HDPE pipe provided an alternative solution to the original plan for this ADOT design-build stormwater project in Surprise, Ariz. The pipe met ADOT specifications, reduced costs, and shortened the construction schedule. Fabricated manholes were produced at the Phoenix manufacturing plant. The pipe, manholes, and other fittings were delivered to the jobsite on a just-in-time schedule.

Connecting the smaller laterals to the main 54-inch lines was done using ADS Inserta Tees. They provided quick and economical watertight connections for 18-, 24-, and 30-inch HDPE pipe.

MAJOR INTERCHANGE REVAMP RELIEVES CONGESTION

TWIN STORMWATER PIPELINE PROVIDES PATH TO SOLVE ARIZONA HIGHWAY REALIGNMENT.

TO ALLEVIATE traffic congestion at one of the busiest intersections in Maricopa County, the Arizona Department of Transportation (ADOT) decided to build a new overpass; add roads, lanes, and ramps; plus make other critical improvements. Located 45 minutes northwest of downtown Phoenix, Surprise has a population of 130,000 and is the spring training home for the Texas Rangers and the Kansas City Royals.

Contractor Coffman Specialties, Inc. (San Diego) was given eight months to complete the $41.9 million design-build project at the intersection of Bell Road and Grand Avenue. It was part of the Maricopa Association of Governments' (MAG) Regional Transportation Plan approved by county voters in 2004. Funding sources included a county half-cent sales tax for transportation projects and a contribution from MAG's federal highway funds.

According to the plan, a portion of Bell Road would have to be closed, with the construction schedule fitting between the holiday shopping season and the start of spring training. Both events bring higher-than-usual volumes of traffic.

"The city and ADOT gave us a short time to close down Bell Road because they didn't want work going on during spring training, plus they wanted everything on Bell Road open by Thanksgiving for the holiday shopping season," said Jason Brunker, P.E., the Coffman engineer responsible for the project. "They wanted everything on Bell Road completed within that eight-month window to complete the overpass so everything on Bell was very accelerated. A big part of our concept was diverting traffic onto westbound Grand Avenue-U.S. 60 — which would require the stormwater runoff going into a storm drain underneath the westbound lanes of U.S. 60. We had to get that completed as quickly as possible."

The intersection closed April 1, 2016, and reopened just before Thanksgiving — less than the seven months mandated.

The new interchange is a median urban diamond design, which has connections at the center rather than ramps to the right of Grand Avenue travel lanes. The design minimized the impact on neighboring shopping centers and businesses by not requiring ADOT to acquire as much property.

A Burlington Northern and Santa Fe (BNSF) railroad track runs along Grand Avenue. The grade rail crossing at Bell Road becomes impassable when trains travel across it, resulting in additional delays and the potential for train/vehicle collisions.

"Because this was a design-build, we opted to realign Grand Avenue closer to the railroad tracks. By doing that we restricted all the stormwater drainage that was to go between the railroad tracks and Grand Avenue," Brunker said.

In the initial design, stormwater was to flow in a concrete-lined open ditch channel between the tracks and Grand Avenue. Another considered alternative was to bury large-diameter reinforced concrete pipe. Instead of either one of those alternatives, it was decided to use two runs of 54-inch-diameter high-density polyethylene (HDPE) pipe. This would allow Brunker and his crew to combine the offsite flows adjacent to the BNSF railroad tracks with the onsite flows coming off Grand Avenue. Running the pipe underneath Grand Avenue made it possible to reduce the height of the bridge, shorten the ramps, and keep the established landscape areas.

The new interchange is a median urban diamond design (see inset photo), with traffic now diverted over the railroad tracks.

"By shifting the road and putting the stormwater drainage underground, we were able to keep the existing landscape along the eastbound lanes of Grand Avenue. We were also able to separate the project into two work areas as opposed to three smaller areas. This helped with traffic and enabled the project to be accelerated. Having two large work areas meant we could do more work at a time."

The system was designed for a 100-year storm event with a capacity of 300 to 400 gallons per minute. More than 6,500 feet of Advanced Drainage Systems' (ADS) N-12 corrugated HDPE pipe was used for the twin 54-inch-diameter runs. Additional N-12 pipe was used for the 18-, 24-, and 30-inch-diameter laterals. Depth of cover over the pipe ranged from 1 foot to 4 feet. The ADS pipe was also used to make modified manholes for access into the storm drain. The ADS plant in Phoenix manufactured the pipe and fabricated the fittings and manholes, making just-in-time delivery possible.

With a corrugated exterior and smooth interior, ADS N-12 HDPE pipe provided both strength and optimum hydraulic capacity. Because it is lightweight, ADS corrugated pipe was easily handled with minimal equipment by a one- or two-person crew, providing a favorable alternative to concrete pipe. And with a long "stick" length of 20 feet, the number of joints were reduced, saving labor and installation time.

Named for its Manning's "n" rating of 0.012, the N-12 pipe was designed in 1987 by ADS specifically for culverts, storm sewers, highways, airports, and other civil design construction. ADS pipe is available in diameters from 4 inches to 60 inches. Incorporating an integral bell and spigot, N-12 WT IB pipe meets ASTM watertight standards. The pipe's structural capacity to withstand vehicle weight has been proven under Cooper E80 Loading conditions and has a rated use life of 100 years.

The pipe's strength is due to its design, HDPE resin, and manufacturing process, according to ADS. The structural integrity of corrugated HDPE pipe can be validated using the design procedures outlined in the AASHTO Load Resistance Factor Design (LRFD) Bridge Design Specifications. AASHTO LRFD Section 12 is a strain-based design procedure suitable for thermoplastic pipes such as HDPE, polypropylene, and PVC. The AASHTO LRFD code considers the actual failure modes of thermoplastic pipe such as thrust, wall buckling, as well as combined strain to ensure a viable design. Deflection is considered as a service limit and serves as confirmation of the design and ensures suitable long-term performance.

Connections from the 54-inch pipe to the smaller laterals was done using the ADS Inserta Tee. The fittings are designed to provide a fast method of watertight lateral service connection for wastewater and stormwater pipe systems. Inserta Tees for 2- to 30-inch services readily fit ADS pipe. Inserta Tee fittings can also be used to connect corrugated metal pipe, PVC pipe, corrugated and solid-wall HDPE pipe, and profile wall pipe, regardless of the manufacturer. Inserta Tees meet ASTM 3212 air pressure testing and are watertight to meet project requirements for storm and sanitary sewer lines.

"One of the concerns that ADOT had was the maintenance and accessibility to the storm drain," Brunker said. "So, we made manholes out of the ADS pipe that we could just drop into place and slurry backfill. We didn't have to form up any manhole structures; we just used the pipe."

Using the HDPE pipe reduced the total budget by as much as 20 percent, which included materials and labor verses the alternatives of a ditch or concrete pipe.

"The accessibility of the ADS product allowed the crew to come in, unload, and put it in," Brunker stated. "It was a lot quicker process than it would have been with 54-inch concrete pipe. And speed was critical because we were allowed to close down Bell Road for just seven months."

Information provided by Advanced Drainage Systems (www.ads-pipe.com).

February 2018 Vol. 4 Issue 11

civil + structural ENGINEER

CELEBRATING THE WORLD AROUND US

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