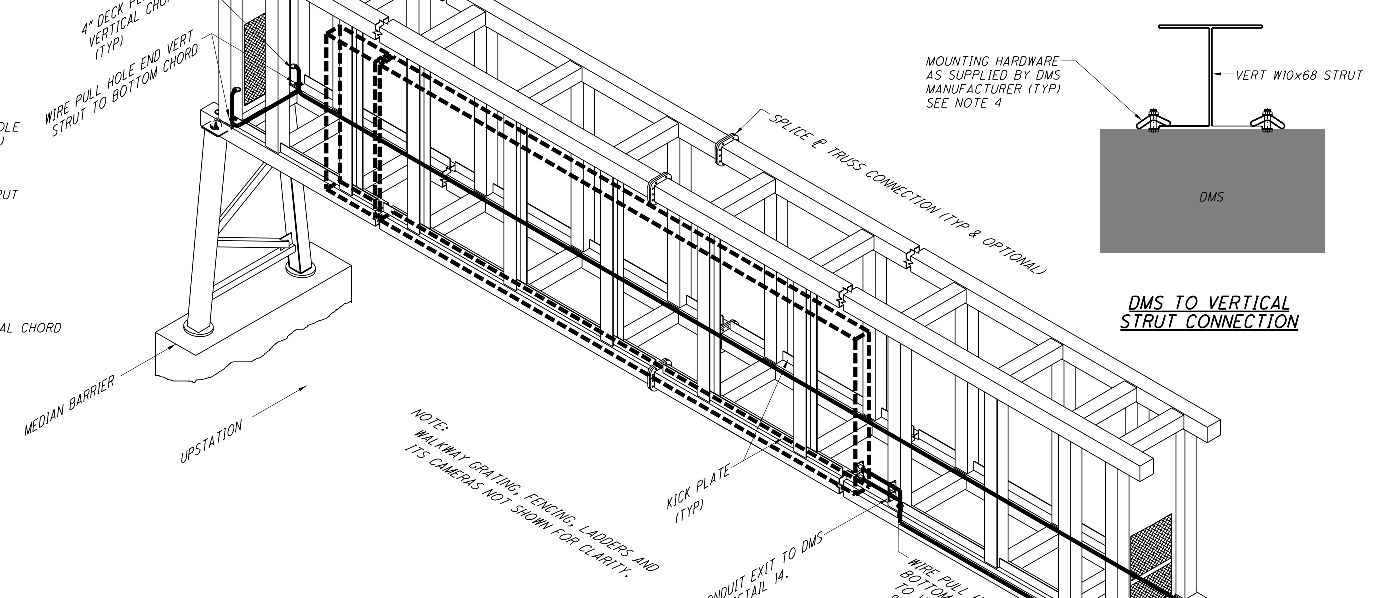
TYPICAL DECK PLATE AND WIRE PULL HOLE DETAIL
NOT TO SCALE

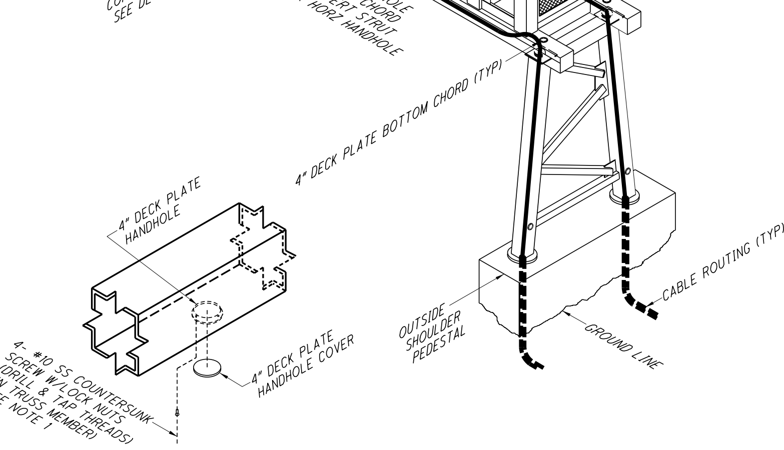


DETAIL 14
CONDUIT EXIT DETAIL
(ELEVATION AS VIEWED FROM INSIDE TRUSS LOOKING AT BACKSIDE OF DMS)
NOT TO SCALE

NOTES

1. AS AN ALTERNATE, THE SCREWS MAY BE ATTACHED WITH NUTS AND LOCK WASHERS ON THE INSIDE OF THE TRUSS MEMBER.
2. THE DMS SHALL BE SET LEVEL WITH A MINIMUM OF 1" CLEAR BETWEEN THE DMS AND CHORD, INCLUDING SPLICE PLATES IF PRESENT.
3. LEDGER SHELF BOLTS SHALL BE SLIP CRITICAL. SEE GENERAL NOTE SHEET (1089/1361)
4. THE DMS MANUFACTURER IS REQUIRED TO SUPPLY ALL THE APPROPRIATE MOUNTING HARDWARE WITH THE DMS. THE MANUFATURER IS REQUIRED TO SPECIFY THE SPACING OF MOUNTING HARDWARE IN THE SHOP DRAWINGS.





TYPICAL DECK PLATE DETAIL
(UNDER MOUNT ARRANGEMENT SHOWN SIDE MOUNT ARRANGEMENT SIMILAR)
NOT TO SCALE

DRAWN RGC | CHECKED JCL

CABLE ROUTING & SIGN MOUNTING DETAILS

FRA-670-5.03 EB