Vasona Light Rail Signal Design Challenges

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Abstract

The Vasona line is the most recent extension of Santa Clara Valley Transportation Authority’s (VTA) light rail system. This 5.5-mile extension opened for revenue service on October 1, 2005, about 4 months ahead of schedule. It ties in to the existing system in Downtown San Jose, and follows a generally southwest alignment to Winchester Station in the City of Campbell. It goes through and along congested intersections, major arterials, freeways, and an existing freight corridor. The congested intersections and their close proximity to Light Rail Station led to a challenging signal design.

The Vasona Light Rail Extension was constructed in the existing right-of-way of an active freight line previously owned by the Union Pacific Railroad. The Vasona Project relocated the single-track freight line to make room for the Vasona Light Rail tracks, which was constructed in the existing freight right-of-way.

The Signal Design incorporated Bi-directional signaling with a combination of single and double track. There are 17 signalized grade crossing and 11 pedestrian crossings.

The acute and obtuse angles of the crossing along with the close proximity of traffic signals made equipment placement difficult. Two of the crossing had four quadrant gates, one had a three quadrant gates while five had medians installed.

To ensure safe operations of the Vasona Light Rail Project, Integration Testing was performed during Operator Training in order to fine-tune the timing of each highway crossing, pedestrian crossing and the Traffic Signal Interface.
INTRODUCTION

In 1998 Santa Clara County Transportation Authority (VTA) entered into negotiations with the Union Pacific Railroad (UP). VTA proposed to build the Vasona Light Rail Extension along side the UP right-of-way know as the Vasona Industrial Lead. VTA proposed to build this line in two phases the first phase being from the intersection of Woz Way in downtown San Jose to Winchester Station in the City of Campbell. Phase two would continue the line from Winchester Station in Campbell to Vasona Junction in Los Gatos. It was determined during negotiations that there was not sufficient right-of-way to maintain 25 foot track centers between the freight track and the light rail tracks restricting UP ability to maintain this track under their present rules. VTA decided to buy the Vasona Industrial Lead from Cahill Interlocking to Vasona Junction, UP would continue to maintain from Camden Ave to the end of Line until VTA began construction of Phase 2 from Winchester Station to Vasona Junction.

Vasona Industrial Lead

The Vasona Industrial Lead is a single-track line that begins at the Cahill Interlocking on the Caltrain’s System and traversed west through an industrial area of downtown San Jose, paralleled the Southwest Expressway into the downtown area of the City of
Campbell. The Vasona Industrial Lead serves three customers, a Flooring company at the intersection of Auzerais and Sunol Avenues, a Lumber Yard at Camden Ave in Campbell and Hanson Permanente Quarry in Cupertino. The Quarry being the major consignee with an average of three trains a week serving their needs. The Vasona Industrial Lead had fifteen highway grade crossings, fourteen with gates and flashers and one with flashers only. These crossing were all upgraded as part of the freight track relocation and Light Rail Construction.

**Vasona Light Rail Extension**

The Vasona Light Rail Extension alignment begins at the intersection of West San Carlos and Woz Way where it meets the existing Guadalupe Line. A half-grand was installed at this intersection where side running would begin traversing south on West San Carlos and then west on Delmas Avenue crossing Park Avenue at grade protected with traffic signals. The line then crossed San Fernando and Delmas Avenues at grade protected by gates and flashers to the first station San Fernando. San Fernando has a pedestrian crossing at the south end protected by flashers and bells. Continuing south the line crosses Autumn Street protected with gates and flashers and then descends into the Diridon Tunnel. The Diridon Tunnel was constructed; using the cut-and-cover method under the Caltrain's mainline and yard.
tracks. Arising from the tunnel the line heads south entering Diridon Station. There are two pedestrian crossings at each end of Diridon Station. There is a JPB/AMTRAK maintenance road south of the station protected with gates and flashers. Continue south past the maintenance road, which is the beginning of single track, the Vasona Industrial Lead appears to the west of the Vasona Light Rail tracks. The first crossing shared by LRT and Freight is West San Carlos Avenue, protected with four quadrant gates and flashers. Continuing south the line crosses Sunol, Auzerais, and Lincoln Avenues before entering Race Station. Race Station has one pedestrian crossing, with flashers and bells at the north end and Race Street crossing protected with gates and flashers is at the south end. There is one pedestrian crossing protected with flashers and bells between Race St. and Parkmoor Avenue. Race/Parkmoor crossing is protected with 10 (ten) sets of crossing gates and concrete barriers.
Flashers and Traffic Signals were mounted on the same traffic bridge. There is a gated pedestrian crossing south of Parkmoor Ave providing access from a commercial office building to the parking lot on the east side of the LRT. The next crossing and Station is Fruitdale Avenue, where double track begins. Fruitdale Avenue crossing utilizes center barriers and also has traffic signals and flashers on the same traffic bridge. There is a pedestrian crossing at the south end of Fruitdale Station. Traveling further south we cross Leigh and Stokes Avenues before coming to Bascom Station. There are two pedestrian flashers at each end of Bascom Station. Single track begins again as we cross South Bascom Avenue. Gates and flashers also protect South Bascom with concrete barriers installed.
Note this is one of the severe angled crossings.

The LRT is elevated over Hamilton Avenue with an aerial station. Since this is single track there is no pedestrian crossings. The freight track remains at grade protected with gates and flashers on concrete barriers. Traveling further south we enter into downtown Campbell crossing Civic Center Drive, Campbell Ave and Orchard. The crossings are protected with gates and flashers. Both Civic Center Drive and Orchard are one-way streets. Double track begins just north of Orchard Avenue and continues from there to the end of the line. Campbell Station has one pedestrian crossing at the south end of the station. Kennedy Avenue is the last crossing on the LRT and it is protected with four quadrant gates and flashers, this
crossing is another on a severe angle.

We now reach the end of the line at Winchester Station; there are two pedestrian crossings at each end of the station leading to the Park and Ride area.

**SIGNALING**

The Vasona Light Rail Extensions begins at the intersection of Woz Way and San Carlos Street, this area is considered Street Running, and movements are controlled by traffic signals. Movement onto the Vasona extension is via a power switch controlled either from central, locally (via control panel) or with TWC (train to wayside communications). Street Running continues over Park Avenue where bi-directional ABS (Automatic Block Signaling) begins.

Track Circuits on the light rail extension is a combination of Audio Frequency Track Circuit (AFTAC II) and Coded Track Circuits (Electro-Code with Electrified Electric Code). The freight track uses redundant crossing predictors for crossing controls. The Vasona Industrial Lead is Manual Block.
Central Control, Local Control Panels or Field Automatic (by way of TWC) is used in the clearing of all LRT routes. Field Automatic is the normal operation. Vital Processors are used for both crossing and interlocking controls. Solid-state switch controllers with dual control switches are used in all interlockings. Solid-State event recorders are used in all crossings and interlockings. Signals use LED displays. Traffic Pre-emption is provided at all intersections.

There are six interlockings on the Vasona extension starting with the half-grand at Woz Way, Diridon has a double crossover with a storage track and begins the first piece of single track approximately 1.3 miles to Fruitdale with a single turnout beginning double track. Double track continues for 1.2 miles to Bascom with a single turnout to begin single track. Single track continues over Hamilton Avenue into downtown Campbell approximately 1 mile to a single turnout in Campbell beginning double track. Double track continues for about ½ mile to a double crossover at Winchester Station and the end of the line.

Controlled Signals were installed at all Stations; these signals are normally at red. Due to the proximity of the grade crossing to the stations the signals clear after station dwell time has passed with enough delay to insure that the crossing gates and or pedestrian flashers have been down or flashing 20-25 seconds prior to the train entering the intersection or pedestrian walkway.
One of the challenges was the acute angles that the rail line crossed most of the intersections. It was noticed during early reviews that this would be an issue but the Authority did not want to address the purchase of easements that would be required to install the crossing equipment at right angles. This forced the installation of some very long gates. South Bascom Avenue had two fifty foot gates and one at Auzerais was also fifty feet. A number of other gates were in the forty-foot range. More than once high winds caused the shear bolts to brake at South Bascom causing the gate to hit the catenary. This caused some minor damage to the equipment. The fifty-foot gate at Auzerais went into the catenary completely destroying the signal house a number of gate motors and all the LED flashers on the crossing. Field surveys by the contractor never address these angles. Blank poles were finally procured and poles drilled in the field so the equipment would be at the proper angle to be viewed.

**Pre-Signals**

The installation of pre-signals at the crossings, compounded by the angles was another challenge. The City of San Jose standards conflicted with the already installed crossing equipment. The light standards blocked a majority of flashers. Special stacks were installed to help offset the flasher around the traffic poles.
The Vasona Industrial Lead had immediate traffic pre-emption for the freight crossings.
The new system called for pre-signal inputs in the railroad corridor to be approximately 50
seconds in advance of the crossings. Final timing adjustments were made with the Cities
of San Jose and Campbell to coordinate the movements through the intersections.
Scheduling these adjustments with San Jose became problematic when we learned that
there were two different traffic engineers with different street assignments.

**Grade Crossing Timing**
Prior to Light Rail running in this corridor the neighborhood people were use to three trains
a week traveling this line. Usually around midday until construction began, when trains
would not be called until after 3:00 PM. The public was very sensitive to the added
disruption to there traffic routines. With trains planned for 15 minute headways meaning
about 7 ½ minutes on the single track we needed to fine tune the gate down times to as
close to minimum as we could get. During operator training there were some major delays
to traffic until the operators got a feel for the line and were able to maintain track speed.
The timing of these gates was an ongoing process that took almost three months.

**Bells, Horns and More Bells**
With the opening of the Vasona Extension, VTA Customer Services Department was
swamped with complaints over the bell and horn noises. VTA adjusted all the bells on the
line for the minimum db levels allowed, 75db and altered the stroke. VTA assisted the
Cities of San Jose and Campbell in petitioning the FRA for a “Quite Zone”. With some
additional work of installing some longer concrete barriers and some additional pedestrian
flashers the Vasona extension was granted its request for a “Quite Zone”.

**Crossing Angles** – The crossing diagnostic reviews were not performed with input from VTA Signal Design Staff. VTA needs to utilize staff knowledge and input when making decisions that may violate the VTA Design Criteria. The costs of additional easements would be offset by the added maintenance of gates longer than 30 feet.

**Pre-Signals** – The pre-signals and the crossing equipment, such as gates, flasher and cantilever should be shown on one drawing and insure buy-in with the cities on the traffic signal placements.

**Traffic Pre-Emption** – This worked out fairly well after identifying the right individuals to work with on the intersection timing issues.

**Grade Crossing Timing** – This was a long and tedious process that required patience and a through understanding of operations, both rule and equipment operation.

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