ACCELERATED CONSTRUCTION OF THE I-40 METEOR CITY TI OP

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DEFINITIONS

ADOT	Arizona Department of Transportation
AADT	Average Annual Daily Traffic
FHWA	Federal Highway Administration
GRS	Geosynthetic Reinforced Soil
IBS	Integrated Bridge System
NHS	National Highway System
NTPEP	National Transportation Product Evaluation Program
PPC	Polyester Polymer Concrete
SRW	Segmental Retaining Wall
VPD	Vehicles Per Day

INTRODUCTION

Interstate 40 is a vital component of the NHS facilitating transportation of products and services through the State of Arizona. Average AADT at the Meteor City Overpasses is reported by ADOT (1) as 19,058 VPD with 4,481 Trucks. Interruption in mobility on Interstate 40 creates significant economic losses and traffic safety risks. ADOT utilized GRS-IBS to reduce construction phase durations and minimize mobility disruptions on this vital commerce corridor.

PROJECT DESIGN

FHWA (2) "The GRS-IBS is a fast, cost-effective method of bridge support that blends the roadway into the superstructure to create a jointless interface between the bridge and the approach." The Meteor City Overpass GRS-IBS was designed to minimize construction duration and included pre-cast box beams, pre-cast traffic barriers, SRW block, open-graded reinforced backfill, and PPC deck.

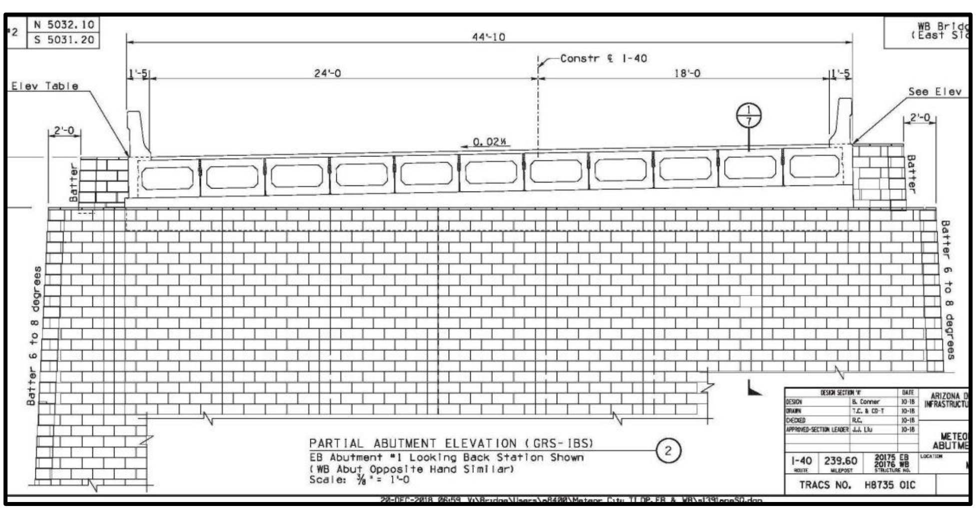

Figure 1

GRS Design

The GRS abutments were designed to utilize existing SRW block products that are commercially available in the state. Design was based on a vertical block height of 8 inches with reinforcements placed at each course of blocks. The block units were dry cast with a minimum compressive strength of 4,000 psi and freeze thaw resistance, FHWA (4). Vertical batter was specified between 6 to 8 degrees to reduce lateral stresses and deformation. Positive connection between blocks and geogrid was achieved with fiberglass pins. The positive connection between blocks produced uniformity in block setback and provides security against vandalism.

Reinforced backfill was designed as an open graded crushed rock, similar to AASHTO #57, to facilitate rapid compaction and acceptance. A method specification was developed to assure uniformity of compaction and limit damage to the geogrid during compaction. Design friction angle of the backfill was selected at 40 degrees based on aggregate property studies performed by FHWA (5). Reinforced backfill physical property specifications included a requirement for a minimum of 60% of the plus #4 rock particles to have a minimum of two fractured faces. Analysis of the design friction angle of the reinforced backfill demonstrates the importance of this property. A design friction angle of 34 degrees requires a 37% strength increase in reinforcement when compared to a design friction angle of 44 degrees. Design selection and construction evaluation of reinforced backfill friction angle is an essential component in efficiency and performance of the GRS system.

Biaxial geogrid with a 1.0 inch aperture was selected as the reinforcement to produce composite behavior of the GRS due to interlocking of the open graded backfill and geogrid reinforcement. The use of biaxial geogrid with open graded crushed rock produces a coherent mass. Vertical spacing of 8 inches between reinforcement layers with a 1 inch nominal rock product maintains an effective zone of reinforcement influence, NCHRP (3). Biaxial geogrid was a polyester product with PVC coating. Use of NTPEP evaluated geogrid products accelerated product acceptance during construction and reliability of selected design parameters. The method specification for compaction of the 8 inch lift of open graded reinforced backfill limited the size of the vibratory compactor to no more than 7,000 pounds to minimize installation damage to the geogrid during compaction.

IBS Design

Pre-cast bridge components including box beams, traffic barriers, and beam seat were utilized to accelerate construction. A total of 11 box beams were cast for each bridge at a facility in Phoenix, AZ and transported to the project site. Traffic barriers and beam seat were cast on-site by the general contractor. Box beams on the exterior of the bridge were cast monolithically with the barrier.

Integration between the roadway and bridge was achieved by extending biaxial geogrid and aggregate base across the roadway as support for the roadway asphaltic concrete paving. Lift thickness of the reinforced aggregate base was 8 inches.

Deck surface drainage requires a 2% cross slope. The beam seat thickness was tapered from 1 ft to 1 ft 11 inches to accomplish cross slope surface drainage. The bridge deck surface is composed of PPC.

Superstructure Design

The two structures were given unreinforced 2 ½” PPC deck as opposed to ADOTs normal practice of using a 5” reinforced deck. The PPC deck is expected to prevent longitudinal cracking between the box beams and prevent water infiltration. The PPC deck also has a greatly reduced construction time verses a reinforced concrete deck. As the first GRS-IBS bridge by the State of Arizona and the first to use PPC rather than Portland Cement Concrete as a deck it was decided to not include an asphalt overlay. The bridge does have steel angle iron installed at bridge ends to protect the PPC deck from snowplow damage.

LESSONS LEARNED

Although the project is a success there are several items that ADOT can improve on future projects. The first and most significant is when placed in thicker sections, several inches thick, PPC cannot be placed in the same manner as a PPC overlay. Different methods and even different screed machines need to be utilized.

Build-up is also a significant issue. Generally build-up is defined after girders are placed and actual top of girders are measured in the field. Because the PPC deck is nonstructural the camber of the girders was higher than in box beams of similar bridges. This meant that the buildup at the ends of the bridges was 3 inches, more than doubling the thickness of the PPC deck. Given the high cost of PPC buildup this project change order was not an incidental item and needs to be considered early and specifically called out in the plans.

PPC is considered an overlay. Special effort must be made to make clear that PPC is not used as an overlay in this situation and that does make a difference in the PPC placement.

REFERENCES

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