Roundabouts and Light Rail Combined: An Innovative Intermodal Solution

Paper Author: Bill Baranowski, P.E. RoundaboutsUSA

References

Utah Transit Authority
Steve Meyer, P.E.
(801) 466-4697

University of Utah
Anne Racer, Planning Dir.
(801) 581-6081

RoundaboutsUSA
Bill Baranowski, P.E.
(801) 569-5047

A modern roundabout intersection with light rail running through the center began full operation on September 29, 2003 as part of the University of Utah Health Sciences Center Light Rail Extension in Salt Lake City, Utah. It is located on the University Line between the Stadium station and the South Campus station. The roundabout made center-running tracks possible at a major campus intersection. The roundabout is a clear enhancement for the light rail trains as the intersection priority is switched from giving priority to vehicular traffic to allowing the trains full priority.

The use of similar roundabouts with rail crossings was observed by the author on trips to Europe and Australia. These served as the inspiration for the application in the USA. As roundabout usage becomes more common in the USA, creative uses such as this one should be considered. This project was made possible through the cooperation of the Utah Transit Authority (UTA), the Utah Department of Transportation (UDOT) and the University of Utah.

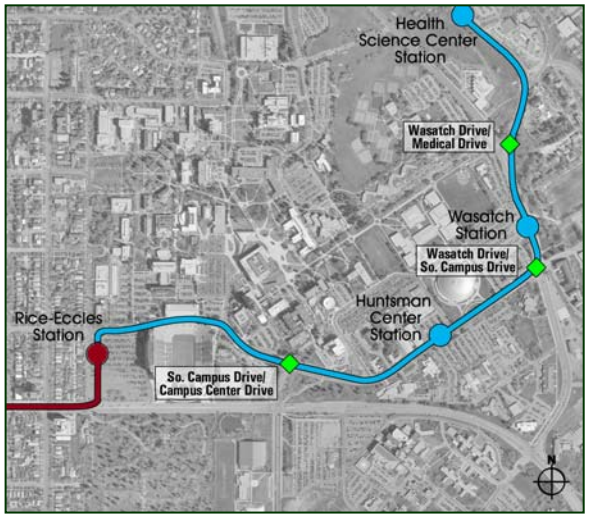
UTA TRAX

RoundaboutsUSA

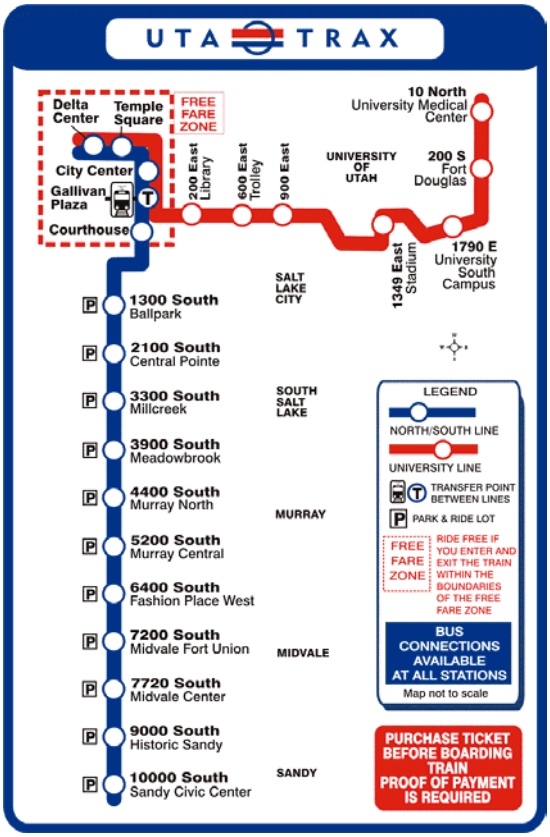
Narrative Description

Background

The original section of light rail constructed in Salt Lake County is the 15-mile north/south line between Sandy City and Salt Lake City completed in December 2000. The Main Street to University of Utah Trax line includes two sections. The first section, shown in red below, is located on 400 South/500 South between Main Street east to the Rice Eccles Stadium on the University of Utah campus. It was completed in 2001.



University of Utah Light Rail Project Stations



Existing TRAX System Map

Background

The second section shown in blue at left, is the Medical Center light rail Extension at the University of Utah Campus. It begins at the Rice-Eccles Stadium Station and follows South Campus Drive and Wasatch Drive for 1.4 miles. The extension includes three stations and three major intersections.

The Medical Center light rail Extension opened on September 29, 2003. It has the potential to serve many of the hospital campus' 9,000 employees and the 500,000 outpatient-clinic visitors per year. The existing north-south LRT line carries an average of 20,000 riders per day; the 2.5 mile extension to the Stadium carries 6,000 riders per day. During the recent Winter Olympics the LRT system carried over 140,000 riders per day on the busiest days. There is an existing shortage of parking on campus which provides an excellent opportunity for transit growth.

Several alternative light rail track alignments within the existing roadway corridors were proposed along with station locations, intersection control options, and pedestrian crossing locations. The design of the stations and intersections allowed for existing and future traffic needs along the 1.4 mile extension.

The roundabout intersection described in this report is located at South Campus Drive/Campus Center Drive. This intersection is one of the major entrances into the campus with 2,000 vehicles per hour during both the AM and PM peak travel periods.

Track Alignments and Station Locations

Several alternative light rail track alignments within the existing roadway corridors were proposed along with station locations, intersection control options, and pedestrian crossing locations. The designer was asked to review the proposed track alignments, analyze 3 key intersections and to give recommendations for the placement of the tracks and stations.

Center-running track is an operational advantage over side running on South Campus Drive. The number of track crossings is reduced to only those at signalized intersection locations. This has eliminated several gated crossings on the north side of South Campus Drive. Right-in right-out access is maintained for the driveways on both sides of South Campus Drive. Two-lanes of traffic are provided on each side of the tracks north of the roundabout and one-lane of traffic is provided on each side south of the roundabout. Automobile traffic is strictly controlled as they are allowed to cross the tracks only at gated crossings, signalized intersections and the roundabout. Center running tracks allows the continued operation of the University Shuttles and UTA transit bus stops on both sides of South Campus Drive near the Library and the Huntsman Sports Center. The roundabout option makes center-running light rail possible where a traffic signal would be possible within the given right of way constraints.

The change in track alignment on South Campus Drive from side running to center-running improved access and operation of the shuttle vehicles and buses running on both sides of the tracks. The roundabout allows center running light rail and enables left turns by automobiles in all directions at this key intersection. The photos below show where the tracks shift from side running to center running west of the Stadium.

Side-running to Center-running Transition Point

Pedestrian Undercrossing

Intersection Analysis: Roundabout and Traffic Signal Comparison

Before the roundabout was constructed, the intersection of South Campus Drive and Campus Center Drive was a “T” intersection with South Campus Drive along the top of the “T” running east west. Yield signs controlled traffic at the top of the “T”. Bypass lanes existed at the two corners and across the top of the “T”. This intersection is one of the major entrances to the campus with about 2,000 vehicles per hour in both the AM and PM peak travel periods.

South Campus Drive/Campus Center Drive Intersection before the Roundabout Construction. Yield signs control the traffic along the top of the T-intersection. Bypass lanes existed at the two corners and across the top of the “T”. Because of the existing free movements the change to a roundabout operation was not as extreme for drivers.

The south leg is Campus Center Drive, which connects to 500 South/Foothill Boulevard, which is a major 6-lane east-west arterial connecting downtown Salt Lake City to Interstate 80 near the mountains. The 500 South intersection is located approximately 320 feet to the south is controlled by a traffic signal with heavy double left-turn traffic towards the roundabout. The two light-rail tracks run in the center of South Campus Drive (the top of the “T”) with one lane of vehicle traffic in each direction to the west of the intersection and two lanes of vehicle traffic in each direction to the east of the intersection. The dual lane bypass that existed before the roundabout conversion was retained in the new intersection.

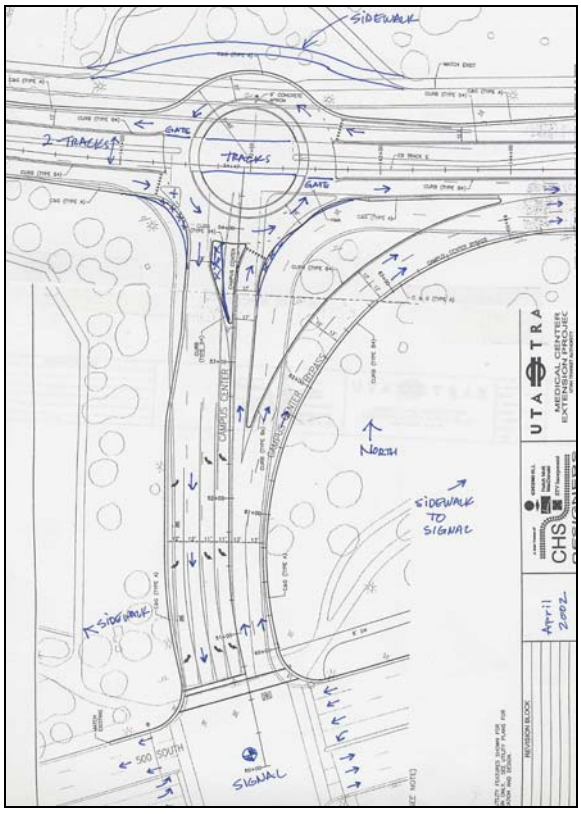
Computer analysis and simulations were prepared to show the traffic impacts with the center running Trax line on South Campus Drive at the intersection with Central Campus Drive. The two alternatives considered included a roundabout with bypass lanes on the southeast corner and a signal-controlled intersection with double left-turns in the northbound and westbound directions.

SYNCHRO (traffic signal analysis software) was used to generate the traffic capacity reports for the signal and RODEL (British roundabout analysis software) was used to produce a Level of Service (LOS) analysis based on the geometry of the roundabout. Movie type simulations of vehicles merging and making lane changes were created using VISSIM a common simulation model that is very effective at modeling both light rail and roundabouts.

The following table summarizes the results of the LOS analysis.

Intersection LOS Comparison 2020 Turning Movement Volumes (LOS/Ave. Delay)*						
	Roundabout		Signal		Signal (dual lefts)	
	AM	PM	AM	PM	AM	PM
Northbound	A / 7.8	A / 4.8	C / 34.6	F / 89.6	C / 25.1	B / 15.1
Eastbound	A / 4.2	A / 6.0	C / 28.8	D / 49.3	C / 26.9	C / 20.7
Westbound	A / 4.2	A / 7.8	D / 37.2	E / 55.9	A / 7.2	B / 11.2
Overall	**A / 6.0**	**A / 6.8**	**D / 35.3**	**E / 63.4**	**B / 17.6**	**B / 12.6**

*Does not include Trax light rail effects.



Roundabout Construction Drawing: 4 Gates

The four gates drop in succession to allow most vehicles already in the circle to exit before the train arrives. After the train leaves the circle, the two gates next to the tracks raise first allowing vehicles coming from the traffic signal to get a head start into the roundabout.

The design speed for vehicular traffic in the roundabout is 18 mph. The safety of the intersection is enhanced by low vehicular speeds and the lower number of conflict points inherent in the roundabout design.

The analysis found the roundabout option to experience less delay for vehicular traffic and no delay at all for light rail trains. The traffic signal option however, experienced at least twice the amount of delay as the roundabout option during peak traffic periods. In addition, the with the traffic signal option light rail trains had a 50% chance of stopping at the intersection to wait for the intersection to clear. Pedestrian crossings are provided at signalized locations away from the roundabout.

Intersection LRT Control and Safety

The safety concerns of allowing the trains to cross vehicle traffic was solved by installing railroad gates, flashers and bells on two of the entries and two where the vehicles cross the tracks inside the roundabout.

A total of four railroad gates with flashers, and bells are provided at the roundabout. Sensors in the tracks allow the gates to go down before a train arrives.

Roundabout during Winter Driving Conditions

Conclusions

The traffic analysis and computer simulations of the study intersection demonstrated the advantages of the roundabout alternative. The roundabout intersection alternative makes center running LRT possible on South Campus Drive. The roundabout gives the light rail trains full priority at the intersection. The low speed design of the vehicular traffic in and out of the roundabout enhanced the safety of the intersection. The project is an example of an innovative intermodal solution that may be applied at other locations in the USA.

TRAX Ribbon Cutting – October 29, 2003

Author Information

Bill Baranowski, P.E.*
RoundaboutsUSA
Provo, Utah
www.RoundaboutsUSA.com

*Bill Baranowski is the President of RoundaboutsUSA and City Traffic Engineer in West Jordan City, Utah and was the consultant/project manager of the University of Utah Light-Rail Extension Study and Design. He was a transportation project manager with the Sear-Brown Group in Salt Lake City at the time of the project.