BUS RAPID TRANSIT PROJECT: LA MATANZA, BUENOS AIRES, ARGENTINA

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ABSTRACT

Several Bus Rapid Transit (BRT) were developed in Latin America during the last decade, showing the growth, maturation and evolution of this high-quality bus based public service.

The BRT presented in this paper is located in the National Highway 3 (RN3), in La Matanza city, Buenos Aires, Argentina. The corridor has about 11 km of segregated lanes, including extensions in mixed traffic as well.

Argentina has other BRT lines already circulating through the country, all of them have had great acceptance and have been successfully developed in different corridors. Each existing system has its own distinctive elements, but this is the first "full" Bus Rapid Transit project in terms of BRT Standards, which makes it the most ambitious project so far.

This paper presents the guidelines and criteria followed for functional and physical design of La Matanza's BRT, projected with trunk-feeder structure, off board fare collection and segregated right-of-way infrastructure in the Province of Buenos Aires.

The restructuring methodology of the existing system into a trunk-feeder will be treated, combined with local and express services in order to provide greater connectivity and accessibility both in La Matanza and with regard to the Capital Federal. Finally, aspects related to the architecture and infrastructure of the new system are described, taking into consideration local and socio-demographic urban conditions.

At the end and as a conclusion, social benefits associated to the project will be addressed, in order to show the convenience of its construction and implementation.

Keywords: Bus Rapid Transit, BRT, station, capacity, bus operation, public transportation

ACTUAL SITUATION

The municipality of La Matanza is located in the province of Buenos Aires and is part of the Metropolitan Area of Buenos Aires (AMBA), which also includes the City of Buenos Aires (CABA) and the other 23 municipalities of Buenos Aires. It is the largest suburban city, with a total area of 325.71 square kilometers.

Within the province of Buenos Aires, La Matanza is the most populated municipality (1,775,816 inhabitants) with social heterogeneity and a strong presence of both formal and informal employees. This historically sparsely populated territory had an accelerated urbanization process in just over 50 years.

The main reason for people mobility is work, where the 74.2% of the working population corresponds to a salaried condition. The main economic activities of the municipality's population are industry, commerce, construction and transportation.

Current mobility patterns

La Matanza city has grown and developed along the axis of the National Highway 3 (RN3). This corridor links La Matanza longitudinally, working as a structural centerline. It is also the main connector with the Federal Capital.

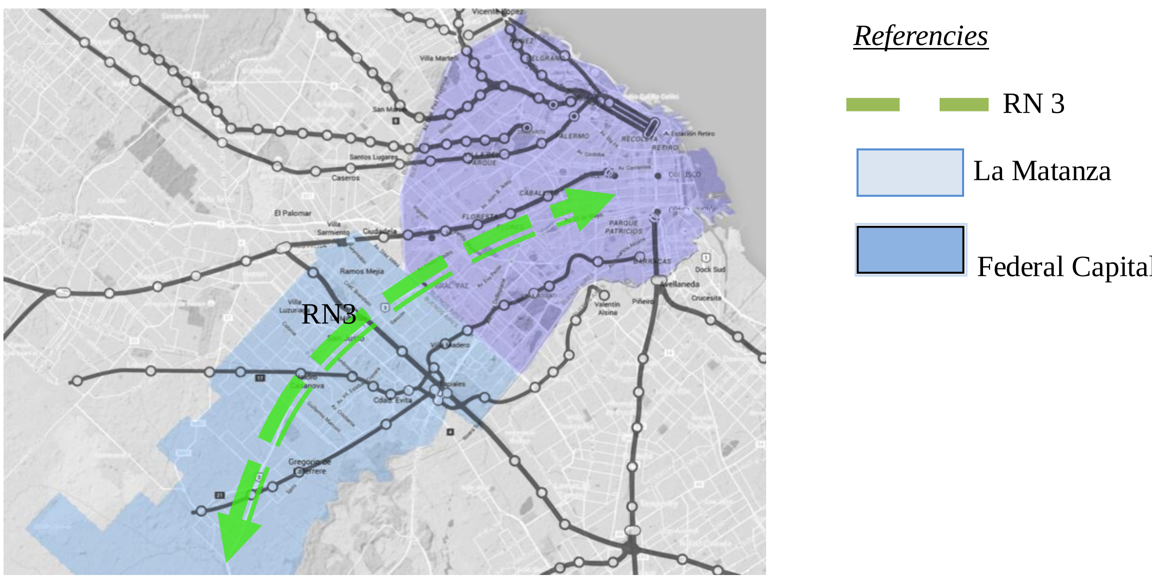


FIGURE 1 RN3 corridor.

RN3 level of service in the existing conditions is very poor. Buses, automotive freight and private transportation coexist, generating major congestion and delays, unsafe conditions, long travel time and significant emissions.

Current mobility in the corridor, associated to work reasons as previously exposed, are mainly concentrated within La Matanza itself. Internal trips represent the 58% of total in the morning, and 72% in the afternoon.

The area is currently served by a set of 15 lines of different jurisdictions (National, Provincial, Municipal), carrying 77 million of passengers annually.

Current system consists in 12 lines, divided as well in 76 branches. These large amount of services cover the whole area, directly addressing each neighborhood. Projected BRT combines existing services as feeders, developing three trunk routs.

Existing Urban Environment

The lack of organization in public space, is the result of the urban growth without planning. This has become evident in La Matanza, lineally structured along the RN3, where the population density decreases as the route moves farther from Capital City.

Today, pedestrians have no protection nor green spaces. Vehicles have earned the circulation priority, deteriorating public space. Sidewalks are filled with parked vehicles or occupied by illegal shop expansions.

Existing Typical Cross Section

National Highway 3 (RN3) traverses La Matanza city in all its length. This project is located between the intersection with Provincial Highway 4, in San Justo City, and Provincial Highway 21. Today is an urban route regulated by traffic lights. Cross section consists of 3 lanes per direction, physically divided by New Jersey barriers.

The length in study presents two typical existing cross sections, Section I: From Cristiania Av. to Provincial highway 21. This section has unidirectional collector roads; and Section II, with accentuated urban features: from Provincial Highway 4 to Cristiania Av.

Regarding the existing pavement structure, in the first section the pavement for circulating lanes is flexible with parking lanes constructed in concrete. Total cross section width is 25.20 m.

In Section II, central lanes are constructed in flexible pavement, while the third lane is rigid. Cross section width is 21.60 m.

Today, bus-stops are along the right rigid lane, passengers waiting shelters are in sidewalks. The high number of circulating buses result in traffic obstructions, not only in stop lanes but in the adjacent one. Deteriorating the corridor level of service.

BRT PROJECT

Objectives

A Bus Rapid Transit pretends to be a high quality bus based transit system, with similar operational characteristics of a rail-based system, implying significantly lower initial investment costs.

A system of this kind has as main objectives:

- La Matanza’s accessibility improvement,
- Reduction of travel time,
- Enhancement of the travel experience,

- Optimization of transfers within the system as a whole, and with the CABA public transportation network,
- Improvement of Public Space.

Then, the expected benefits are:

- Reductions in travel times by improving the vehicle speed operation,
- Reductions in travel times by reducing dwell time,
- Operational Benefits (operating costs reduction),
- Improvement of Public and Road Safety,
- Emissions Reduction.

When considering operational and infrastructure BRT aspects, is possible to find key features in order to achieve great level of benefits:

- Integration of trunk lines with feeder network,
- Central dedicated right-of-way,
- Closed stations, off board fare collection, high quality transfers.

Functional Design

Three types of services are proposed:

1. **"Local" Trunk lines**, along the trace of the RN3. Those are high capacity services, with a designed stop distance on the order of 500-600 m, prepared to meet high level of demand within the municipality of La Matanza.
2. **"Expresos"** Trunk lines, similar to the "local" trunk lines, with more spaced stops. This lines will connect those points with greater density of travels' generation / attraction, within the Municipality and in relation to the CABA**.**
3. **Feeder lines**, based on existing municipal and provincial lines. These lines have lower capacity but can offer a higher level of accessibility into areas distant from trunk lines' paths (RN3).

Restructuring criteria routes

As mentioned before, public transportation through RN3 in La Matanza, is dominated by domestic travels. From network restructuration, lines are to assume different functions as feeders, local and expresos.

A special case was considered when restructured the existing system, where the itinerary of the lines overlap trunks in a considerable proportion of the corridor (more than 20% coincidence). In those cases, lines are allowed to enter the dedicated lanes, in order to avoid the generation of trunk-feeder transfers.

Related to the transfers also, 47% of trips are made in two or more stages and considering that transfers generate an inconvenience to passengers, the criterion that new routes should not generate more than one additional transfer, was strictly observed. This point emerged as very important, because generating more than a transfer to current travels, could create a strongly negative image of the system.

Trunk Lines

Connection with the Autonomous City of Buenos Aires(CABA)

Today, two lines (88 and 96) cover the entire RN3 corridor, connecting La Matanza with the CABA. These lines have routes with terminals in Constitution and Once in Buenos Aires city. (Plaza Miserere).

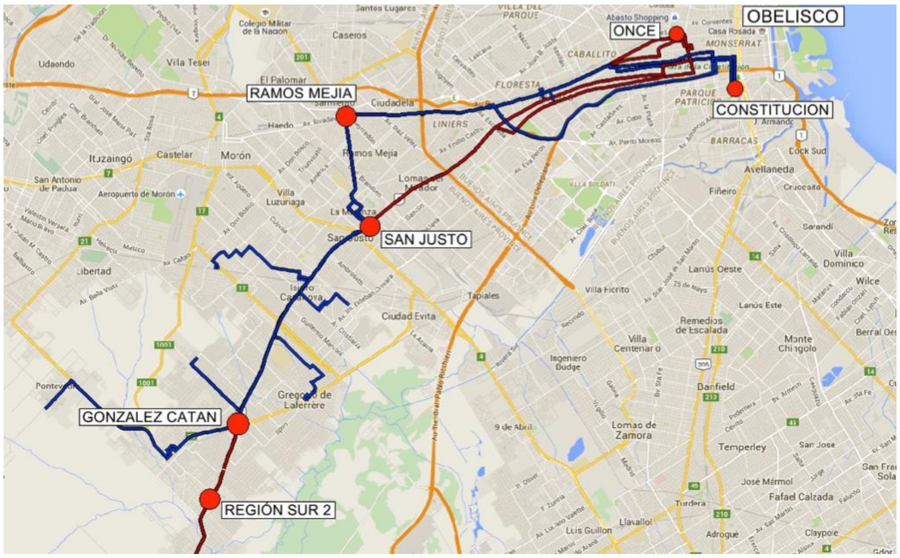


FIGURE 2 National Lines 88 and 96 routes.

Analyzing the mobility between La Matanza and CABA, the second works as an attractor. It is desirable that selected routs give direct connectivity to major trip attractors and linkage to mass transit systems as metro, train and metrobus (segregated right-of way bus infrastructure in CABA). This way, it is possible to structure high capacity services with a wide coverage.

On the other hand, the restructuration into a trunk-feeder system implies that the current ramifications of domestic national routes in different neighborhoods of La Matanza, will be converted into feeders. Considering the criterion of not generating more than one additional transfer, it is necessary to maintain current paths to and in the CABA.

Current lines have three main axes in CABA:

- Avenue Rivadavia
- Avenue Juan Bautista Alberdi
- Freeway Perito Moreno and Freeway 25 de Mayo

The paths over Rivadavia Avenue link in Liniers, a major CABA terminal center with Sarmiento Suburban Railway and Metrobus Juan B. Justo, allowing a quick access to the north of the city. Then there are linked to the Subway network in Line A, San Pedrito Station.

The traffic circulation on Av. Juan Bautista Alberdi will be enhanced by the future implementation of a segregated right-of-way infrastructure on it, providing significant improvements in the speed to access different areas of the city and culminating with connectivity to the Plaza Miserere station.

Finally, the paths using freeways, on which a segregated right-of-way infrastructure is under construction, will enable a quick connection with Constitución, and connection with the South of the AMBA region by rail and line C of the subway network. In addition, this line can continue with optimal commercial speed, toward the central area of the city ending the route at the Obelisco.

Trunk lines terminals

Terminals where placed based on the current lines analysis and the criteria of not generating more than a new transfer per trip.

Today as mentioned, Once and Constitución are the terminals of the existing national routes in the corridor, and are important transfer centers in Buenos Aires City, linking other modes as Railways and Subway. The existence of Metrobus 9 de Julio generates the opportunity to continue Constitución services to the Obelisco providing a fast connection between La Matanza and downtown Buenos Aires and three subway lines.

In La Matanza, the locations of San Justo and Ramos Mejia are mainly south-generated trips attractors urban centers, and therefore intra municipality trip terminals.

Gonzalez Catan is currently an important terminal node, disordered and partly informal. Therefore it is a natural terminal also linked to Belgrano Sur Suburban Railway.

The location of the future Transfer Center facilities in Gonzalez Catan, generates the need for another southern terminal to work in a complementary manner and with ample opportunities for growth. Because of this, Región Sur 2 was implemented as the south terminal. Its location is defined in terms of an incipient concentration node travel as it is settled near a branch of the National University of La Matanza and municipal headquarters.

Trunk lines routes

The final outline of four trunk lines routes is presented below and shown in (figure 3):

1. Región Sur 2 / González Catán – San Justo – Ramos Mejía
2. González Catán – San Justo – Ramos Mejía – Constitución / Obelisco (CABA)
3. González Catán – San Justo (Through Indart st. /Through Illia av.)
4. Región Sur 2 - González Catán – San Justo - Once (CABA)

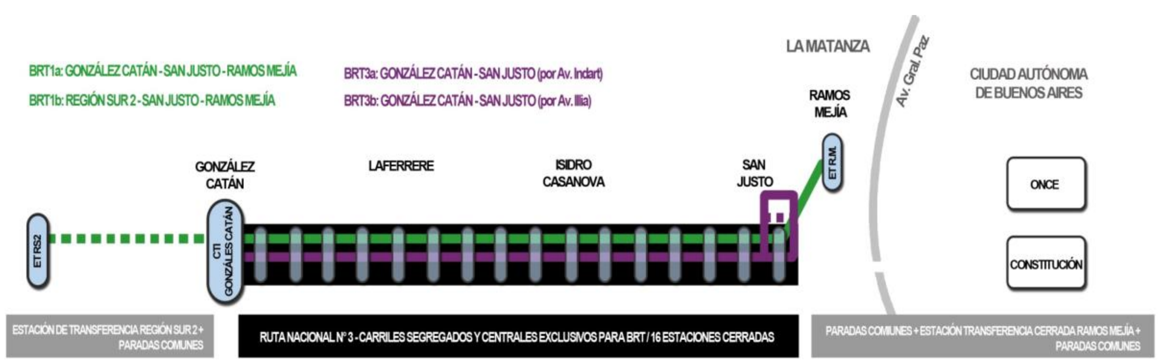


FIGURE 3 Trunk lines Outline.

Trunk Line 1 connects the RN3 corridor with San Justo and Ramos Mejia, with two branches (A and B) starting in transfer centers with the feeder lines: CTI Gonzalez Catan and Región Sur 2. This line will serve locally RN3 corridor, with 16 stops between Gonzalez Catan and San Justo.

Trunk Line 2 connects the RN3 corridor from Gonzalez Catan, with Ramos Mejia and CABA with express services between major points along the route to Constitución and Obelisco (CABA).

Trunk Line 3 connects the RN3 corridor with San Justo, ending its route there, serving locally RN3 corridor, with 16 stops between Gonzalez Catan and San Justo. Given the urban density between Indart, Av. Illia, Peron and Rivera Indarte streets in San Justo, there will be two branches (A and B) with different routes in this area.

Trunk Line 4 connects the RN3 corridor from Región Sur 2, with CABA (Once) with express services.

Feeder lines

In the new public transport scheme proposed by this project, existing lines are restructured to assume different function as feeders, direct links, or integration into the corridor.

Moreover, all the districts of La Matanza not supplied by any kind of public service were analyzed, and some existing routes were modified or extended.

This analysis ensures public service accessibility to all the neighborhoods, at a walk able radius.

Current network restructuration in a trunk-feeder system generated 52 feeder lines, from 64 existing branches, belonging to 12 lines and 5 different companies.

TABLE 1 Trunk lines Demand and frequency estimation

TRUNK LINE	1-A	1-B	2	3-A	3-B	4	TOTAL
FRECUENCY (Bus/h)	**15**	**27**	**26**	**6**	**6**	**10**	**90**
HEADWAY (Min)	4,0	2,2	2,3	10,0	10,0	6,0	
PAX TOTAL DAY (Pax)	**30.331**	**55.223**	**52.662**	**24.266**	**20.666**	**35.331**	**218.479**
PAX TOTAL PEAK AFT. HOUR – ONE WAY (Pax/h)	1.699	3.092	2.949	1.359	1.157	1.979	
MAX. LOADING (Pax/h)	**904**	**1645**	**1.569**	**723**	**615**	**1.053**	
TYPE OF VEHICLE	CONV.	CONV.	CONV.	ART.	ART.	ART.	
VEH. CAPACITY (Pax/veh.)	65	65	65	160	160	160	
SERVICE CAPACITY (Pax/h)	**975**	**1.755**	**1.690**	**960**	**960**	**1.600**	

STATION LAYOUT

Stations Capacity – Vehicles

Integration of BRT services with feeder lines, demand a station design for comfortable transfers. To achieve this goal, special feeder line stop places were provided, allowing transfers between these lines and trunks on the same platform. These stations are also served by express services.

Stations were designed with spaces upstream of each stop place, in order to allow a comfortable entry of vehicles and create "buffer" opportunities, providing greater operational clearance. This layout allows an independent operation of each stop.

At the same time, when close to a signalized intersection, an area of "buffer" between this intersection and the first stop place was included, helping to reduce the negative effect of red light in station capacity.

Moreover, stations are design to serve feeder and trunk services with conventional vehicles (12 meters long) and articulated (18 meters long). Therefore, stations provides a stop gap for articulated vehicles, positioned in first place downstream, minimizing maneuver number for these vehicles. Likewise, feeder stops are positioned in the last place, giving these vehicles the opportunity to exit the corridor from the same lane, leaving the passing lane continuously enabled.

The proposed layout, compared with the programmed supply, allows saturation levels below 45% in all stops, leaving significant room for growth in supply system.

The figure below shows schematically the proposed station layout with a place for feeder stop.

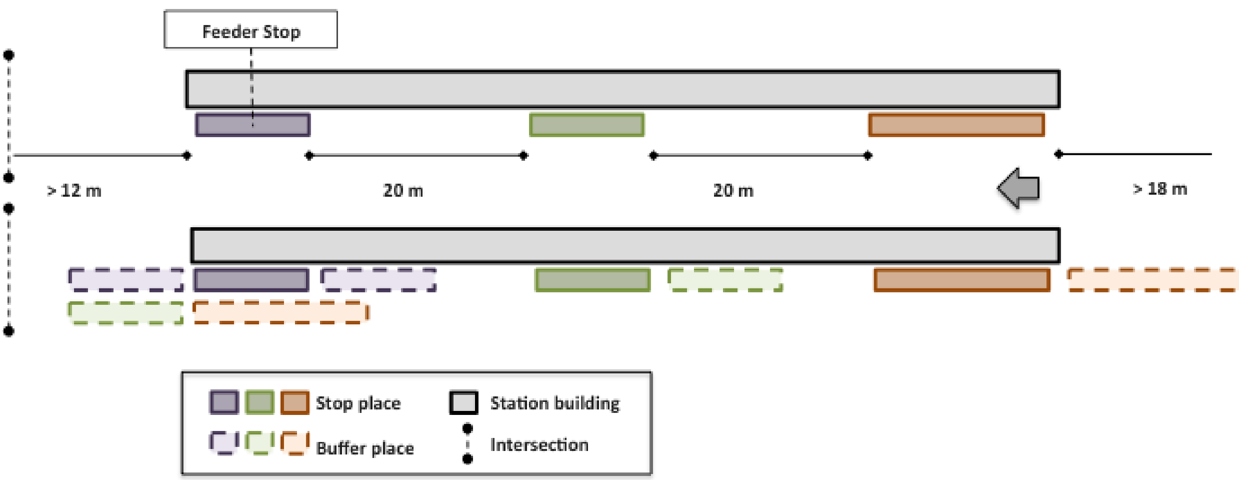


FIGURE 4 Station layout with a place for feeder lines stop

Station Capacity – Passengers

Based on the calculation methodology for stops capacity, the ability of the proposed schemes were calculated and compared with projected demand of users.
While the length of stations is determined by the capacity in terms of vehicles, which involves the necessary loading and unloading passengers docks and required buffer spaces, from the point of view of the accumulation of waiting passengers, the critical factor is the width of the station, as loading passengers are expected to agglomerate around the doors waiting to upload. Downloading passengers will be dispersed quickly. In this way, the width is determined by the passenger demand at each dock.
The following equation, summarizes the calculation of the required width of the station.

$$Wp = 1 + Wu + Wc + Wopp \quad (1)$$

Where:

- Wp = total width of platform
- 1 = required width for infrastructure
- Wu = required width for the awaiting passengers in one direction.
- Wc = required width for circulating passengers.
- $Wopp$ = required width for the awaiting passengers in the opposite direction.

In our case, with platforms separated by flow direction, W_{opp} is equal to zero.
Normally, about 2000 pedestrians can pass through a meter-wide sidewalk per hour, with a reasonable level of service.

Based on the following parameters and the maximum load data for the afternoon rush hour and the feeder lines docks (which is the most heavily loaded at the station and therefore determines the width), the platforms of the most loaded station are dimensioned. The calculated width of the station is 3,46 meters.

- 1 m^2 can accommodate 3 awaiting passengers.
- 2447 circulating passengers per hour.
- 2223 Boarding Passengers per hour on the BRT line.
- 25 buses/hour for the line.

As a general premise, it was sought to minimize the width of the stations in order to allow the typical cross section to have in all cases a bypass lane and two mixed traffic lanes per direction. In addition to the growth capacity of the system, the number of validation posts at the station's entrances, adopted width of platform was *Wp* of 4.10 meters. This allows a 26% growth margin for this dock.

General guidelines for construction methodologies
As a starting point, five basic design criteria are established:

- Modular system that allows the repetition of standardized elements,
- Flexibility for future growth,
- Facility for construction and maintenance (resistance to intensive use, weather, impacts and vandalism,
- Transparency,
- Positive urban impact,
- Ticket off-board validation.

Modular system that allows the repetition of standardized elements
Adopted module has a total width of 4.10 m by 3.3 m long, allowing the coordination of the opening gates with the buses doors without any interruption. This consists of a pre-shaped foundation of reinforced concrete and metal frames that support the roof, metal sheet side walls and glass doors.
The precast bases are designed to streamline time and minimize the impact of work area since the system is independent and rests directly on the road. The same precast base resolves the platform height needed (0,40 m) including paving and protection on the back of the station against the mixed traffic vehicles, while supporting the metallic structure in the form of porches.

Flexibility for future growth
Being a modular and prefabricated system, the stations are simply expandable by adding modules in the longitudinal direction. Allowing to absorb future system growth.

Construction and maintenance

Constructability is given by the prefabricated elements, whether the base, metal frames precast or modular coatings in sheet metal are all noble, durable and easy replaceable materials.

Transparency

The side walls of the station are resolved through a system of perforated metal panels, allowing stations closure, giving security and control to the entrance, always keeping the natural ventilation and ensuring transparency in the order of 60%, thus avoiding blind spots that generate insecurity feelings.

At the awaiting areas for the ascent and descent of passengers, the closure of perforated panels is interrupted giving rise to automatic glass doors, ensuring a full visual of the arrival and departure of the bus.

Positive urban impact

In addition to the architectural project of the stations, it has been developed a comprehensive project for the corridor, which contributes to the structuration, improvement and renewal of the spatial system and their urban role, recovering spaces to be used by citizens:

- Provision of citizen - civic character,
- Creation of a new green corridor,
- Construction of new identity,
- Appropriation of space by neighbors / generation of a belonging sense,
- Promotion of social exchange,
- Incorporation of green/public space.

FIGURE 5 Projected corridor.

Ticket Pre validation

Stations are equipped with an access control system in each one of the entrances, varying in number according to the type of station and the planned load.

Constructive technology

The requirements listed above are the key factors when designing a system that can be solved through standardized elements of continuous production at workshops or factories, leaving for the work site only the assembly of the elements.

Four types of material are used to solve the stations entirely. Concrete for the most requested part of transit in contact with the public, the steel for the main structure , the perforated metal panels and glass for automatic doors.

All these parts are developed to respond to the module of 3.30 meters marked by the opening of the buses doors.

The three designed stations are structured through repetition and combination of two typical modules of 3.30 meters long by 4.10 meters in width:

Module 1

To access into the station and movement between docks.

Consists of a prefabricated concrete base built in 2 parts of 2.40 m and 0.90 m wide respectively, linked with a total length of 3.30 m. Across the length of the prefabricated base will be 4.10 m. The metallic structure, approximately 4.10 m height, will be placed in the axis of the base.

Module 2

Module for the bus stop.

This module is similar to the module type 1 and it has the same structure, but in this case the shape of the roof is curve and it has a corbel which protects users in case of rain. Also, this different shapes indicate where buses must stop and it makes easier for drivers to distinguish exactly the place.

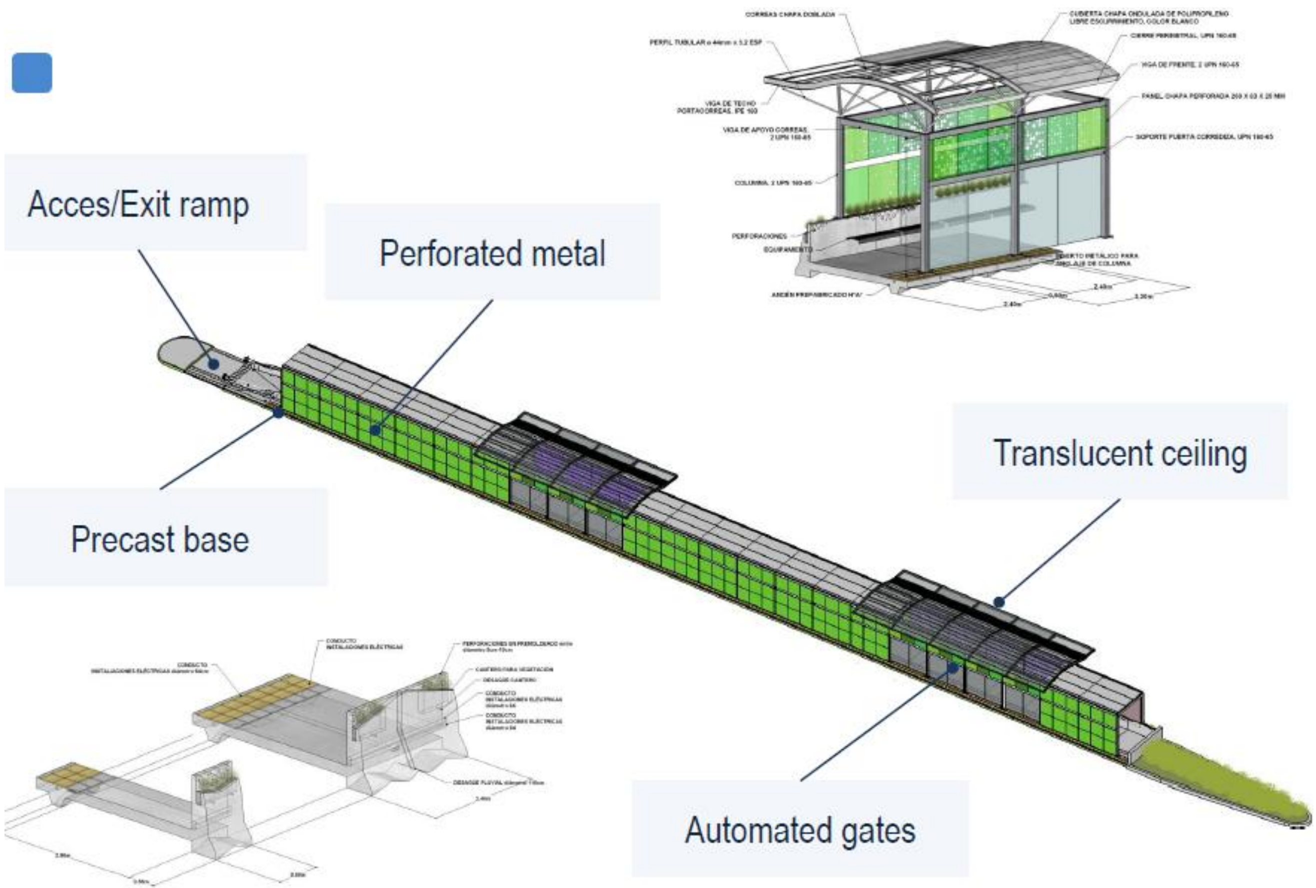


FIGURE 6 Typical station modules.

ROAD INFRASTRUCTURE

Road infrastructure design has several constraints: Available right of way; intermediate stations; station dimensions determined from the number of bus stops (main lines and feeders); left turns from and towards exclusive busway; mixed traffic left turns.

Geometric design key factors:

- Design Speed: 60 km/hs;
- Passing lanes at stations;
- Typical cross section width at stations: 27.80 m (Figure 7);
- Asymmetrical centerline in order to concentrate the widening construction at one side;
- Transition lengths as recommended in geometric design guidelines;
- Typical cross section width between stations: variable (Figure 7);
- Typical cross section for buses left turn from exclusive busway (Figure 7)
- Mixed Traffic left turns according to existing cross section. In Section I, left turns are performed from collector roads, In Section II from previous street.

Proposed Typical Cross Sections

In (Figure 7) typical cross sections are presented.

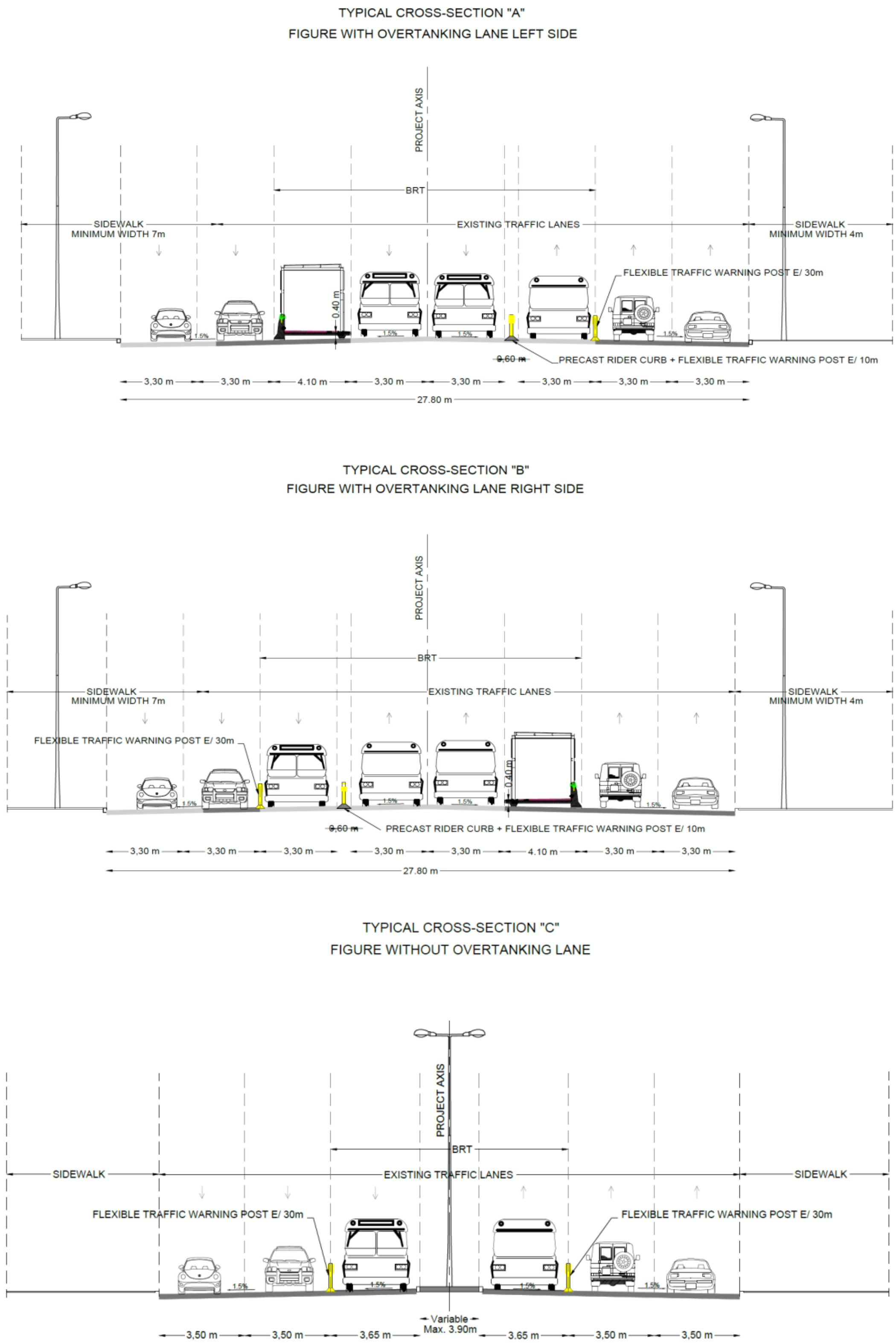


FIGURE 7 Typical cross sections.

Typical Pavement Structure

Concrete was selected to the refunctionalization of BRT excusive busway in stations. Due to the existing transit volume, the constructive method chosen is the Whitetopping, in order to minimize construction times.
Soil studies have been performed to ensure the viability of the adopted solution. In all cases, the existing pavement structure had thickness enough to serve as a base, after milling the thickness of the projected concrete slab.
After calculating BRT traffic for 25 years of serviceability, thickness of busway slab resulted 29 cm. Depending on the available milling machine, the work should be specified in several passes.
Widening in station sections were calculated for 25 years also, but in this case for mixed traffic.
Extra width is projected with concrete, adding a poor concrete base below.

Passing Lanes Design

One of this BRT distinctive feature is the passing lane at stations. Approaching to the bus stop, typical cross section C (Figure 7), turns into A or B (Figure 7) when the passing lane and station width is added to the cross section. These widening, are preceded and followed by transition lengths (Figure 8). Those transitions have been designed following the recommendations given in "A Policy on Geometric Design Highways and Streets" AASHTO 2011 (2), chapter Auxiliary Lanes, where 30 m are recommended for single lane widening and 45 m for two.
In (Figure 8) typical station design is shown. Note this is Section I configuration, cross section with collector roads, where the widening and mentioned transitions can be seen.

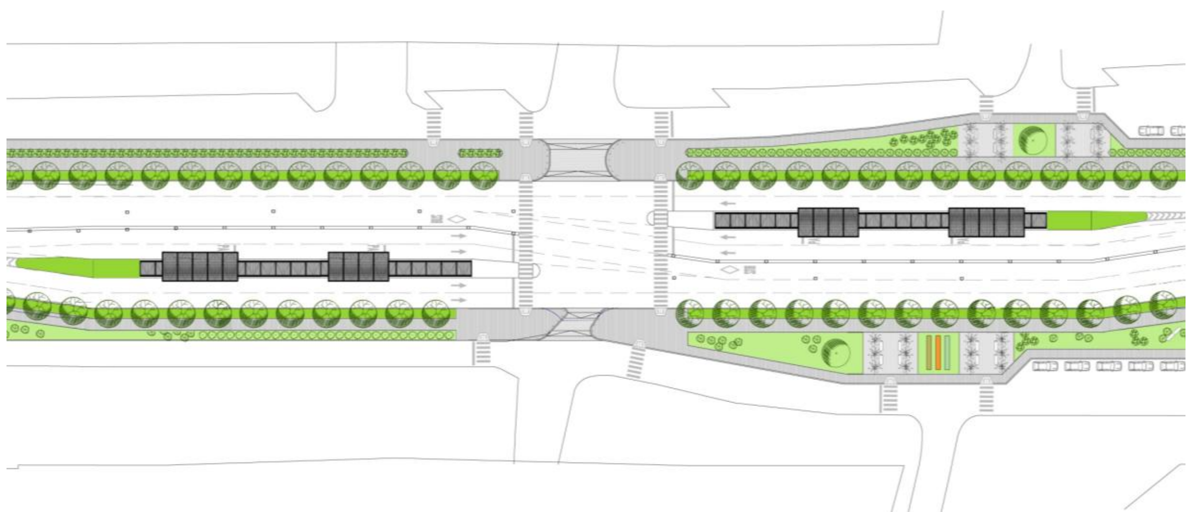
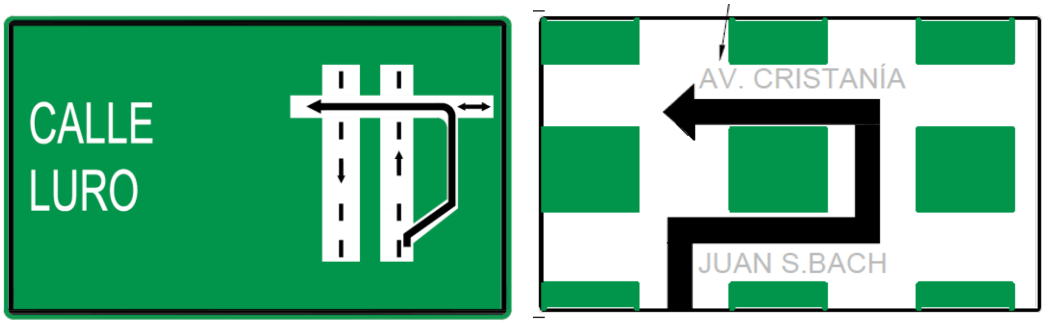


FIGURE 8 Typical intermediate station layout.

Left Turns

As mentioned before, one of the objectives pursued with this project, is the reduction of traveling time. Exclusive busway in center lanes, in intersections where left turns are allowed, are in contradiction with this goal as it means the need of a third movement in a classic traffic light. Left turns are permitted in a few intersections, where feeder lines incorporate or exit exclusive busway, in order to minimize transfer times.

Left turn for mixed traffic has to be considered as well. Remembering both typical existing cross sections, the solutions can be clearly differentiated along the corridor. For Section I, left turns have been designed from collector roads. Left turn is performed from the transversal street, preserving classic two traffic light movements. (Figure 9A) shows how to follow the path.



(A) **(B)**

FIGURE 9 (A) Signalization for left turn in Section I / (B) Signalization for left turn in Section II.

In Section II, left turn is replaced by a right turn in a previous street, as shown in (Figure 9B)

ECONOMIC AND SOCIAL EVALUATION

Social Costs

Costs were divided in the following categories:

TABLE 2 Construction and maintenance costs

Items	(AR$)	Commentaries
Infrastructure	229.474.522	Segregated busway, bridges, streets, culverts
Stations	446.342.899	Terminals, intermediate station, control stations
Environment	127.943.813	
Access devices	14.567.737	
Traffic control devices	6.172.978	Vertical, horizontal
Lighting system	30.379.327	
Control equipment	75.657.600	ITS (automatic doors not included)
Optic fiber	3.521.604	
Traffic lights	53.288.841	
Others	25.826.152	
Total	**1.013.175.473**	
Operation		**$ 27.824.881**
Ticket sellers	$ 6.541.301	
Control center supervisor	$ 501.224	
Control center operator	$ 4.064.819	
General Vigilance	$ 7.413.120	
Plus night workers (21 - 06)	$ 4.077.216	
Cleaning and maintenance manager	$ 202.294	
Station cleaning personnel	$ 1.690.496	
Maintenance of green spaces personnel	$ 994.410	
Materials	$ 630.000	
Electricity	$ 900.000	
Water	$ 360.000	
Telephone	$ 270.000	
Internet	$ 180.000	
Maintenance		**$ 31.328.771**
Maintenance of buildings and stations	$ 3.250.000	
Maintenance of green spaces	$ 1.291.371	
ITS Systems	$ 19.014.400	
Automatic gates	$ 4.845.000	
Access devices	$ 2.928.000	

Social Benefits

Considered benefits are listed below:

- Time savings: morning rush hour 23.5% ; afternoon rush hour 24.4%. Total day 18.4%. Time costs have been adopted as 50% of the average salary.
- Reduction in number and severity of accidents: due to the BRT dedicated right of way, the regulation of turns and traffic lights, the inclusion of central stations with pedestrian marked crosswalk, the corridor's safety will be improved. In order to estimate social costs associated to an accident, a research was made to know the number of incidents associated with passenger transport. Then the factor accident/fleet was used to calculate the number of deaths due to traffic crashes. As recommended by International Road Assessment Program (iRAP), accident costs have been considered as 17 times salary per person when injured, and 70 times per death.

- Emissions reduction: evaluated in terms of NOx and MPx emissions, because of their health impact. The situation with project is improved by 6-8 ton/year of NOx and between 300 and 400 kg/year of MPx.
- Operative costs reduction: Due to the speed rising, the path lengths reduction and the system efficiency.

Costs and benefits detailed calculation are available at request.

Social Evaluation

Both costs and benefits associated to the project have been calculated as actual costs, using a discount tax of 12%.

Actual costs value: (MMAR$) 1367.87
Actual Benefits value: (MMAR$) 1944.90
Net actual value: (MMAR$) 577.08
TIR: 20.8%
B/C: 1.42.

Sensivity Analysis

Four factors were chosen to measure the project's sensibility:

- Initial Investment
- Number of accidents in the corridor
- Time savings
- Operative costs reduction

Detailed calculation is available at request, in all cases the project showed a positive Net Actual Value with a discount tax of 12%. The TIR always keeps values around 17%, indicating that the investment in this project is convenient.

CONCLUTIONS

From all the data included in this paper, is possible to conclude, that the BRT Project for RN3 in La Matanza, is convenient from social, economic, environmental, organizational and efficiency point of view.

REFERENCES

1. *Transit Capacity and Quality of Service Manual, Third Edition. In TRB's Transit Cooperative Highway Research Program (TCRP) Report 165*, Transportation Research Board of the National Academies, Washington, D.C., 2013.
2. *A Policy on Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials. 2011.

3. *The BRT Planning Guide*. Institute for Transportation & Development Policy, New York, 2007.