Level Crossing on Route 78 in the Town of Veinticinco de Agosto

VISSIM Modeling of the Level Crossing

December 2017

Index

Index of Figures

Index of Tables

1. Introduction

The proposed passage of a new train will result in a different traffic behavior in the area.

This report describes the analysis of the impact of the passage of the new train on Route 78. Also, the impact of this new situation on the junction of Routes 77 and 78, located north of the town of Veinticinco de Agosto, will be studied.

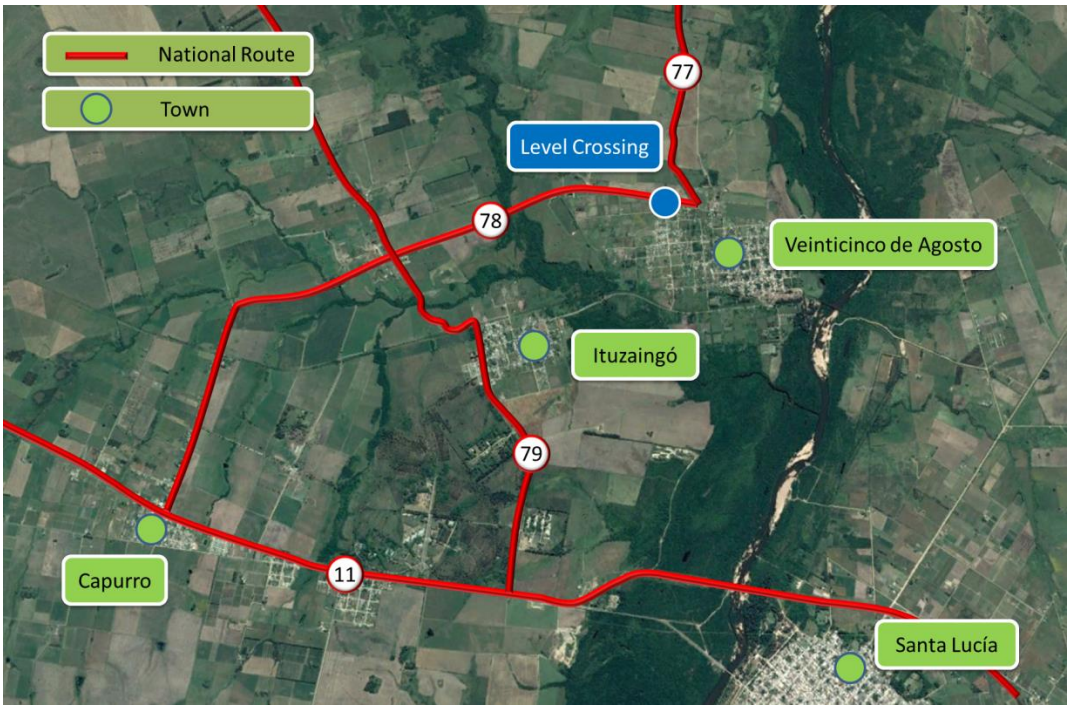
Currently, the crossing between the railway line and Route 77 is through a level crossing. The crossing is signalized by a crossbuck and a stop sign.

The first proposal is to maintain the level crossing and add a barrier to prevent the crossing of vehicles while the train passes.

Due to the fact that some northbound and southbound traffic obstruction can be registered, from the queue generated by the interruption of westbound flow, a modification for the junction of Routes 77 and 78 has been proposed.

In order to evaluate the new situation, a microsimulation model was developed using the software VISSIM.

Figure 1 – Area of influence of the study



VISSIM allows generating traffic simulation models, at a microscopic level, which consider the behavior of drivers, the characteristics of the vehicles and the geometry of the roadway network, among other variables.

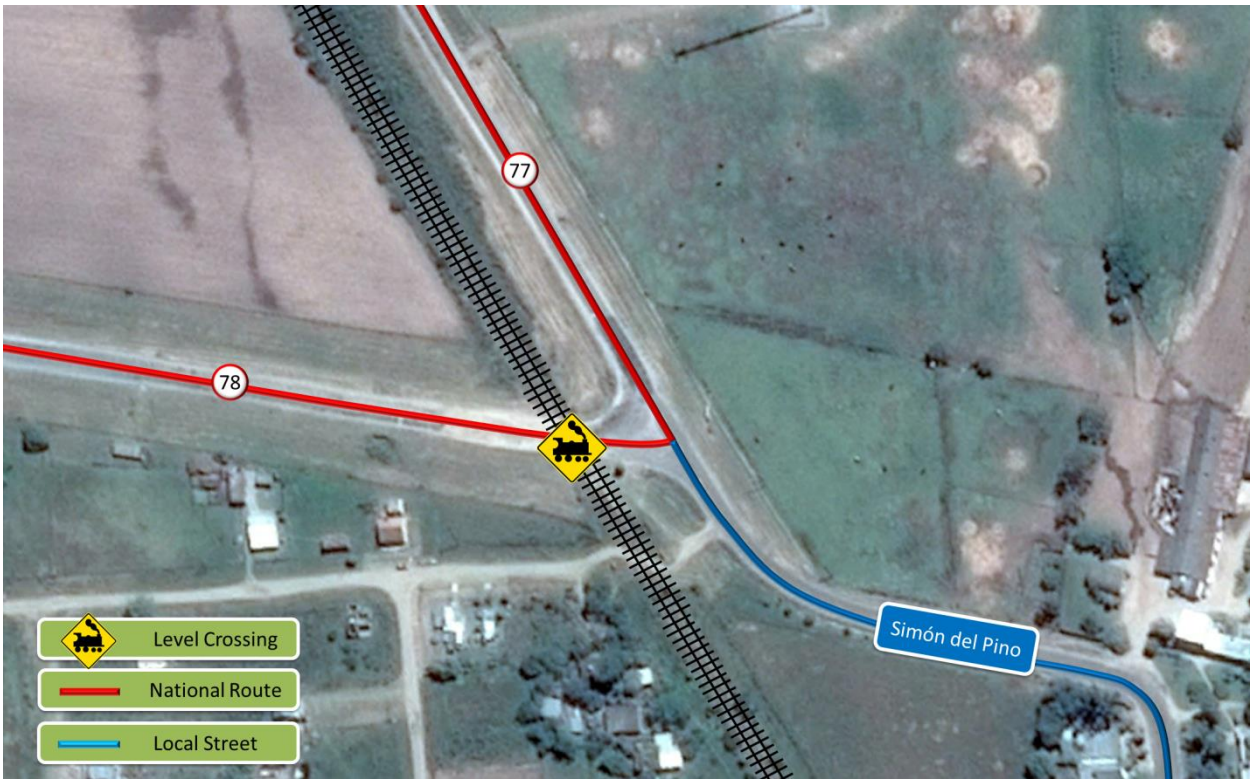
The parameters used by the software are result of an investigation performed at the University of Karlsruhe in Germany. To validate the values of these parameters at a local level, calibrations have been done in several urban and rural areas.

Figure 2 – Intersection model in VISSIM

2. Current operation of the intersection

The level crossing under study is located on Route 78; twenty three meters form its intersection with Route 77 and Simón del Pino Street.

Figure 3 – Level Crossing Area



Route 78 connects Route 11 with Veinticinco de Agosto and Route 77. Also, Route 77 communicates with the towns of Independencia, Cardal and Veinticinco de Mayo to the North of Veinticinco de Agosto.

Simón de Pino officiates as the main access to Veinticinco de Agosto.

Currently, the crossing between the railway line and Route 77 is through a level crossing. The crossing is signposted by a crossbuck and a stop sign, without barriers. The train frequency is low, so the modeling of the current situation will be considering that there are no trains crossing during the peak hours.

The passage of bicycles and pedestrians is scarce.

3. Future operation of the intersection

Due to the new railway traffic conditions, the new situation will be modeled.

The passage of the train is planned to be every two hours. In addition, the longest possible train will be 800m long.

It is considered that the signaling will prevent the crossing of vehicles 30 seconds before the passage of the train (barrier advance time), keeping the barrier low for 5 seconds after having crossed it entirely (barrier rise time).

The time that the traffic will be interrupted is calculated as follows:

$$T = T_{BA} + T_{TC} + T_{BR}$$

Where:

- T – Total time with interrupted traffic
- T_{BA} – Barrier Advance Time – 30s
- T_{TC} – Train Crossing Time
- T_{BR} – Barrier Rise Time – 5s

The Train Crossing Time is obtained in the following way:

$$T_{TC} = \frac{3{,}6 \times W}{S}$$

Where:

- W – Road Width (including shoulders) – 15m
- S – Train Speed – 50km/h

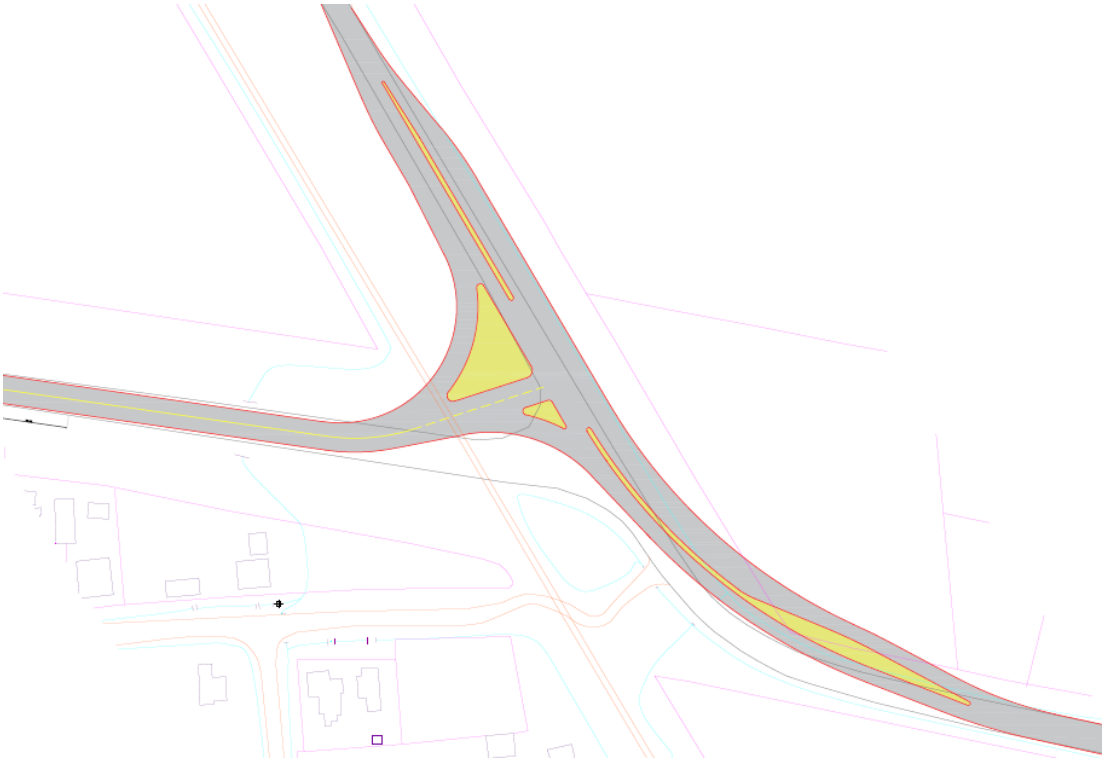
From the above calculations, it is obtained that the time which the vehicular flow will be stopped due to the passage of the train is 95 seconds.

It has been observed that in certain situations, the queues generated by the passage of the train for westbound vehicles may partially invade Route 77. For this reason, two project alternatives have been developed:

- Alternative 1 – Future train demand without geometric modifications
- Alternative 2 – Future train demand with geometric modifications

Alternative 1 considers maintaining the geometric design of the level crossing and the intersection including the new demand of trains, while Alternative 2 raises the possibility of a new geometry that better fits in the new scenario.

Figure 4 – Geometric design for Alternative 2



This new geometric design contemplates the construction of turning lanes for traffic from the North and South, for those users who want to take route 78 westbound. Likewise, the design considers reducing the current skew of the level crossing.

4. Simulation model

In order to evaluate the operation of the intersection with the proposed modifications, a simulation model of the level crossing and the intersection of Route 77 and 78 using the VISSIM software was developed.

The scenarios modeled were the following:

- Scenario 1 - Baseline scenario. Morning peak hour traffic.
- Scenario 2 - Baseline scenario. Afternoon peak hour traffic.
- Scenario 3 - Future train demand without geometric modifications. Morning peak hour traffic.
- Scenario 4 - Future train demand without geometric modifications. Afternoon peak hour traffic.
- Scenario 5 - Future train demand with geometric modifications. Morning peak hour traffic.
- Scenario 6 - Future train demand with geometric modifications. Afternoon peak hour traffic.

Figure 5 – Baseline and Alternative 1 model

Figure 6 –Alternative 2 model

4.1. Model input data

For the generation of the models, data of the current geometry of the intersection, the proposed modifications and traffic were recorded.

All the data were loaded into the model, starting with the geometry of the intersection and the immediate surroundings, using the road widths verified on site. Then, within the generated network, the traffic data was loaded: volume, vehicle composition, ratios between the volumes of different turning movements, among others.

4.1.1. Traffic demand

To calculate the current traffic of the intersection, a manual vehicle count was performed on June 15th, 2017.

From the data obtained, the fifteen minutes with the highest vehicular flow through the level crossing were identified for the peak hour of the morning and afternoon separately.

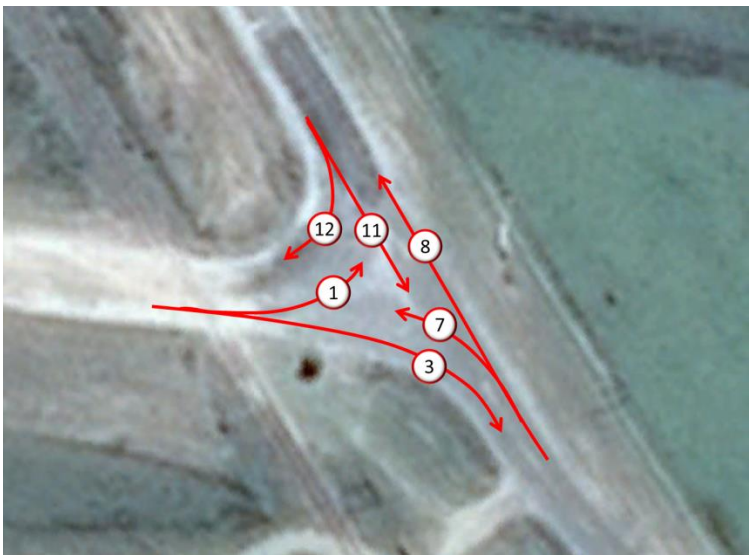
From this study, the fifteen minutes found to have the highest vehicular flow are the following:

- Morning: From 9:45 to 10:00
- Afternoon: From 16:00 to 16:15

The maximum hourly flow for each peak hour was calculated as the traffic of the fifteen minutes with the highest vehicular flow multiplied by four.

The turning movement coding convention used is the following:

Figure 7 – Turning movement coding convention



The traffic values implemented in the models are presented in the following tables.

Table 1 – Turning movement distributions – Morning peak hour

Turning movement	Vehicle flow (veh/hr)				
	Motorbikes	Cars	Buses	Simple Trucks	Articulated Trucks
1	0	12	0	0	0
3	0	0	4	0	0
7	4	0	0	0	0
8	4	8	0	0	0
11	12	4	0	0	0
12	4	24	0	12	12

Table 2 – Turning movement distributions – Afternoon peak hour

Turning movement	Vehicle flow (veh/hr)				
	Motorbikes	Cars	Buses	Simple Trucks	Articulated Trucks
1	4	16	0	0	8
3	0	0	0	0	0
7	4	4	0	0	0
8	0	4	4	0	0
11	8	16	0	4	0
12	4	44	0	0	4

5. Evaluation and results

In order to compare the proposed scenarios, the interaction between the network and the traffic flow was analyzed, seeking for possible conflicts.

From the simulations, the travel times during one hour of modeling and the queues generated in the level crossing were obtained for all scenarios.

To analyze more accurate results, three different random runs of the model were generated for each scenario.

The tables below show the results of travel times obtained by turning movement and scenario, and the queues generated by the traffic interruption for each direction.

Table 3 – Average travel times (in seconds)

Turning movement	Scenarios					
	Morning			Afternoon		
	Baseline	Alternative 1	Alternative 2	Baseline	Alternative 1	Alternative 2
1	22,0	23,6	22,5	22,1	23,8	23,5
3	24,1	24,1	22,3	-	-	-
7	22,1	22,1	21,4	24,2	23,8	22,9
8	18,3	18,3	16,2	18,6	18,2	16,3
11	20,9	20,9	20,0	20,7	20,5	19,8
12	22,8	25,7	21,2	22,5	22,6	18,2

Table 4 – Maximum queues (in meters)

Direction	Scenarios			
	Morning		Afternoon	
	Alternative 1	Alternative 2	Alternative 1	Alternative 2
Eastbound	18,1	16,1	26,6	21,0
Westbound	32,9	26,9	0,0	0,0

Figure 8 – Maximum queue obtained in the morning peak hour – Alternative 1

Figure 9 – Maximum queue obtained in the afternoon peak hour – Alternative 2

Figure 10 – Maximum queue obtained in the morning peak hour – Alternative 1

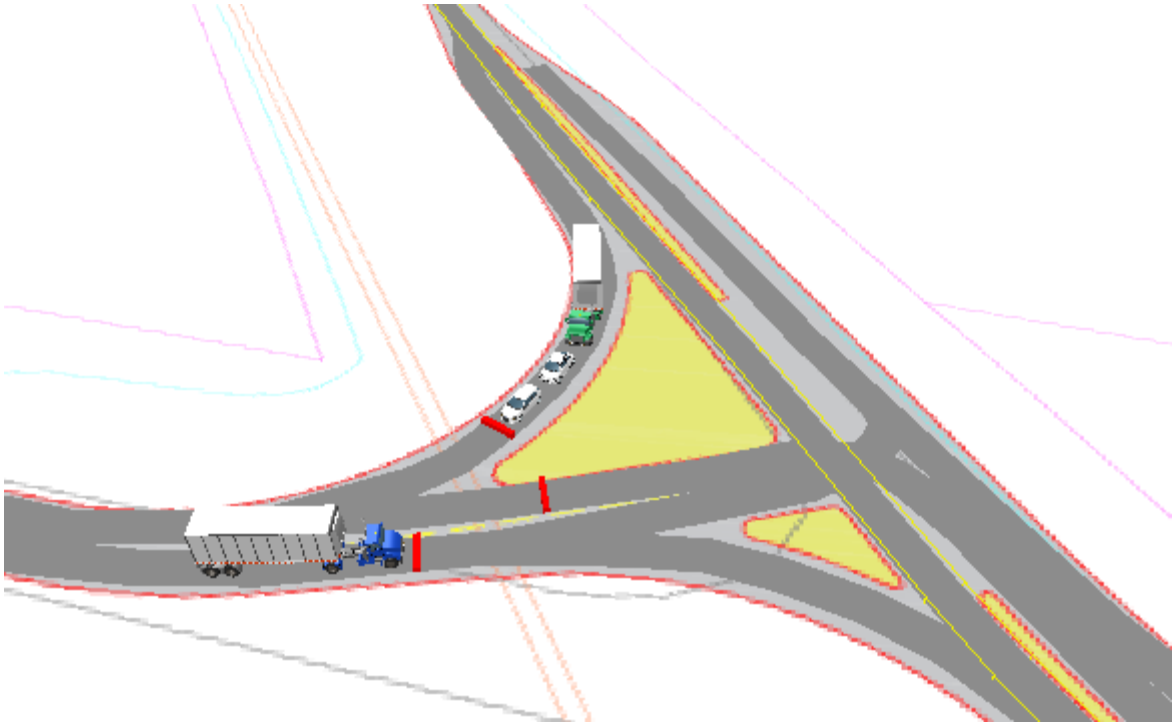
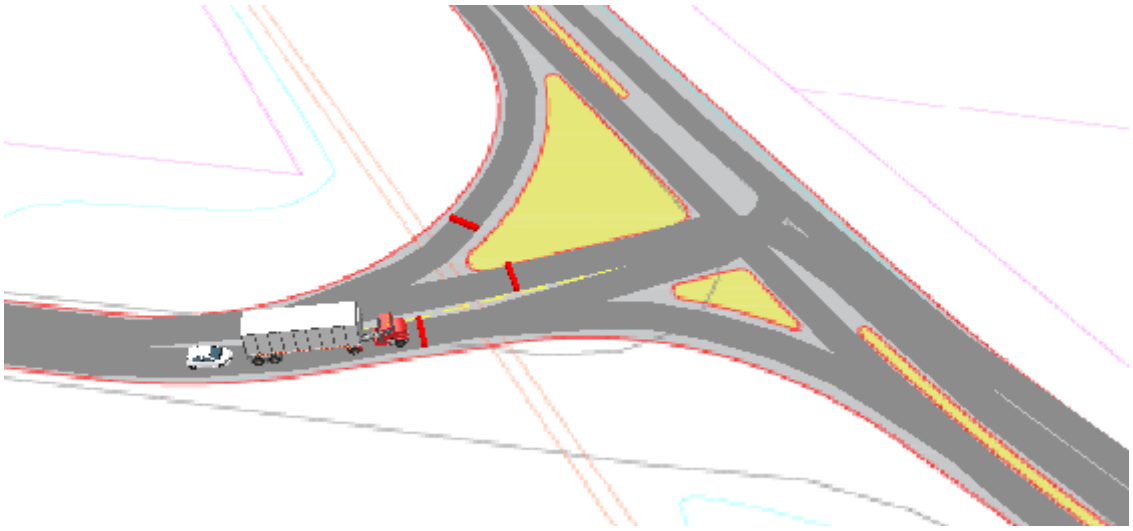


Figure 11 – Maximum queue obtained in the afternoon peak hour – Alternative 2



6. Conclusions

The results presented in the previous chapter show that the difference between the travel times of the baseline scenario and the alternatives is very small. It is concluded that the impact generated by the passage of the train does not considerably affect the travel times of actual road users.

One-hour scenarios have been modeled in which vehicular traffic will be interrupted only once and for 95 seconds. This means that at most some vehicles must wait a minute and a half.

The queues generated by the interference of the train will be of at most 32,9 meters. This could be a problem in Alternative 1 since the junction of Route 77 and 78 (and the access to 25 de Agosto) is only 23 meters East of the level crossing. It should be noted that this problem has been recorded in a single run of the morning scenario of Alternative 1.

Due to this possible interference with North-South traffic, a preliminary design with turning lanes has been presented, in order to allow westbound vehicles that wish to continue on Route 78 to do so without interfering with the traffic through Route 77 and Simón del Pino. This new design has been named Alternative 2. The geometry drawn will require a small expropriation of the property located northeast of Simón del Pino.

The modeling of Alternative 2 allows concluding that vehicles waiting, in any situation, will not interfere with the remaining traffic.

The flow of pedestrians and cyclists at the point of study is low. For this reason it is concluded that the impact on this type of users is reduced.