USDOT Region V Regional University Transportation Center Final Report

NEXTRANS Project No. 139TUY2.1

Develop Preliminary Engineering Design and Study the Benefits of Providing an Access to the Indiana Toll Road at State Road 327 near Orland, IN

By

Dr. Ryan Overton, P.E.
Associate Professor
Trine University
overtonr@trine.edu

DISCLAIMER

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TECHNICAL SUMMARY

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Introduction

This report includes the preliminary design aspects for the proposed new toll exit at the intersection of I-80/90 and State Road 327 in Orland, Indiana as seen in Figure 1. This report also gives our understanding of the project, what services were provided, and an estimated construction cost for the project.

Figure 1: Aerial Photograph of Site

Findings

A new toll road exit is proposed at the intersection of I-80/90 and SR 327 in Orland, Indiana. The new exit is needed to facilitate travel for a proposed manufacturing plant to be established on a 500-acre site east of SR 327 and south of I-80/90 (see Figure 1).

The construction will consist of on and off ramps that connect to both the east and westbound lanes of the toll road and a single toll plaza. There will be a small parking lot and a utility building next to the toll plaza. A bridge will be needed over the toll road so vehicles can access the toll road from the east and west. Finally, the new access road will connect to SR 327 that is already in place.

Existing Conditions

The site was visited to evaluate the existing conditions. The area south of the toll road is mainly a crop field. There is a deep valley on this side of the toll road. On the north side of the toll road the land is a grassy field with several rolling hills. These hills cause the elevation to vary by about 30 feet across the entire site. In addition, there is a drainage ditch constructed parallel to both sides of the toll road. City utilities are not present at the site, and the nearby residence on the south side of the toll road appears to be on a well and septic system.

Recommendations

I. Roadway Alignment

Horizontal Alignment

The horizontal alignment was designed according to the Indiana Design Manual (IDM) requirements. The design was restricted by an existing overpass on the east and existing wetlands on the west. All driving lanes were designed as 16-ft lanes to accommodate the anticipated truck traffic. The horizontal curve radii were determined assuming an 8% maximum

superelevation per IDM 43-3.01. The design consists of a 444-ft, a 314-ft and three 214-ft radius curves for 40, 35 and 30 mph design speeds, respectively. These radii are the minimum radii as stated in Fig 43-3A(3) of the IDM for an 8% superelevation. The design meets the minimum deceleration lengths of 500 ft for a 30 mph curve and 460 ft for a 40 mph curve according to Fig 54-3A of the IDM. The alignment also meets the minimum acceleration length of 1,200 feet stated in IDM chapter 48-4.02(3).

Vertical Alignment

The vertical alignment was designed within the specifications of Figure 54-2A of the IDM. The maximum upgrade allowed for a rural interchange is five (5) percent. The maximum allowable downgrade is five (5) percent. The acceleration and deceleration lanes running parallel to the existing toll road were designed at the same grade and elevation of the existing toll road. The overpass elevation was designed to provide a minimum clearance of 16 feet as stated in 54-3.02(3) of the IDM. An additional seven (7) feet was added to the elevation of the overpass abutments in order to compensate for the anticipated depth of the bridge deck structure. The seven (7) feet was determined from previous INDOT overpass designs from previous projects.

Intersection at SR 327

The preliminary design also included intersection improvements at SR 327 and the toll plaza on/off ramp. The toll plaza ramp is designed to have a left turn lane onto SR 327 and a second lane for the combination of through traffic and right turn traffic onto SR 327. A right turn lane will be needed on the southbound lane of SR 327. An additional lane is also needed for the northbound lane of SR 327 in order to convert the existing lane into a left turn lane. The added lane on SR 327 is designed to be a combination lane for through traffic and right turn

traffic. A corner radius of 20 feet was used in the design located on SR 327. This is the minimum corner radius allowed according to Figure 46-2D of the IDM for a 90 degree angle with passenger cars. This minimum radius was used to limit the truck traffic traveling on SR 327. This also assumes that the entrance to the 500-acre site will be directly across SR 327 from the toll plaza ramp. A traffic signal will be needed for this intersection, but is beyond the scope of our services.

II. Earthwork

Borrow Pits

From the AutoCAD renderings and calculations, it has been projected that there is a need for 152,036 cubic yards of fill. To minimize costs, the fill will be gathered from onsite borrow pits. Because most of the fill for the roadway will be needed on the north end of the project, there will be two borrow pits on the north side of the toll road. These two pits are depicted as the red boxes on Figure 2. The larger onsite pit will be to the northeast of the entrance/exit ramp loop. The dimensions of the borrow pit will be approximately 600 feet long 600 feet wide and 10 feet deep. The second pit will be located to the northwest of the entrance/exit ramp loop. This pit will be approximately 200 long 200 wide and 10 deep. On the south side of the toll road there will be a natural retention pond between the toll road and the SR 327 access route. The pond is represented by the blue box in Figure 2. Minimal fill needs on the south end of the project can be extracted from this area.

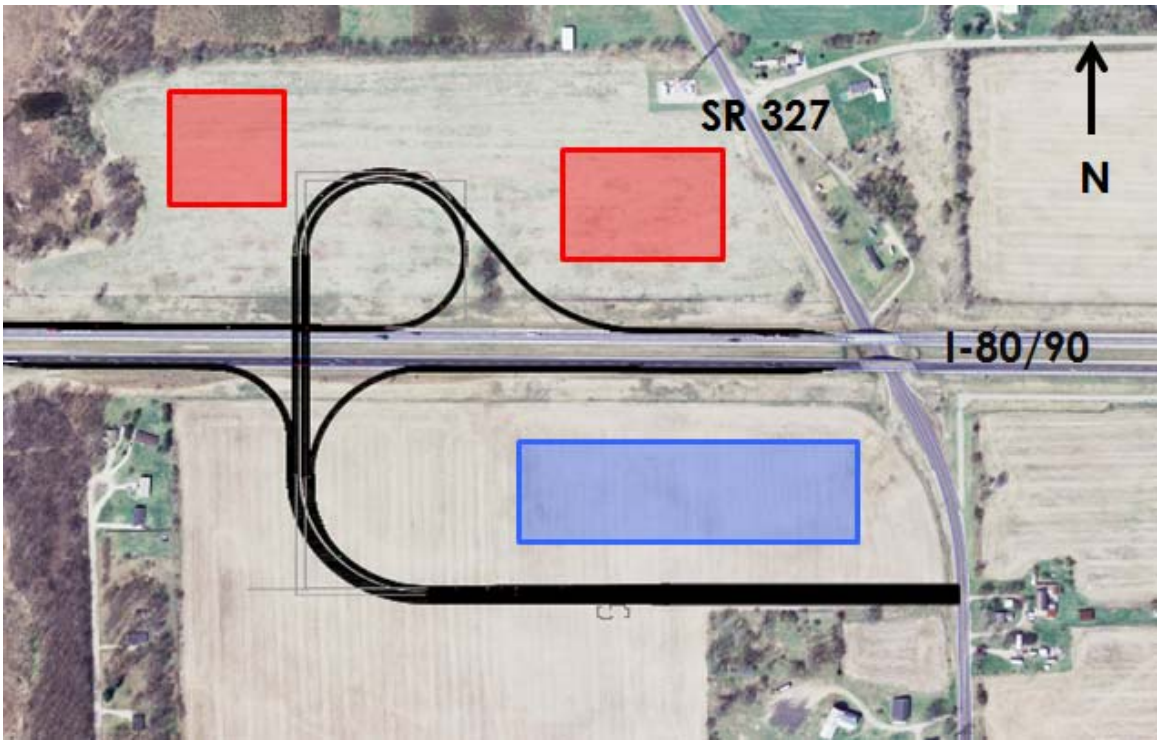

Figure 2: Proposed Borrow Pits and Retention Pond

III. Geotechnical Considerations

Subsurface Conditions

Soil borings could not be performed for this project due to the limited time and no funding. In order to have some understanding of the subsurface conditions the United States Department of Agriculture (USDA) web soil survey was used. Figure 3 shows an aerial photograph of the site with the soil classifications indicated for the top six (6) feet of soil present at the project site. Directly to the north of the project the soil is Udorthent loamy sand (Ud) that is adjacent to the wetland further north. Just south of that is where the loop will be located for the exit and entrance ramps of the westbound lanes. This area is predominantly Casco gravelly sandy loam (CaC). South of the toll road at the west end of the area is Boyer-Ormas loamy sand (BoD). This is where the bridge will be located over the toll road, also the exit ramp of the east bound lanes. East of that is Chelsea fine sand (ChB), here is where the entrance ramp to the east bound

lanes will be. The soil south of the toll road at the east is Casco gravelly sandy loam (CaD2). There is a deep valley here that will be used as a retention pond. The last soil that is within the project area is Kosciusko sandy loam (KoB). The land in the project area is good subsurface grade soil that is generally class A-2. The groundwater table was not found within the top six feet of soil.

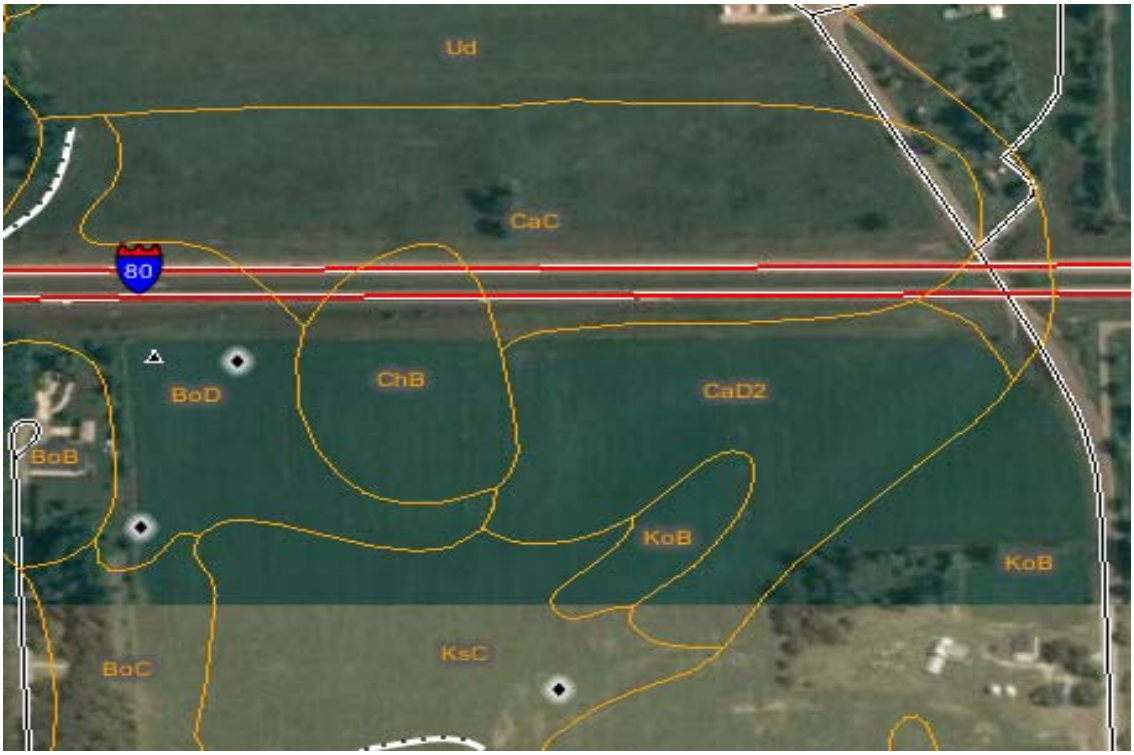

Figure 3: Subsurface Soil Types at the Site

Recommended Future Investigation

Site soil borings should be drilled to know the exact soil type that is deeper than the topsoil. The soil borings can also provide information on the quality of the soil. The projected soil borings are as follows. Roadway borings should be 10 feet deep and located every 200 feet staggering side to side of the purposed roadway. There will need to be 39 roadway borings for our roadway. The utility building will need two borings, each at diagonal corners drilling to 15

feet. Finally the bridge will need three borings, one at the center support between the east and west bound toll road lanes, one to the south of the toll road where the bridge will start, and finally one at the north of the toll road where the bridge will end.

IV. Toll Plaza Design

Site Layout

We developed a preliminary site layout for the toll plaza using the *Toll Plaza Design*. We referenced lane widths, awning height, and booth widths for the toll booths and lanes to determine accurate distances so cars and semis have safe access to the toll booths. The height of the awning (16-ft 4-in) was determined by using the *Toll Plaza Design* book and the height requirement for bridge overpasses. We used the *Trip Generation Manual* to determine that the number of toll booths needed was three (3). Also, referencing similar toll plazas on Google Maps we developed the size of the building and parking lot.

Utilities

The Administration building requires electric, water, and sewer services. The proposed city utilities provided for the manufacturing plant on the 500-acre site will also service the Administration building. There is already an overhead power line, which we will connect to for the electrical supply.

V. Construction Cost Estimate

The estimated construction cost of the project is $6,782,945. This cost includes the estimated construction cost of the bridge, soil borings, toll booths and awning, administration building, pavement, drainage and excavation costs and the cost of the land. A summary of these costs is as follows:

150 FT SPAN BRDIGE - NO SKEW

DESCRIPTION	QTY	UNIT			PRICE			AMOUNT
STRUCTURAL BACKFILL TYPE 3	3,042.00	CYS	@	$	25.34	=	$	77,084.28
DENSE GRADED SUBBASE	44.00	CYS	@	$	61.70	=	$	2,714.80
REINFORCED CONCRETE BRIDGE APPROACH 12"	352.00	SYS	@	$	75.69	=	$	26,642.88
PILE STEEL H HP 12" X 53	1,555.00	LFT	@	$	52.87	=	$	82,212.85
CONCRETE A SUBSTRUCTURE	106.40	CYS	@	$	632.39	=	$	67,286.30
REINFORCING BARS EPOXY COATED	122,200.00	LBS	@	$	1.04	=	$	127,088.00
CONCRETE C SUPERSTRUCTURE	337.40	CYS	@	$	545.83	=	$	184,163.04
CONCRETE BRIDGE RAIL TRANSITION TBT	2.00	EACH	@	$	1,507.73	=	$	3,015.46
RAILING PS-2	300.00	LFT	@	$	117.28	=	$	35,184.00
CONCRETE BRIDGE RAILING TRANSITION TPF-2	4.00	EACH	@	$	1,679.56	=	$	6,718.24
RAILING CONCRETE C	150.00	LFT	@	$	104.81	=	$	15,721.50
STRUCTURAL MBR CONC BULB-T 54 X 48"	1,200.00	LFT	@	$	275.00	=	$	330,000.00
LEVELING PAD	445.00	LFT	@	$	14.04	=	$	6,247.80
FACE PANELS CONCRETE	2,000.00	SFT	@	$	15.92	=	$	31,840.00
WALL ERECTION	2,000.00	SFT	@	$	9.30	=	$	18,600.00
						TOTAL	$	1,014,519.15

GEOTECHNICAL

DESCRIPTION	QTY	UNIT			PRICE			AMOUNT
39 - 10' ROAD BORINGS	390.00	LFT	@	$	10.00	=	$	3,900.00
2 - 15' SINGLE STORY STRUCTURE BORINGS	30.00	LFT	@	$	10.00	=	$	300.00
1 - 90' PIER BORING	90.00	LFT	@	$	10.00	=	$	900.00
2 - 70' EMBUTMENT BORINGS	140.00	LFT	@	$	10.00	=	$	1,400.00
							$	6,500.00
COST OF ENGINEER							$	6,500.00
EQUIPTMENT TO SITE							$	300.00
						SUB TOTAL	$	13,300.00
COMMON EXCAVATION	152,035.92	CYS	@	$	11.00	=	$	1,672,395.12
						TOTAL	$	1,685,695.12

TOLL BOOTHS AND AWNING

DESCRIPTION	QTY		PRICE			AMOUNT
AWNING	1.00	@	$ 60,000.00	=	$	60,000.00
BOOTHS	3.00	@	$ 20,000.00	=	$	60,000.00
EQUIPTMENT	3.00	@	$ 25,000.00	=	$	75,000.00
				TOTAL	$	195,000.00

PAVEMENT (ROADS)	QTY	INCHES	LBS	TONS	PRICE	AMOUNT
SURFACE AREA (SYS)	38,208	*	*	*	*	*
SURFACE (LBS/SYS)	165	1.50	6,304,393	3,152.20	$ 65.72	$ 207,162.36
INTERMEDIATE (LBS/SYS)	275	2.50	10,507,322	5,253.66	$ 50.06	$ 262,998.28
BASE (LBS/SYS)	330	3.00	12,608,787	6,304.39	$ 47.10	$ 296,936.93
OG DRAINAGE (LBS/SYS)	300	3.00	11,462,533	5,731.27	$ 50.03	$ 286,735.27
BASE (LBS/SYS)	330	3.00	12,608,787	6,304.39	$ 47.10	$ 296,936.93
#53 CRUSHED STONE (LBS/SYS)	1305	11.86	49,862,020	24,931.01	$ 6.75	$ 168,284.32
TACK COAT (LAYERS)	4	-	-	-	$ 0.15	$ 22,925.07
		24.86			Total	$ 1,541,979.15

PAVEMENT (PARKING LOT)		QTY	INCHES	LBS	TONS	PRICE	AMOUNT
SURFACE AREA (SYS)		2,076	*	*	*	*	*
SURFACE (LBS/SYS)		165	1.50	342,558	171.28	$ 65.72	$ 11,256.47
INTERMEDIATE (LBS/SYS)		275	2.50	570,931	285.47	$ 50.06	$ 14,290.39
#53 CRUSHED STONE (LBS/SYS)		1305	11.86	2,709,325	1,354.66	$ 6.75	$ 9,143.97
TACK COAT (LAYERS)		4	-	-	-	$ 0.15	$ 1,245.67
			15.86			Total	$ 35,936.50

ADMINISTRATION BUILDING

Item Name	Material	Labor	Equipment	Total
Excavation	--	1,803.00	595	2,398.00
Foundation, Piers, Flatwork	4,790.00	6,111.00	1,211.00	12,112.00
Rough Hardware	468	598	119	1,185.00
Masonry Frame	15,974.00	17,848.00	1,275.00	35,097.00
Insulation	2,901.00	1,608.00	--	4,509.00
Exterior Finish	14,461.00	6,901.00	1,047.00	22,409.00
Exterior Trim	934	1,193.00	237	2,364.00
Doors	1,416.00	963	--	2,379.00
Windows	2,438.00	1,344.00	--	3,782.00
Finish Hardware	236	161	--	397.00
Roofing, Flashing, Fascia	5,106.00	3,473.00	--	8,579.00
Finish Carpentry	860	3,512.00	--	4,372.00
Interior Wall Finish	4,126.00	5,168.00	--	9,294.00
Painting	2,465.00	4,668.00	--	7,133.00
Wiring	2,503.00	3,833.00	--	6,336.00
Lighting Fixtures	1,877.00	479	--	2,356.00
Flooring	1,453.00	1,673.00	--	3,126.00
Carpeting	2,892.00	837	--	3,729.00
Bath Accessories	716	358	--	1,074.00
Plumbing Rough-in and Connection	2,634.00	5,188.00	392	8,214.00
Plumbing Fixtures	5,351.00	1,375.00	--	6,726.00
Heating and Cooling Systems	6,204.00	9,305.00	--	15,509.00
Subtotal Direct Job Costs	**$79,805.00**	**$78,399.00**	**$4,876.00**	**$163,080.00**
Final Cleanup	--	814	--	814
Insurance	5,695.00	--	--	5,695.00
Permits & Utilities	3,457.00	--	--	3,457.00
Plans & Specs	814	--	--	814
Subtotal Indirect Job Costs	**$9,966.00**	**$814.00**	**--**	**$10,780.00**
Contractor Markup	25,422.00	--	--	25,422.00
Total Cost	**$115,193.00**	**$79,213.00**	**$4,876.00**	**$210,544.00**

DRAINAGE

DESCRIPTION	QTY	UNIT		PRICE		AMOUNT
8" CORRUGATED STEEL PIPE	115.00	LFT	@	$ 19.00	=	$ 2,185.00
12" CORRUGATED STEEL PIPE	225.00	LFT	@	$ 27.00	=	$ 6,075.00
6" UNDERDRAIN	13226.00	LFT	@	$ 5.10	=	$ 67,452.60
AGGREGATE FOR UNDERDRAIN	6,368.07	CYS	@	$ 39.25	=	$ 249,946.91
					TOTAL	$ 325,659.51

LAND ACQUISITION						
SEC/TWP/RNG	PARCEL ID	QTY	UNIT			AMOUNT
17-38-12	760417000005010000	105.96	ACRES	=	$	82,900.00
17-38-12	760417000005000000	7.47	ACRES	=	$	81,100.00
				TOTAL	$	164,000.00

MISCELLANOUS							
BRACKET ARMS, 1 ARMS	4	BRACKETS	@	$ 273.00	=	$	1,092.00
ROADWAY AREA LUMINAIRE, 135 WATT	4	LUMINAIRE	@	$ 1,025.00	=	$	4,100.00
STEEL POLE, GALVANIZED, 40' HIGH	4	POLES	@	$ 2,900.00	=	$	11,600.00
IMPACT BARRIER, UTMCD, BARREL TYPE	10	BARRELS	@	$ 610.00	=	$	6,100.00
CORRUGATED STEEL, GALV. STL. POSTS, 6'-3" O.C.	13226	LFT	@	$ 25.50	=	$	337,263.00
CONCRETE BARRIERS	415.68	LFT	@	$ 67.00		$	27,850.56
SURVEYING	-	-	-	-	=	$	2,000.00
FENCING	6855.00	LFT	@	$ 13.00	=	$	89,115.00
					TOTAL	$	479,120.56

ROAD LENGTH		
PRTP EXIT	983	LFT
PREB ENTRANCE	2582	LFT
PRWB ENTRANCE	4125	LFT
PRWB EXIT	3463	LFT
PREB EXIT	2073	LFT
TOTAL	13226	LFT

ROAD WIDTH	
26	LFT

SURFACE AREA	
343876	SFT

SUB TOTAL	$	5,652,454.00
CONTINGENCY		20%
TOTAL COST	$	6,782,945.00

Total Costs		
150 FT BRIDGE - NO SKEW	$	1,014,520
SOIL BORINGS	$	13,300
COMMON EXCAVATION	$	1,672,396
TOLL BOOTHS AND AWNING	$	195,000
ADMINISTRATION BUILDING	$	210,544
PAVEMENT		
ROADS	$	1,541,980
PARKING LOT	$	35,937
DRAINAGE	$	325,660
LAND ACQUISITION	$	164,000
MISCELLANOUS	$	479,121
CONTINGENCY		20%
TOTAL COST	$	6,782,945

Contacts

For more information:

Dr. Ryan Overton, P.E.
Trine University
One University Avenue
260.665.4892
260.665.4814
Overtonr@trine.edu
www.trine.edu

NEXTRANS Center
Purdue University - Discovery Park
3000 Kent Ave.
West Lafayette, IN 47906

nextrans@purdue.edu
(765) 496-9724

www.purdue.edu/dp/nextrans