CASE STUDY

TORUS

Roundabouts No Longer Have Engineers Spinning Their Wheels

Dynamic software delivers solutions for BETA Group

By Chris Johns, Transoft Solutions

Transportation engineers across North America are bringing roundabouts back into their construction toolbox after they gained popularity in other countries around the world. For BETA Group Inc., a multi-disciplinary engineering company with offices in Connecticut, Rhode Island and Massachusetts, technology is an integral part of their business. As any engineer will say, building a roundabout is no easy task.

As one of the engineers responsible for two roundabout projects for BETA Group in Connecticut, Jorge Simbaqueba tried the traditional methods of calculating all the geometry needed for a roundabout. “Back in July 2012, I looked into using the traditional software intersection design tools, where it’s only a two-dimensional geometric layout of the roundabout based on the approaches. It was very time-consuming and a lot of trial and error. Using the traditional method, every time I ran an iteration of a roundabout, or changed some of the metrics, it became more complicated.”

His project in Fairfield County, Connecticut is very challenging. With a golf course on one side and very tight right-of-way considerations, the four-way intersection created literally hundreds of variables he had to account for.

“Having to re-align the approaches to fit the roundabout where we need them to be is very tough,” said Simbaqueba. “I realized that simply changing one approach would impact that calculation for everything.”

Innovative Technology Provides the Answer

As it turned out, the solution was just around the corner. A colleague in his office had read about TORUS in a trade publication and Simbaqueba was assigned to conduct some more research and determine whether it could help BETA Group Inc. Powered by the trusted AutoTURN engine from Transoft Solutions, TORUS takes the innovative approach of generating roundabout geometries using vehicle swept path movements. He asked for a demonstration version of the software and began testing.

“We had already purchased AutoTURN and were very happy with that,” said Simbaqueba. “Right off the bat, (TORUS) was very user-friendly and all the menus are very straightforward. With the demo version, I was able to do everything I had done previously and more on that complex intersection within minutes. It took me ten minutes to do what I had done with the other software in three weeks. I’m only at the beginner level of roundabout design, so it was a learning experience for me,” recalled Simbaqueba.

The time-saving features of TORUS include re-calculating all the design elements whenever a change is made to one aspect of the design. Engineers like Simbaqueba never have to start from scratch again. “Once we have the radius that we want, we put the roundabout where we want it, we tie it in to the approaches and the program automatically, dynamically

updates every calculation that you need to make sure that it complies with the guidelines," marveled Simbaqueba. "I accomplished all this just by dragging the mouse."

There's more to roundabout design than making cars go in a circle. Engineers have to determine the capacity requirements and all roundabout designs must meet these requirements. TORUS enables users to import traffic data from SIDRA to examine intersection capacity numbers, which allows designers to look at the big picture. "We are looking to put a single-lane roundabout (in Fairfield County) because of the land constraints and we're also getting involved with the traffic volumes that are going through there," said Simbaqueba. "We're trying to do the capacity analysis, so we're taking advantage of the fact that TORUS has the ability to import the SIDRA files. That's another aspect that's helpful to us, not just in this project but in all projects."

"Once we have the radius that we want, the program automatically, dynamically updates every calculation that you need to make sure that it complies with the guidelines. I accomplished all this just by dragging the mouse."

Jorge Simbaqueba-BETA Group

Designing With the End-User in Mind

When creating the functionality of TORUS, the software engineers at Transoft Solutions put themselves in the position of the engineers in the field and imagined the challenges they would face. Inherently, they knew every intersection isn't graded to be uniformly flat and all roads don't meet at perfect 90-degree angles.

"We're beginning to see in one of our other projects in the area there is a substantial grade change within the roadway," recalled Simbaqueba. "TORUS allows us to develop a 3D grading model through that proposed intersection. Then, using AutoCAD (Civil 3D), you can go in and combine the two surfaces (existing and proposed) and show the client where you are matching the existing surface. That is a tool that is really beneficial for us in the new version of TORUS 4.0. It wasn't available before."

One of the key design checks that engineers perform is fastest path analysis, which anticipates vehicle speeds in the roundabout based on its geometric design. Because Torus recalculates fastest path speeds after every design change, designers and engineers are saved the time-consuming task of repeatedly redrawing fastest paths and receive instant feedback on the effects of design changes.

"Just being able to select a specific design vehicle and turning radius, it sets everything up for you based on that design vehicle," says Simbaqueba. "You can drag the roundabout anywhere you want it and TORUS updates the fastest path to ensure you are within the guidelines. It's good that it shows certain warnings to help you throughout the design process to reach an optimum design."

One of the Transoft Solutions' engineers who are well-versed in the functionality of TORUS is Jarvis Autey. He talks to roadway planners about finding the balance between speed and safety when building roundabouts. According to Autey, when the roundabout geometry is adjusted in TORUS, the leveraged technology of the AutoTURN swept paths generates the optimal resulting lane widths.

"Roundabout approaches and entries are designed to regulate entering vehicle speeds so they are consistent with circulating traffic speeds," says Autey. "You might want to use a larger diameter roundabout to have a faster circulating speed, but you always have to make sure that entering vehicles, especially those going straight through, can't go considerably faster than the circulating speed."

The NCHRP Report 672 guidelines which are built into TORUS include the geometric elements that tell engineers whether their design can safely accommodate the traffic capacity they are proposing.

Autey has an interesting analogy for how Torus implements a more logical design process of roundabouts: A tailor designing a suit for a specific client manufactures the suit to the dimensions of the average person and makes repeated alterations until the suit fits the client. With TORUS, the tailor measures the client and then designs accordingly. During a conventional roundabout design process, the swept paths of design vehicles are checked only after a preliminary layout is prepared, leading to iterations of swept path checks and geometric adjustments. Using Torus, design vehicles and movements are defined at the start, and geometric elements are dynamically adjusted to accommodate the vehicle swept paths at all stages of the roundabout design. "Not surprisingly, we've found that when you design with TORUS, your roundabouts tend to meet the guidelines," said Autey.

Now that BETA Group Inc. has the power of TORUS behind them, engineers like Simbaqueba can plan roundabouts with increased skill and confidence. He knows that the geometric calculations which used to take him weeks, can be done in minutes. "We can show them all the options in a shorter timeframe and then it's the clients' decision. That's really helpful to us, not just in this project but in all projects." ■

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