itransporte

ENGLISH EDITION*

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Journal
of transport
engineering
and consultancy

ineco

2011
Issue 1

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Editorial

We are proud to publish the first edition of our magazine **itransporte** English Edition and to share the projects we have been developing both at home and abroad with our clients and friends. It is a great opportunity to be able to coincide this first edition with the inauguration of the new high-speed train line to Levante. You can now travel the 438 kilometers (272 miles) between Madrid and Valencia, Spain's third largest city, in just one and a half hours. With this inauguration, as of December 2010 Spain already boasts 2,060 kilometers (1,280 miles) of high-speed lines, the third highest figure in the world.

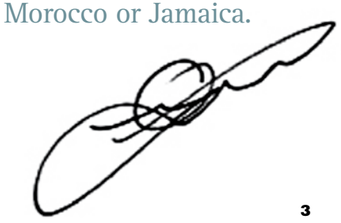
The participation of Ineco right from the beginning in the development of high-speed lines in Spain has been an important factor in the growth and expansion of the company; we are today a team of more than 3,000 professionals in consulting and engineering for the transportation industry. We have taken advantage of our drive and know-how to enter deep into the international market, a terrain in which we have many years of experience. We complement this work with our national projects and our shareholders, the Spanish state-owned companies Adif, Aena and Renfe.

We have participated actively in the modernization of airports and roads, as well as in many emblematic projects in Spain; particularly noteworthy in this edition are the projects of the expansion at Malaga Airport, the construction of the Pajares Tunnels, the expansion of Atocha Station in Madrid, the commissioning of the first subway line in Seville and the developmental work on the train in Tenerife.

The experience that we have gathered over time and the trust that our international clients place in us has led us to sign important new agreements with countries such as Mexico, Algeria, Turkey, Egypt, Kuwait, Costa Rica, Morocco or Jamaica.

We hope you enjoy this magazine as much as we do.

IGNASI NIETO
Chairman & CEO of Ineco



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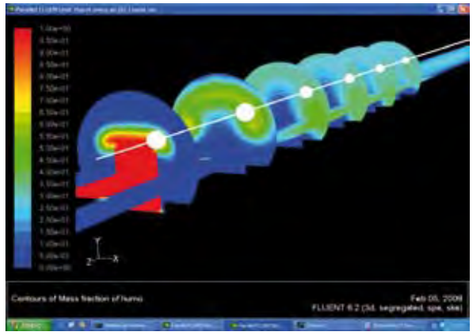

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International news

ALGERIA

A modern and efficient transportation system

Ineco leads the public consortium carrying out the project for the renovation of Algeria's National Transportation Plan (PNT), which includes Spanish firms such as Consultrans, Imathia and FIIAPP, as well as Algerian ones, such as AIC. Javier Cos (in the picture), Ineco's general manager for Development and International, signed the contract in May 2009. The Plan will define the investment and projects required for the different modes of transport until 2025.

COURTESY OF PATIER (RENFE ARCHIVES)

The Spanish high-speed train network arrives in Valencia

The Spanish high-speed rail network continues to grow with a new line joining Madrid, Cuenca, Albacete and Valencia from December 2010. The 438-kilometer link between the Spanish capital and its third most important city brings two economic centers together. The project has been a challenge in engineering, consisting of 160 viaducts, 50 tunnels and digging works, 8 new stations and the remodeling of Atocha Station in Madrid. Ineco has participated in all of the different phases making up the project: from preliminary studies, to facilities and systems, environmental studies and construction project management. *More information on page 12*.

TURKEY

Spanish supervision of the new high-speed rail construction

The Turkish State Railways (TCCD) awarded **Ineco** the contract for the supervision of the track improvement project on the section Köseköy–Inönü and the track which joins Istanbul to Ankara. The goal of the Turkish Government is to adapt this conventional track to be able to handle speeds of up to 250 km/h and to link it up to the future tunnel under the Bosporus. The Spanish companies OHL (which constructed the first section) and CAF have taken part in the project.

COSTA RICA

Ineco will develop the National Transport Plan

Costa Rica entrusted **Ineco** with developing its National Transport Plan, with the objective of analyzing the current rail, airport, ports and urban transportation situation and to plan further development until 2035. In parallel and in conjunction with another Spanish company (Iberinsa), Ineco also developed throughout 2009 a large study for the Costa Rican Institute for Rail Transportation (INCOFER) on the country's entire rail network of 414 kilometers, with a view to its revitalization.

EGYPT

Ineco is awarded with the renovation of the air navigation system

Ineco won the international tender held by the Egyptian Holding Company for Airports and Air Navigation (EHCAAN) for developing a modernization strategy for the country's air navigation systems. The project, which was entitled *Development Strategy of Air Traffic Control Infrastructure and Management*, is primarily aimed at analyzing the current CNS/ATM infrastructure in Egypt, proposing a new network of airways for its airspace and implementing the specifications for a new air traffic control system for the Control Center in Cairo. It is Ineco's first project in Egypt, which was awarded in October 2010.

New ATC tower at El Cairo Airport.

JAMAICA

Expansion of the Montego Bay Airport

The private consortium MBJ Airports, which operates Sangster International Airport at Montego Bay (the second most important city in Jamaica), entrusted Ineco with drawing up the expansion project for its airfields and the adaptation of its facilities to ICAO safety standards. This is the second project for Ineco at the airport, after completing in 2009 the Master Plan. According to the new document, this Jamaican airport currently welcomes three out of every four visitors to the island, and could see passenger figures rise from the current 3.3 million to 4.7 million in 2028. The consortium MBJ Airports has a 30-year franchise to run the airport and a subsidiary firm of the Spanish Abertis group owns a 74.5% majority stake in it. *More information on page 52*.

In the picture above: Ignasi Nieto (right), presidente of Ineco, and Fernando Bosque, CEO of MBJ Airports, signing the contract on October 2010.

King Juan Carlos I (center of the picture), next to the Minister for Development, José Blanco (right) and the President of Aena, Juan Lema Devesa.

Malaga Airport will continue to grow in 2011 with the construction of a second runway

It is the fourth biggest airport in Spain for volume of traffic, and when the current expansion process (which Ineco has been involved in since 2001) is finished, it will have the capacity to receive 30 million passengers, compared to the current figure of 12 million. On March 15, 2010, the King and Queen of Spain inaugurated the third terminal (T3), which covers an area of 250,000 m². In September 2010, the new suburban rail access line came into service, which runs under the second runway (currently under construction) and connects the airport with the city centre, located 8 kilometers away.

Throughout all of these projects, the state body Aena has relied on the cooperation of Ineco, which has also participated in the operational transition to the new facilities, carrying out preliminary testing before starting the service to make sure that everything ran as smoothly as possible. Ineco is also responsible for the environmental impact of the construction work and has planned the new rail access to the airport.

COOPERATION WITH THE GOVERNMENT OF MEXICO

Ineco will carry out a study on three Mexican expressways

The project consists of a study into improved signaling in three expressways of the National Infrastructure Fund, whose fiduciary is the National Bank of Public Works and Services of the country (Banobras S.N.C).

The expressways in question are Mexico City–Veracruz, Mexico City–Irapuato and Mexico City–Acapulco. The project is result of the cooperation agreement signed in 2010 with Banobras, with which the Mexican Government is planning an ambitious improvement plan for transport infrastructure over the coming years, with more than a hundred projects with a combined value of €35 billion.

Alonso García Tamés, CEO of Banobras.

International news

ATC AND AFIS

Ineco, air navigation services provider

Ineco received the certificates from AESA (the Spanish Air Safety Agency) that formally authorises it as an air navigation services provider to give Airports Air Traffic Services (ATS) and Aerodrome Flight Information Services (AFIS). The cerficates were obtained on June 2010 (AFIS) and November 2010 (ATC), in accordance with applicable requirements of the Single European Sky regulations, and are essential requirements to becoming an AFIS and ATC services provider for a specific aerodrome in Spanish airspace. After Aena, Ineco is the first company to be awarded these certificates in Spain. In the picture above, the room simulation at SENASA facilities in Madrid (Spain).

KUWAIT AND OMAN

The Office of Consultation and Career Development of Kuwait has contracted Ineco as international consultant to revise the Master Plan of the Industrial Area of Shadadiya and the preparation of tender documents for its design and construction. The objective is the development of a new 4 km² industrial area located south of Kuwait City. Ineco will also participate in the tender and the selection of the contractor who will design and construct the infrastructure planned by the Kuwaiti Public Industrial Authority.

In parallel, the Sultanate of Oman awarded the Master Plan for the new Musandam Airport, a strategic enclave in the Persian Gulf, to the consortium made up of Ineco, GOP Architects and TRIAD Oman Consultants International.

From left to right: J.M. Llorente, project lead; Javier Cos; Adam Al Mulla, director of OCCD, and Hussain Al Sayegh, Ineco sponsor in Kuwait.

Spain backs rail freight transportation

The Spanish Ministry of Development announced in September 2010 its Strategic Plan for the Promotion of Rail Freight Transportation, the main measures of which were decided upon by all 17 regional administration bodies during a meeting of the sector in Madrid (see picture above). Ineco has worked closely with the Government in its preparation, including an analysis and assessment of a sector which in Spain only transports around 4% of freight, whereas the European average is 12%. This situation is set to change over the coming years with the measures proposed in the Plan, which are directed both towards improving management and infrastructure, as well as planning logistical nodes and intermodal connections and the definition of a basic rail network destined for freight transportation.
The goals are to increase the efficiency and reliability of the sector, promote its development and support a form of transport which is considered to be more environmentally-friendly.

Ineco opens a new local office in India

In association with the Spanish firm Prointec, Ineco has opened a new office in Delhi, which joins offices in Mexico City and São Paulo (Brazil), in operation for over a decade now. Besides these permanent offices, Ineco also has staff onsite temporarily in countries where projects are underway, such as Algeria, Mauritania or Turkey, among others. On Spanish soil, apart from the Madrid headquarters building, there are regional offices in the most important cities: Barcelona, Valencia and Seville. Ineco added recently another regional office in the Basque Country.

Picture: Carlos Franco, manager of the new Delhi office.

A long road leading to great results

The Spanish high-speed rail network just reached 2,060 kilometers

Published in itransporte 10

In February 2008, the first commercial high-speed trains made the long-awaited connection between Madrid and Barcelona a reality. This finally occurred almost 11 years after the Spanish Government awarded the project for the construction of the high-speed line between Madrid, Barcelona and the French border.

It has been a long road for the Spanish high-speed railway, embarking on its journey with the opening in 1992 of the Madrid–Seville line. This was when the term AVE (Alta Velocidad Española or Spanish High-Speed) appeared for the first time. AVE is now a popular acronym known worldwide, referring both to the high-speed network itself and the services that have gradually started to weave together for the whole of Spain. This important milestone for the country marks the consolidation of the high-speed network in Spain.

There are currently four corridors operating: the Southern Corridor (Madrid–Cordoba–Seville, Madrid–Cordoba–Malaga and Madrid–Toledo, with 655 kilometers), the North/Northeast Corridor (Madrid–Valladolid, with another 209 kilometers) and the Northeast Corridor (connecting to the Madrid–Guadalajara–Zaragoza–Lleida–Tarragona–Barcelona and Zaragoza–Huesca lines, with a total of 805 kilometers). The fourth line was added in 2010, the Eastern Corridor, which connects Madrid to Cuenca, Albacete and Valencia.

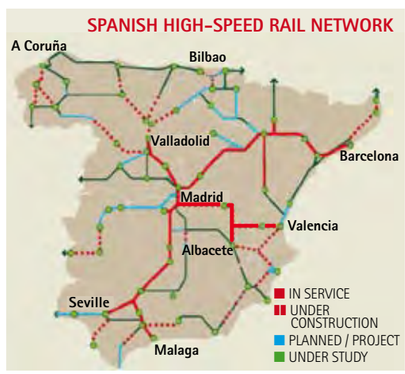
These lines have a total length of 2,060 kilometers in service. Construction work will be continued to extending the North and Northwest corridors, as well as the Mediterranean and Levante corridors, and also a connection to Portugal on the cards.

Ineco has been involved in the development of the Spanish high-speed railway since its inception. Back in 1974, the company drafted an initial viability study and preliminary plan for a high-speed line between Madrid and Barcelona and its extension towards the French border. Starting at that time, its participation in executing the high-speed network has been permanent. From the railway access project to Andalusia (southern Spain), and its transformation into the high-speed line, to the latest openings and the sections currently under construction, Ineco engineers have been involved in all developmental phases of the Spanish high-speed lines. Their tasks included all reports, from prior viability, demand and financing studies, to information surveys and construction plans, both for civil engineering, electrification and signaling works.

They have executed station designs and city planning operations for access routes to cities, performed technical assistance and works management, and provided support to logistics operations and project management. Finally, they have received rolling stock, test equipment and help with the start-up of the infrastructure. We could say that our joint work on the development of the Spanish high-speed rail network continues to be the area with the greatest volume of activity for Ineco.

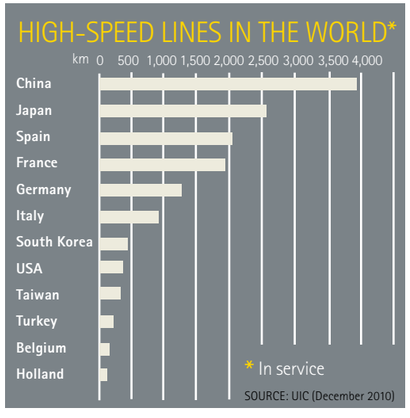
Our professionals have devoted our greatest effort to this endeavor, surpassing 10 million working hours in the last 30 years. ✱

SPANISH HIGH-SPEED RAIL NETWORK



Japanese origins

The history of high-speed trains is relatively recent. The first line, Tokyo–Osaka (Japan), 515-kilometer long, opened in 1964 to be ready for the Tokyo Summer Olympics. Europe would have to wait until 1991 to enjoy the advantages of this mode of transport, the year in which the Paris–Lyon line opened (410 kilometers). Later, Germany (1991, Hannover–Würzburg line, 327-kilometer long) and Spain (1992, Madrid–Seville) would join the elite club of countries with this railway infrastructure. Today, the European high-speed rail network has close to 6,000 kilometers of tracks, with planned growth of approximately 300 kilometers per year. Countries like the United Kingdom, Belgium, Netherlands and Italy have joined the network, whose interoperability has been a concern of the EU. They have principally used the European Railway Traffic Management System (ERTMS), which means the end of borders due to the different railway systems on the Old Continent. Spain commits to an open technical architecture and was the first country to implement advanced levels of ERTMS, wich enable interoperability between suppliers.



High-speed comes to Spain

> 1974

The year INECO started drawing up the first draft project for the future high-speed line between Madrid and Barcelona. From that point, its participation in the high-speed network has never stopped.

> 1987

It could be said that the Spanish Railway Transport Plan approved in 1987 was the beginning of AVE's journey into Spain, which included the development of NAFA (New Rail Access to Andalusia). Subsequently, its technical characteristics would be changed to adopt the international standard width and section features adapted to high-speed, thus allowing new developments to be integrated with the Trans-European High-Speed Network.

> 1993

Year in which the Infrastructures Master Plan (PDI) was approved for 1993-2007, outlining a 1,800-kilometer high-speed rail network, structured around corridors. It is coherent with the high-speed scheme defined by the European Union. The Madrid–Seville line was already operative in the Southern Corridor, and a further 1,400 kilometers of new construction was planned. These were distributed between the Northeast Corridor (Madrid–Barcelona–French border), with the Zaragoza–Pamplona–French border axis declared as a priority; the Northwest Corridor (Madrid–Valladolid) and the Eastern Corridor (Madrid–Cuenca–Albacete–Valencia). Finally, a study was made for a future connection with Portugal. This, however, is still pending the signing of the pertinent international agreement between the two countries.

AVE routes to Levante

Unique features abound in this new high-speed line

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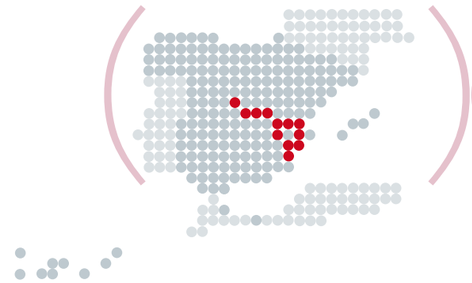


Electrification, train signaling and protection systems and communications make railway operations possible. Ineco provides its extensive experience on the line that connects Madrid, Castile-La Mancha, Community of Valencia and the Murcia region.

The high-speed network continues to grow and railway access to Valencia and Albacete its a reality since December 2010. Ineco is also participating on the transport hub linking Madrid to Castile-La Mancha, Valencia and, in the near future, the Murcia region.

Trains on this line start at Madrid Atocha, and will initially share the Madrid–Seville infrastructure to Torrejón de Velasco (KP 28). Another exclusive parallel platform is also planned. The line will be 943 kilometers long, leaving Madrid and going towards Cuenca and Motilla del Palancar (see map on the opposite page). From this town, one section will continue on to Valencia and another will split off to Albacete and La Encina. From this nucleus, one section will lead to Xàtiva and Valencia to connect with the high-performance Mediterranean Corridor between Valencia and Barcelona. Another section will run towards the southeast, to Monforte del Cid, splitting into two sections, one directly to Alicante and another to Murcia.

Ineco, a pioneer in applying the new systems for high-speed lines, will continue providing its services to Adif (the Spanish administrator of railway infrastructures) in the unfolding phases of the Levante Eastern Axis. It will be involved in everything ranging from the design stage (with the drawing up of the functional, basic and construction plans) to the works phase (providing executive management and technical assistance to worksite managers).

Ineco has executed electrification works on all sections, encompassing electric substations, overhead contact lines, automatic monitoring and control systems and electric and remote-control dimensioning studies, among other works. ✱

NEW DESTINATIONS

VALENCIA. The arrival of the AVE entails a great boost for the city's revitalization project, which is undergoing a stage of unprecedented economic recovery in the region.

ALICANTE. The busy beaches of the Spanish Costa Blanca will end up even closer to Madrid with this connection, planned for 2012.

MURCIA. The extensive golf courses dotting the region are its main tourist allure, as well as being a genuine catalyst for Murcia's economy.

Unique elements

The line required the construction of two new stations in Cuenca and in Utiel–Requena, as well as the remodeling of the stations in Albacete, Valencia, Alicante, Elche and Murcia. Unique features abound, such as a railway viaduct with the network's longest arch, in Contreras, with a span of 261 meters. Another noteworthy construction is the La Cabrera tunnel, which is 7,157-meter long and employs a double-tube composition, making it the longest on the line.

>PROTECTION IN TUNNELS

Railway tunnels require special attention to obtain adequate levels of protection and safety. For this reason, each one has been equipped with different facilities to prevent risks and to avoid incidents. They are also equipped with evacuation systems. Civil protection and security facility projects were executed were needed in each of the tunnels on the line in accordance with the TIS (Technical Interoperability Specifications) on safety in tunnels in conventional and high-speed trans-European railways.

Ineco's work in drafting projects

Ineco has drawn up the facilities projects for the sections depicted on this map in green: Albacete–Monforte del Cid–Alicante–Murcia and Albacete–La Encina–Valencia.

Ineco has drawn up the functional and construction projects for the high-speed line to Valencia. It also acted as executive manager and provided technical assistance to the works management for the systems whose main characteristics are described on these pages.



Electrification

Prior to drafting the electrification projects, Ineco created and drew up the electric dimensioning studies for the entire Levante Eastern Axis. With regard to catenary projects, the introduction of the CATMASTER system merits mention. It is employed for design automation and construction plan generation using the features of the different sections, leading to an increase in overall project quality. In addition to the catenary, with 1,203 kilometers of overhead contact lines with 13,838 poles, the associated systems were installed in the sections in question. These included the heating of point switches (preventing ice or snow from obstructing needle changes), lighting and electricity in tunnels, as well as the construction of eight traction-power substations and 38 automatic transformer stations. The voltage supply to the catenary is 2x25 kV, equal to the latest high-speed lines in service.



Train signaling and protection

The majority of signaling and protection systems were already introduced in previous projects, such as the high-speed line Madrid–Zaragoza–Barcelona and the line Madrid–Segovia–Valladolid. In the initial sections of the Levante Eastern Axis, there are 1,423 track circuits, 504 signals and 13 electronic interlockings. It will also include Level 1 and Level 2 of the ERTMS/ETCS train protection system. Planning for Level 1 includes the installation of 2,790 signaling balises. Level 2 will have a total of 6 radio block centers (RBC). As this system is fully interoperable, trains from other European countries that meet the established requirements will also be able to travel on this line. The Control and Reporting Center (CRC) in Albacete is equipped with the same systems as other existing CRCs. The back-up equipment at the Madrid-Atocha CRC will provide control and reporting redundancy.



Fixed and mobile communications

There is an increasingly-pronounced trend in fixed communications towards a single, multi-purpose IP network, due to its numerous technological and economic advantages. With regard to works, 2,500 kilometers of fiber optic cables will be laid and over 300 SDH transmission systems will be installed. In radio communications, the implementation of the GSM-R (Global System for Mobile Communications-Railways) is essential for interoperability. It is being installed across the entire high-speed network, both to offer voice coverage and to support data for Level 2 of ERTMS/ETCS. In the Eastern hub sections running to Valencia and Albacete, 110 BTS (base transceiver stations) and 73 booster stations were installed. In parallel, the infrastructure was built so that public mobile telephony operators can install their equipment and provide voice and 3G services to passengers.



Technical buildings

The great challenges for this section included the high number of buildings which had to be accommodated, their geographic dispersion and extremely tight delivery periods. Over the length of the 450 kilometers of line, a total of 23 technical buildings, 27 signaling cabins and 38 tunnel cabins were installed. This covers the commitment to provide a suitable technical response and architectural quality in line with the importance of the infrastructure. Significant earthmoving and contention works were required in some cases to prepare the locations. The construction process employed a high degree of industrialization that shortened execution time and consisted of 'in situ' foundation laying, prefabricated reinforced-concrete structural panels and hollow-core slabs. These buildings house the signaling, telecommunications and electrical equipment, as well as a LOP (Local Operations Panel).

Shorter distances in Galicia thanks to a new series of viaducts

Works on the high-speed Ourense-Santiago corridor

Published in itransporte 18

Their height, length and slimness are surprising. The viaducts used by the future high-speed line between Ourense and Santiago represent a real challenge to nature.

The difficulties of the terrain represent a challenge for engineers and constructors. The Ourense-Santiago corridor is an excellent example of the effort invested through the use of the most advanced techniques in order to bring together technology, safety and environmental beauty.

On behalf of Adif (Spain's railway infrastructures administrator), Ineco has implemented the different environmental directives and has provided consultancy and support to the project and site management on geological, geotechnical and structural issues.

The stretches that have been completed so far fully comply with all the most advanced high-speed specifications, with 6,000 meters curved radii, 2x25 kV electrical current, GSM-R communication systems and ERTMS Level 1 and Level 2 security. ✱

1

2

SUMMARY OF VIADUCTS

- Total length of high-speed line: 87.10 km.
- Total length of viaducts: 19.07 km.
- Number of viaducts: 35.
- Maximum height piers: 116.884 m (Ulla).
- Max. span between piers: 75 m (Deza).
- Maximum length: 1,484.8 m (Sáramo).

CONSTRUCTION PROCEDURE

- 16 viaducts with self-supporting falsework panel construction.
- 5 viaducts with push-panel construction.
- 6 viaducts with conventional falsework.
- 7 viaducts using prefabricated beams.
- 1 mixed structure with cranes and carriages.

Sáramo Viaduct

Length: 1,484.80 m
KP-KP 11+655.321 – 13+140.121

Distribution of arcs and spans:
46.40 m + 24x58 m + 46.4 m
Curve Alignment R= -6,000 m
Lengthwise slope -0.739%
Number of piers: 25
Maximum pier height: 70 m
Average pier height: 36.46 m
Number of arcs: 26
Maximum arc: 58 m
Minimum span: 46.4 m
Minimum voussoir length: 35.86 m
Maximum voussoir length: 58 m

Rego das Cabirtas Viaduct

(1)

Length: 580 m
KP-KP 1+713 – 2+293

Number of piers: 10
Maximum pier height: 60.98 m
Average pier height: 29.8636 m
Number of arcs: 11
Maximum arc: 55 m
Minimum span: 40 m
Minimum voussoir length: 29 m
Maximum voussoir length: 56 m

Abeleda Viaduct

(2)

Lenght: 368 m
KP-KP 3+038 - 3+406

Number of piers: 6
Maximum pier height: 48.752 m (pier 4)
Average pier height: 30.515 m
Number of arcs: 7
Maximum arc: 55 m
Minimum span: 44 m
Minimum voussoir length: 44 m
Maximum voussoir length: 55 m

Covas Viaduct

Lenght: 975.20 m
KP-KP 4+327.24 – 5+302.44

Number of piers: 15
Maximum pier height: 83.80 m (pier 7)
Average pier height: 54.20 m
Number of arcs: 16
Maximum arc: 66 m
Minimum span: 30 m
Minimum voussoir length: 66 m
Maximum voussoir length: 66 m

The route for the new high-speed line between the two Galician cities will mean a reduction in length compared to the current railway line of more than 40 kilometers.

Barbantiño Viaduct

Lenght: 1,176 m
KP-KP 2+030 – 3+206

Number of piers: 17
Maximum pier height: 97.98 m (pier 7)
Average pier height: 57.18 m
Number of arcs: 18
Maximum arc: 67 m
Minimum span: 52 m
Min. voussoir length - voussoir 1: 16.70 m
Max. voussoir length - voussoir type: 33.50 m

O Eixo Viaduct

(1)

Lenght: 1,224.4 m
KP-KP 3+789.5 - 5+013.9

No of piers: 23
(24, if the span is considered to be a pier)
Maximum pier height: 82 m
Average pier height: 53 m
Number of arcs: 25
Maximum arc: 50 m
Minimum span: 31.9 m

Viaduct over the River Deza

(2)

Length: 1,175 m
KP-KP 2+419.5 - 3+594.5

Number of piers: 16
Maximum pier height: 96.5 m (pier 12)
Average pier height: 45 m
Span arc: 150 m
Height at keystone: 106 m
Number of arcs: 18
Maximum arc: 75 m
Minimum span: 42.5 m
Minimum voussoir length: 20 m
Maximum voussoir length: 35 m

RAILWAYS | **SPAIN** | High-speed

‘SUV’ trains

Implementing the S120 and S130

Published in itransporte 6

These are the first trains capable of traveling throughout Spain using either of the two gauges available without needing to stop. Ineco has been working for years with the train operator Renfe on defining and implementing the S120 and S130.

With the advances being made in developing Spain’s rail network, where stretches of *Iberian* gauge (1,668 mm) and *Internationa l* (UIC) gauge (1,435 mm) coexist, rolling stock was needed that could operate across the whole network. The aim of purchasing these goods is to be able to maximize the use of existing lines, as well as the lines that are currently being designed or built, with a view to improving journey times between cities that are connected by stretches of track with different gauges.

As part of the expansion and modernization process, Renfe has purchased self-powered electric trains fitted with a gauge-change system. This means they can roll on both *Iberian* and *International* tracks. They have capture and drive systems that can operate with 3 kV direct current and 25 kV alternate current power sources. In order to move about on the existing network, both are fitted with different signaling systems, such as several levels of ERTMS and the new ASFA Digital. They also have a GSMR exterior communication system. The consortia Talgo-Bombardier (S130) and CAF-Alstom (S120) are manufacturing these trains.

Ineco is working with Renfe providing technical support during the monitoring phases of the functional and construction design, manufacturing, testing and document management, as well as evaluation during the processes of obtaining authorizations. ✱

S130
>HIGH END

Series 130 trains consist of two power cars and 11 Talgo 7th-generation coaches (3 are first class, 7 are second class and 1 is a dining car). Total capacity is 299 seats and the train is 180 meters long. Two units can also be coupled to create an eight-coach train. It is a self-powered sliding dual-voltage electrical rolling unit, with a maximum commercial speed of 250 kph on ‘International’ gauge and 220 kph on ‘Iberian’ gauge. The S130 is pulled by two locomotives. Each locomotive has a main transformer that is mounted under the chassis, un-centered on the lengthwise axle of the vehicle for reasons of load distribution between the rows of wheels. The variable gauge technology on the S130 enables the gauge to be changed without having to stop, and can be done at 15 kph. This avoids the coupling and uncoupling maneuvers that are currently needed for the ‘Altaria’ models (entailing a minimum of 20 minutes waiting time).

S120
>THE ‘ALVIA’

The S120 is a self-powered sliding dual-voltage electrical rolling unit, with a maximum commercial speed of 250 kph on ‘International’ gauge and 220 kph on ‘Iberian’ gauge. Each train consists of 4 coaches, and 2 further units can be coupled to create an eight-coach train using automatic coupling controlled from one single cabin. It has a capacity for 238 people (81 in first class, 156 in second class and 1 for passengers with reduced mobility). The carriage structure is made of aluminum and incorporates an anti-knock protection system. This model has a distributed traction system with a main transformer located in the MIP coach and one traction inverter per car that acts on the car’s two traction engines via a cardan joint. The engines are controlled via IGBTS power electronics switches. The engines also provide regenerative and rheostatic electric braking, which is supplemented by pneumatic disc brakes.

RAILWAYS | **SPAIN** | High-speed

Interoperable language to protect trains

Validation of the ERTMS railway system

Published in itransporte 9

Software

In just a few years, ERTMS has moved from being merely described in public European specifications to being implemented and in operation. Renfe and other European railway companies signed in Madrid an agreement in the year 2000 to establish the specifications. Spain pioneered its approval and since its creation, Ineco has worked towards implementation across the entire European network.

This interoperable system can be installed on other automatic train protection systems, as well as different signaling components. It can be adapted to many different forms of operating and is valid for conventional and high-speed railways, as well as lines that have high-density and low-density traffic.

The complexity and flexibility of the The European Railway Traffic Management System (ERTMS) requires robust, well-defined validation and verification processes that are subject to European regulations. This process involves independent bodies guaranteeing the certificate of interoperability and the safety evaluation of the ERTMS components.

Resolution of potential problems. Spain has met the challenges of commercial operation with Level 2 ERTMS/ETCS supervision on sections of lines that are in service with Level 1, and installing Level 1 and Level 2 on local railway systems. To do this, potential problems had to be resolved in terms of integrating different manufacturers’ infrastructures and cross-testing tracks and trains.

This is the first time that ERTMS has been installed in a high traffic-density environment, with many different signaling systems, complex stations and interlocking systems with high management capacity. The validation processes need to be reviewed, taking into account current conditions. Backward compatibility of specifications needs to be monitored and laboratory testing needs to be strengthened using real data and reliable environments. This requires the use of new tools for obtaining starting data, testing data and field simulation environments. It is also increasingly important to involve testing laboratories in order to reduce any impact on existing operations. ✱

THE LARGEST TEST IN EUROPE

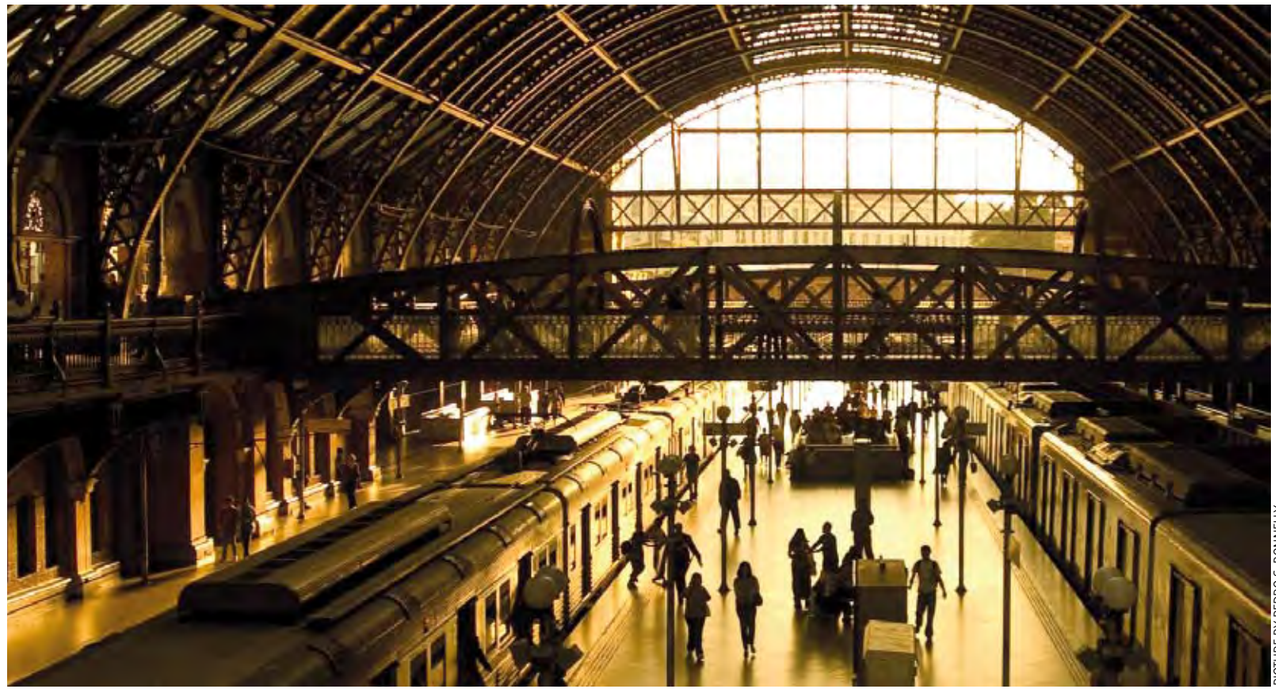
The railway environment that Ineco currently faces in Spain represents Europe’s largest interoperability test, also due in part to the fact that all the companies that make up the Signaling Companies Union (UNISIG) are represented in ERTMS developments. The union was created in 1998 and today is made up of the following multinational companies: Alstom, Ansaldo, Bombardier, Invensys, Siemens and Thales.
Ineco professionals work on an ongoing basis with Adif, Renfe and the Spanish Ministry of Development on validating and accepting ERTMS.

New look for São Paulo's suburban rail network

Ineco participates in the metropolitan region transport modernization project

Published in itransporte 19

São Paulo's Metropolitan Region (RMSP) is one of the three-largest urban agglomerations in the world. It covers 8,000 km² and is home to almost 20 million people. The most important of its 39 municipal areas is the city of São Paulo, with 11 million inhabitants.



PICTURE BY PEDRO S. BONNELLY

The RMSP has undergone a real demographic explosion in the last 50 years –from a population of barely 2 million to close to 20 million. This growth often took place in a disorderly way, meaning that new neighborhoods lack adequate infrastructures and services. Furthermore, transport investment focused on building high-speed railroads and urban motorways to the detriment of the underground system and, in particular, suburban rail systems.

The economic and demographic importance of São Paulo means that there is an incredible number of journeys undertaken every day (39 million in 2002). The current transport system is unable to cope adequately. This means that the region suffers from chronic traffic jams and a growing saturation of public transport. On some lines on the underground system and the CPTM (São Paulo Metropolitan Train Company) densities of 9 passengers per square meter are seen. This situation is intensified by the healthy rate of growth of Brazil's GDP and the expansion of fare-integration policies across the different modes of public transport.

At the end of the last decade, local authorities started to become aware of the need to promote railways as a way of resolving the problems of mobility in São Paulo. Initiatives such as *Projeto Sul* were started, which consisted in constructing a new underground line and modernizing a suburban railway line (Ineco was also involved in this), and *PITU*, which established transport planning for the next 20 years for the region.

More recently, the Metropolitan Transport Secretary has drawn up a *Metropolitan Transport Expansion Plan*, which plans investments of up to €10 billion in the public transport system up until 2014.

The bulk of these activities are focused on the São Paulo Metro and suburban rail network. The €3 billion invested in the CPTM for network modernization should enable 3-minute intervals between trains on the 6 existing lines. Work will be carried out on all the railway subsystems: infrastructure and track, stations, electrification and substations, signaling, telecommunications and control facilities, rolling stock and maintenance equipment. ✱

BRAZIL'S REAL ECONOMIC MOTOR

The importance of the RMSP to Brazil's economy is striking: around 20% of national GDP is directly generated in this region, which is home to almost 20 million people and many of whom use public transport every day to go to work. A further €5 billion is planned for the São Paulo underground system, which will see increased capacity on lines 1, 2 and 3, and new lines 4 and 6 coming into operation, as well as extending lines 2 and 5. This plan of investment will enable rail demand to double and will see rail playing a greater role in the region's mobility.

Viability study and financial structuring

As part of the expansion plan, Ineco carried out a viability study and financial structuring for CPTM's modernization program in 2008. This work has helped define the role of the CPTM transport system for the next 25 years. Activities included the following:

- **Functional analysis.**
- **Study of demand.**
- **Simulation of train circulation and study of railway operation.**
- **Simulation of electricity consumption.**
- **Study of maintenance for fixed facilities.**
- **Inventory of activities.**
- **Technical, economic and legal structuring of a PPP (public-private partnership).**

The study identified a large pent-up demand within the CPTM. This is backed up by the high passenger/square meter ratio and the high percentage of journeys undertaken on foot: these represent 33% of all daily journeys despite the large distances to be covered in the region. Furthermore, on the outskirts of São Paulo there are no alternatives that can be compared to the suburban rail services. This means that as soon as modernization is carried out and capacity increases across the system, demand practically doubles. Therefore, in terms of the tracks, it is planned to abandon the standard American AREMA gauge and move to the 'International' (UIC) gauge, which offers greater flexibility in terms of operations as well as improvements in passenger comfort.
From the point of view of operations, the most important work is the doubling of the size of Estação da Luz terminal station, where 4 lines will merge. For the rest of the subsystems, equally important activities are being carried out –such as increasing the number and power of energy substations, installing compensated overhead power cables, electronic interlocking systems, sizing for railway circuits to allow for 3-minute intervals between trains and integrating train, electrical substation and track control systems in one centralized traffic centre at Brás station.
From the user perspective, the most significant activities will be those that relate to stations and rolling stock. Replacing trains with more up-to-date models that offer improved acceleration, braking power and comfort is essential for the success of the program.

EXPANSION PLAN OBJECTIVES

	Company	2006	2010	2014
Total capacity (passengers/hour)	**CPTM**	96,000	167,000	200,000
	Metro	159,900	234,700	265,700
	Total	255,900	401,700	465,700
Demand on weekdays (passangers/day, in millions)	**CPTM**	1.49	2.78	2.92
	Metro	2.66	4.00	4.44
	Total	4.15	6.78	7.36
Share (%) **of total public transport**	**CPTM**	7	11	13
	Metro	16	19	19
	Total	23	30	32
Average lenght (minutes)	**CPTM**	33	28	25
	Metro	18	11	9

From Buenavista to Cuautitlán

Suburban trains aimed at 100 million passengers per year

Published in itransporte 17

A 26-kilometer long suburban railway is the first step in an ambitious project to provide Mexico City and its suburbs with a modern train system. Ineco provided the coordination, management and general technical support for this project, led by the Spanish railway manufacturer CAF.

More than 4.5 million residents already enjoy a fast and sustainable transport system in one of the most densely-populated industrial areas of Mexico. With the opening of the final stretch to Cuautitlán, it is now possible to travel in just 25 minutes what used to take around two and a half hours.

In August 2005, the Mexican Ministry of Communications and Transportation awarded the 30-year tender to construct and operate this suburban train line between Buenavista and Cuautitlán to the bid headed by the Spanish company CAF. Since 2004, experts from Ineco have advised CAF throughout the preparation of the bid, carried out specific technical studies and coordinated the rest of companies involved in the tender process. Ineco coordinated and managed contracts, and headed the general technical support right up to the moment of the commissioning of the line. This work included supervising the drafting of projects, construction project management and technical support for both the civil engineering works and the supply, assembly and commissioning of the electrification and catenary subsystems, the signaling works, telecommunications and ticketing.

Ineco also took charge of the reception of rolling stock and the coordination of preoperative testing, as well as the preparation of the Operation and Maintenance Plan and the supervision of the Guidance and Training Plan.

The works were carried out on an existing goods track from Buenavista station in the Federal District to the municipality of Cuautitlán in Mexico State. The track, 26 kilometers long, consists of a double electrified line and 7 stations, 6 of which are completely new. The track crosses an area of high demand, which includes a major industrial zone, this being the reasons why it is essential for the transportation of passengers.

In order to complete the project, Ineco had a team of more than 50 professionals from different disciplines. The commissioning of the suburban train line required the reconstruction of railway infrastructure, which in turn required the implementation of technological equipment to meet the needs and specifications of such a project. Furthermore, as many of the population centers are located some distance from the train line, the restructuring and adaptation of urban transportation lines was fundamental in order to bring passengers to the train stations.

Six interchanges (known as Centros de Transferencia Modal – CETRAM) were built. The project was completed in two phases. Phase I corresponds to a stretch of 18 kilometers between Buenavista and Lechería, and includes the stations Fortuna, Tlalnepantla and San Rafael. Phase II is 8 kilometers long, consisting of the stations of Tultitlán and Cuautitlán. ✱

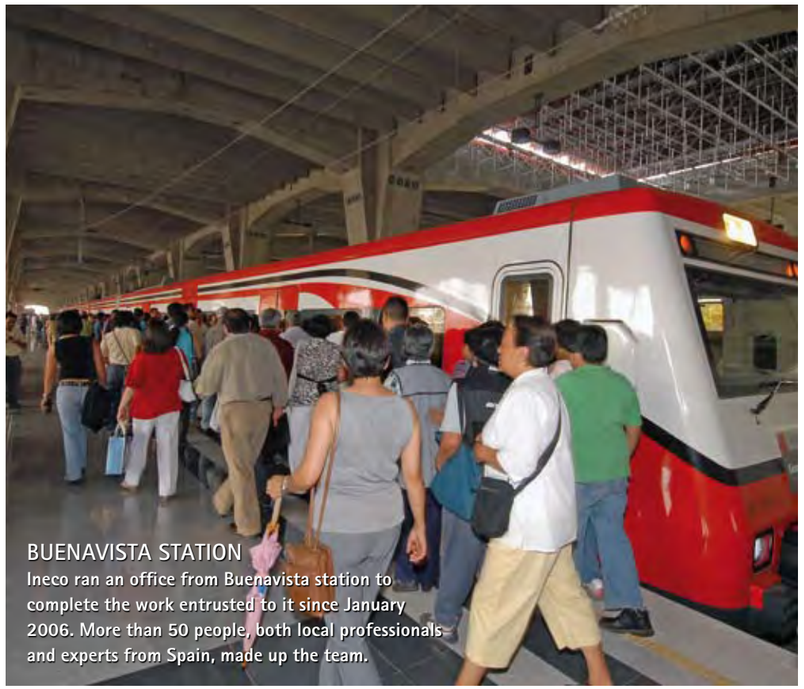
Spanish involvement

PARTICIPATING COMPANIES_The Spanish railway manufacture CAF relied on the expertise of leading companies for the infrastructure and construction of railways.

ACTIVITIES COMPLETED_Abengoa was responsible for the electrification (energy and catenary), Thales took on signaling and railway communication, and Indra was entrusted with the system for automatic ticket issuing machines and access control. With respect to the civil engineering works, OHL was contracted to draw up the civil and rail construction projects, as well as their subsequent execution. Later on in the project, the Mexican construction company Marhnos completed the construction work on the Pantaco workshops. The rolling stock was constructed in the CAF workshops in Beasain (Basque Country, Spain) and is made up of 20 trains of 4 cars each. The configuration of the units is M-T-N-M (with 'M' being the motor car with cab, 'T' the trailer car and 'N' the motor car without cab). Finally, Adif participated in the training of personnel and helped with questions regarding regulations.

SYSTEM 2 AND SYSTEM 3

As a result of the System 1 Tender, Ferrocariles Suburbanos (owned by CAF) acquired the rights to operate three extensions to the track between Buenavista and Cuautitlán. System 1 is part of the framework of an ambitious transport project which also includes two other systems: System 2, running between Jardines de Morelos and Martín Carrera station for a length of 20 kilometers, and System 3, the main stretch of which, from Chalco to Nezahualcóyotl, is 30 kilometers long. Both systems are currently at the tender phase and Ineco has been advising CAF during the preparation of the bid.



BUENAVISTA STATION
Ineco ran an office from Buenavista station to complete the work entrusted to it since January 2006. More than 50 people, both local professionals and experts from Spain, made up the team.

The new double electrified track.

The Traffic Control Center (CCT) in Pantaco.

Completed activities

On the Track

- Renovation of existent railway infrastructure.
- Construction of new stretches of track to separate passenger and goods transportation.
- Construction of two railway bridges in Vallejo and Lechería, of 700 and 800 meters respectively.
- Construction of six new stations with a central platform (Fortuna, Tlalnepantla, San Rafael, Lechería, Tultitlán and Cuautitlán).
- Installation and fitting the line with signaling, electrification, communications, ticketing and CCTV.
- Supply of a fleet of 20 electric trains of four cars each.
- Renovation of the current traction substation in Tultitlán.
- Project management, construction and installation of a second traction substation situated next to Fortuna station.

In the Pantaco Yard and Workshop

The project management, construction and installation were completed for the following:

- Two workshops for both major and minor maintenance jobs on the trains.
- A 1,000 meter long test track.
- An interior and exterior train-wash system.
- A painting cabin for trains.
- Renovation and refurbishment of the parking area.
- Renovation of the buildings in which the Traffic Control Center (CCT), training rooms and administrative areas are housed, as well as general spare-parts warehouses and other service buildings, such as canteens and restrooms.

Italy on the move

Metropolitan area tramway and subway

Published in itransporte 14

Bologna and Milan railway projects are part of Ineco's portfolio of work in the boot of Europe. Local authorities seek industrial and cultural city development.

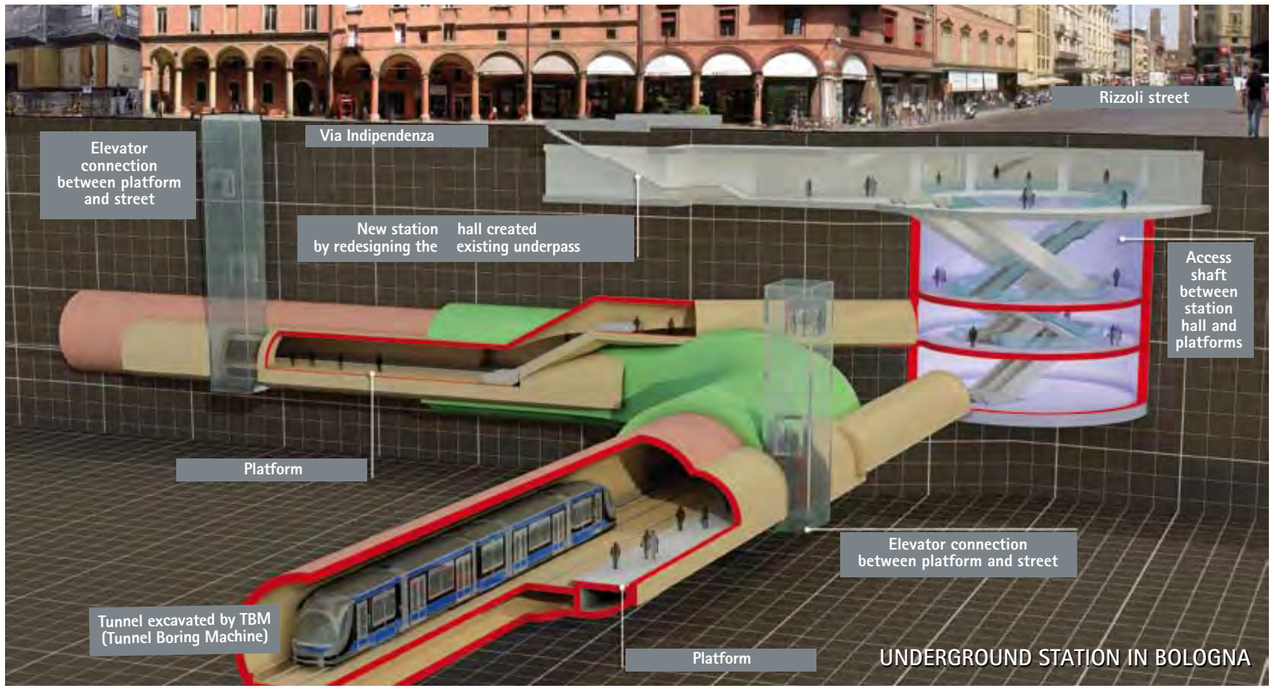
Ineco has once more been working in one of the most prosperous regions of Italy. Following the experience acquired after developing the overall transport plan for the Forli region (see pages 64-65), this article focuses on new projects that local authorities are using to drive industrial and cultural city development.

Bologna is located in a strategic position in the center of Italy. It is the most important city in the Roman region of Emilia, with 375,000 inhabitants. Apart from its great cultural and trading traditions, it is one of northern Italy's most important business centers. As a result of the significant development taking place in Bologna and, following years of studies, proposals and designs, the local city authority (Comune di Bolonia) decided to develop a metropolitan area tramway (Metrotranvia). There has been an increase in the use of tramways in recent years and systems are operating in European cities with environmental and topographical features similar to Bologna.

The decision was based on an analysis of the urban infrastructure, forecast traffic demand and the level of service required: the line runs completely underground in the downtown area and above ground in the suburbs. The tramway solution offers a service that runs at a suitable commercial speed, while enabling the system to be steadily extended.

The first line is 7,860 meters long. The stretch excavated by tunnel boring machine is 5,636 meters long, while 190 meters were excavated using traditional methods and 514 meters are an artificial gallery. It has 12 underground stations and another above ground, as well as 11 air shafts. It is located in a highly-developed area of the city that has increasing mobility, as well as links to other parts of the city.

■ Fiera-Regione: In this area, the project is completed with the final development of the convention center complex, together with a new toll highway that will connect the convention center with Parcheggio Michelino.



UNDERGROUND STATION IN BOLOGNA

■ Historic Center: The tramway crosses the historic center of Bologna from Via Indipendenza to Piazza Maggiore.

■ New high-speed station: This station significantly improves access to downtown and, together with the opening of eight new regional lines, highlights the role of railways in suburban and regional areas.

■ Ospedale Maggiore: The city's main hospital has excellent connections to the center and the suburbs, offering easy and convenient access.

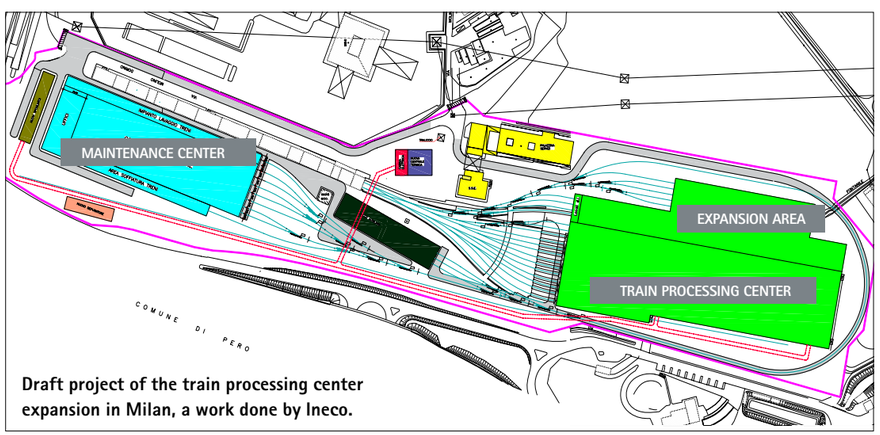
The route is around 5 kilometers long, mainly over viaducts running at an average height of around 5 meters. There are two points of special interest: one, when crossing the Bologna–Venice railroad track; and the other, when crossing the Reno River. In order to promote an integrated use of different means of transport and reduce time when changing between them, the main Metrotranvia station stops (train station and Marconi Airport) are fully integrated into the station and airport. There is an intermediate stop (Lazzaretto) which provides access to the university district. ✱

New train processing center in Gallaratese

Ineco was involved in the Milan–Limbiate tramline upgrade work and expanding the depot (coach workshops) in Gallaratese (Milan). This metro tramline is one of the oldest in the city and is currently being upgraded to modern requirements. It is around 13 kilometers long, starting at Via Vincenzo da Seregno and ending at Limbiate Hospital.

The need to expand the train processing center at Gallaratese arose because of the need to deal with the expected increase in the fleet of metropolitan trains. The area that is being extended is in the north part of the current depot and will involve the construction of a new maintenance office, in line with the characteristics of the new rolling stock. The planned expansion is around 16,800 m², in addition to the existing 14,700 m².

The extension work means that the existing infrastructure can be modernized while improving maintenance efficiency. The capacity for processing trains will be increased and there will be greater flexibility in terms of traffic, essential given the forecast increase in rolling stock.



Draft project of the train processing center expansion in Milan, a work done by Ineco.


New train processing center.

MILAN, THE FINANCIAL CAPITAL OF THE COUNTRY

At the Gallaratese depot, the planned expansion is around 16,800 km², in addition to the existing 14,700 km². The new train processing center in Milan will enable more flexible maintenance and increased capacity for dealing with the new fleet of metropolitan trains. Ineco's work to expand this facility became necessary due to the increase in the number of trains.

Milan is an important international trading and industrial center, as well as Italy's financial capital. Located in the north, this is one of the richest cities in Europe, with a population in the metropolitan area of around 7 million people.

Two cities, one tram

Tenerife develops its future rail network

Published in itransporte 25

The second tram line that links Santa Cruz and San Cristóbal de la Laguna has more than 4,500 users per day. This line represents one more step towards the creation of a network on the island, whose only precedent was the electric tram, defunct since 1957.

The *train-free* island lost this status on June 2, 2007, when the first tram line was inaugurated in Tenerife. The La Trinidad–Intercambiador line had a 12.5-kilometer long route, with 21 stops. The towns of Santa Cruz and San Cristóbal de La Laguna were once again connected half a century after the disappearance of the former tram. It linked the largest urban concentrations on the island, with a total of 400,000 inhabitants.

The second line, La Cuesta–Tíncer, was put into service on May 30, 2008, with 4 new stops and 3.6 new kilometers. Since then, usage has surpassed all of its managers' expectations: more than 4,500 travelers rode the new line every day, with 13 million users for the entire year of 2008.

The network continued expanding with the entry into service of the new Padre Anchieta junction in San Cristóbal de La Laguna. The new station has an area of over 5,000 m^2 that are distributed over three different levels. It will permit exchanges between all different modes of transport: tram, bus, taxi, private vehicles and the future railroad.

Other medium-term projects include extending Line 1 of the tram, from Avenida de La Trinidad to Los Rodeos, and extending Line 2 from Tíncer to La Gallega neighborhood and the Santa Cruz coastline.

Decades after their abandonment, the revival of the light rail and tram is an irrefutable fact both in Spain and in other European countries. However, it is particularly relevant for the Canary Islands. Trams' generalized slide into decadence at the end of the 19th century and first half of the 20th century deprived Tenerife of the only railway infrastructure it had. Thus, its internal transportation system was dependent on private vehicles and regular bus lines, known as *guaguas*. Consequently, the Tenerife Government (Cabildo) calculated that the island now has one of the highest indexes of private vehicles per inhabitant in the entire European Union, with a total of 550,000 automobiles. This has entailed large-scale environmental, economic and road congestion problems.

Growing traffic congestion is profiled as a global trend, converting trams and, in general, railroads, into the best bet for European, State and local administrations in order to provide a more sustainable and efficient mode of transport. It also represents a type of transport that is affordable for citizens with mobility difficulties. According to the Cabildo, 25% of its 886,033 inhabitants belong to this group.

For all of these reasons, Tenerife, like Gran Canaria and other islands, has put great effort into constructing a rail network that offers a viable alternative to cars and buses. This network is not only made up of tram Line 1 and Line 2, but also of the future North and South train lines. Projects for these trains are currently being drawn up, coordinated by Ineco, which is also a shareholder in Metropolitano de Tenerife. ✱

From horse-drawn omnibus to light rail

The first electric tram on Tenerife in the Canary Islands was first inaugurated on April 7, 1901. Like its modern-day equivalent, it linked the towns of Santa Cruz and La Laguna. A stage in transport between both municipalities thus opened up, which until that point had only had horse-drawn omnibuses. The line was expanded in 1904 to Tacoronte.

At the beginning of the 20th century, the number of automobiles registered on the island was only a few dozen, although this number had jumped to 5,000 by 1950.

Tram use was in a downward spiral due to technical and financial woes. The tracks started to be removed from the streets in 1957. Meanwhile, different private companies started covering road–transport demands in the 20s. They would merge in 1978 when Transportes Interurbanos de Tenerife was established (now TITSA). Initial ownership was the Spanish rail operator Renfe and the Tenerife Cabildo. It changed hands to the Government of the Canary Islands in 1986 and became exclusively owned by the Cabildo in 2007.

INECO'S TECHNICAL SERVICES

Ineco is an MTSA (Metropolitano de Tenerife) shareholder and has provided technical services at the facilities: catenary, energy, fixed and mobile communications, video and integration of the command post.

Chronology

>1999
The initiative to build a modern tram is officially presented.

>2001
Basic planning is finished in the metropolitan area and the company Metropolitano de Tenerife (MTSA) is founded.

>2003
A period to submit tenders is opened for works and provision of rolling stock.

>2004
The Tenerife Government (Cabildo) awards the works, as well as the supplying of tram vehicles, and the first works on the new line are started up.

>2005
The first tram unit arrives on the island and track testing begins.

>2007
On June 2, Line 1 opens and the works for Line 2 are awarded.

>2008
Works start on Line 2, which will connect the towns of La Cuesta and Tíncer. Line 1 has carried more than 13 million passengers by year end.

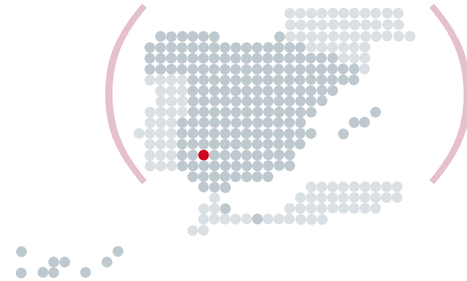
>2009
On May 30, Line 2 is opened and the works for the new junction interchange in La Laguna are awarded.

>2010
Ineco is established as a strategic partner of the island Government for the start up of the Tenerife rail network, working jointly in developing the rail infrastructures for the north and south of the island.
At present, Ineco is coordinating the South Train project and writing the Special Territorial Plan for Infrastructure Planning.

The subway that transformed Seville

Ineco project participation

Published in itransporte 22



Equipped with the latest design and safety advances, the city's state-of-the-art subway, which started running in April 2009, entailed significant technical challenges. Ineco provided its experience in all the phases of the project and construction process, and will continue to do so during the network's expansion.

The sixth-largest subway system in Spain is now a reality in Seville. This city, with almost 700,000 inhabitants, is the fourth largest in the country (surpassed only by Madrid, Barcelona and Valencia). The new Line 1 connects the Andalusian capital to an extensive metropolitan area that encompasses three large population hubs: Dos Hermanas, San Juan de Aznalfarache and Mairena de Aljarafe. At present, nearly 228,000 users already have a metro stop less than 500 meters from their home.

The first 18 kilometers of the network's route started running to coincide with the city's massively attended festivities, including Holy Week and the Feria de Abril, exceeding all forecasts for demand. Through mid-2010, the subway had transported an average of 50,000 travelers on work days, accruing a total of 16.5 million passengers since it opened.

The Autonomous Government of Andalusia (Junta) calculates that both the subway and suburban trains will provide service to 40% of the metropolitan area's population. More than 580,000 of Seville's residents will have a stop within 800 meters of their homes or workplaces. ✱

A long road

Seville's subway is the result of efforts made by the Autonomous Government of Andalusia and the city of Seville since the 70s, when the first project was conceived with three lines. Works started, although they were frozen in 1983. The future subway was stalemated until 1999, when the project was taken up again. The complexity of the works on the city's subsoil, along with a slew of planning incidents, led to the modification of parts of the route and increased execution periods. The total timeline ended up being five years. The execution of the construction tasks involved significant technical challenges. Different systems were used to excavate 13 kilometers of tunnels under the city: 4.5 kilometers with a tunnel boring machine, 7 kilometers with reinforced-concrete screen and 265 meters used shafts.

Top engineering for Line 1

Ineco audited the works and supervised the construction of Line 1, which crosses Seville from west to east. There are 22 stations in service. With light subway features, the route is about 60% underground, primarily within the city of Seville. Ineco has executed geotechnical reports on the actions of the tunnel boring machine and geotechnical issues that arose during construction. It also created reports related to the electrified double tracks with 750-volts, 'International' (UIC) gauge (1,435 mm) and fully built on slabs. Other tasks included suitability verifications and review of the construction projects and processes, executing concessional legal-financial reports, technical advisory services on rolling stock and electric installations, and assembling the platform doors.

Seville fashion designers Vittorio and Lucchino were responsible for the design of the rolling stock.

Cutting-edge technology

TETRA RADIOTELEPHONY creates communications between the central command post and the trains, supervisors and watchmen, using exclusive communications lines.

RAILROAD SIGNALING incorporates two last-generation systems.

ATP (Automatic Train Protection) controls the maximum speed of the trains, preventing any possible problems between the two units running on the same track.

ATO (Automatic Train Operation) improves commercial speed, optimizing journey times between stations.

STATION CONTROL manages the subway network operation in real time, from train traffic, station equipment remote control, energy control in substations, to communications.

Haute couture trains

Seventeen units that were specially manufactured by CAF make up the fleet. The design of this rolling stock was created by Seville fashion designers Vittorio and Lucchino, who also created the uniforms for the conductors and personnel. The trains can accommodate 250 passengers and are comprised of multiple articulated vehicles made of five modules, three of them supported by a rolling system. Due to being vehicles one hundred percent low floors, accessibility is facilitated both for people with reduced mobility, the elderly and people with baby carriages. The vehicle is continuous inside, with wide intercommunication corridors, uses a traveler visual and acoustic information system and has video surveillance from the central control post via Wi-Fi and SIM telephony.

PLATFORM DOORS

Given that the platform height is low compared to the tracks, platform doors were installed. This innovative system employs 3-meter-high partitions that are synchronized to open along with the trains. Ineco provided technical advisory services for the assembly that also required the installation of automated connection systems with the trains. Essential for automated driving, the objective of the system is to improve safety.

ROLLING STOCK TECHNICAL SPECIFICATIONS

Dimensions	
WIDTH	2,650 mm
LENGTH	31,260 mm
VEHICLE HEIGHT	3,390 mm
FLOOR HEIGHT	350 mm
Features	
DOORS PER SIDE	6
MAXIMUM SPEED	70 kph
TOTAL CAPACITY	250 passengers
Equipment	
Air conditioning in the passenger hall	
Information on destinations (optical and acoustic)	
ATP	

Belgrade modernizes its infrastructure

First light rail line

Published in itransporte 8

A new bridge over the Sava River and a tunnel under the historic city center are just a couple of the challenges that were considered when incorporating a light rail to the city. Ineco has been involved in the overall project since its inception.

Fast population growth and sorely-deficient infrastructures after years of serious conflict were the engines that drove the Belgrade City Council to start up the General Transport Plan in 2003. The plan will make the city one of the most modern in Eastern Europe with respect to infrastructure. Belgrade (Beograd or "White City" in Serbian) is the capital of the Republic of Serbia, located at the convergence of the Danube and Sava rivers.

With 2021 on the horizon, the city will have an urban transport system that will revolutionize the quality of its services for its more than 1.6 million inhabitants. In light of this objective, the Agency for the Urban Development of Belgrade, a division of the City Council, contracted Ineco's services in 2004 to draw up the pre-viability study and general design for the first light rail line in Belgrade. This is one of the city's most important projects with regard to urban transport. Years later, in October 2006, the agency once again awarded Ineco a project, this time for managing the works prior to constructing this light rail line, as well as its coordination and supervision and technical assistance in decision-making.

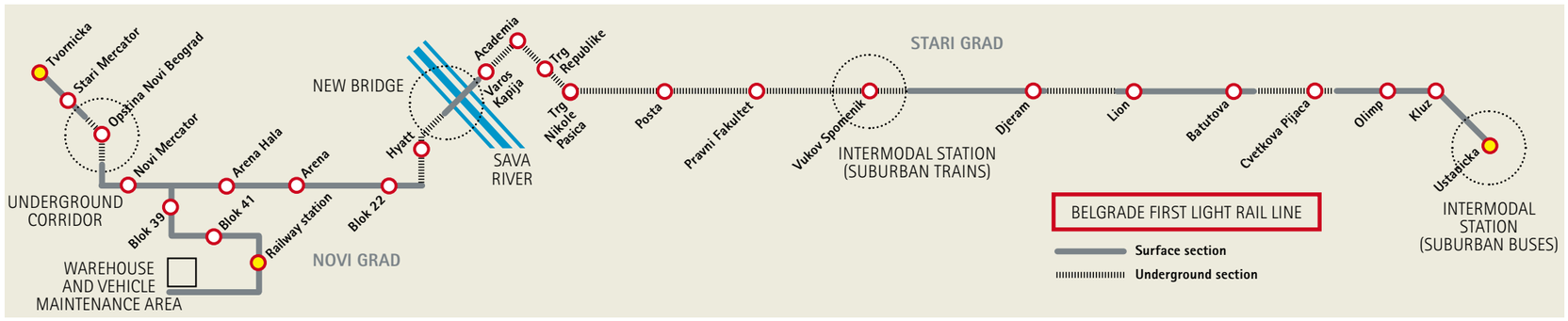
The budget for this consultancy agreement was €4,213,000 for a three-year term. During this period, Ineco worked with three local subcontracted firms: Juginus (transport and urban planning specialist), CEP (architecture and urban planning specialist) and Duodec (a structures specialist).

The importance of the City Council's Transport Plan led to its being awarded the "City of the Future" in 2007, along with other cities. This honor was awarded by the prestigious British newspaper *Financial Times*.

One end point of the line is Novi Beograd, the most modern district in the city, laid out with wide avenues and buildings characteristic of its socialist past, with a clear influence from French architect Le Corbusier and mixed with modern, more recently-constructed buildings. The line then crosses the heart of Belgrade, Stara Grad, a district with significant cultural and commercial activity, to finish in Ustanicka, a residential zone in the old city, pending urban renewal. The line will be 14.6 kilometers long, with a total of 25 stations, 10 of them underground.

The project also outlines the construction of a warehouse and vehicle maintenance area in Novi Beograd that is connected to the rest of the line via an access corridor, along which there will be three surface stations.

The planned operation for the Y-shaped infrastructure is via two lines that will be superimposed in the middle part of the route to attend to the higher demand of travelers. One of the unique features of this section is precisely the need to operate with a shared platform between the light rail (1,435 mm wide) and the existing tram system (1,000 mm wide). The use of a third lane is planned to cover this need. ✱



Technical challenges

The greatest technical challenges imposed by this project were the construction of a bridge over the Sava River and a tunnel that will traverse the city center. According to the study, the bridge will run parallel to Brankov Most, which currently has three lanes of traffic in each direction. The light rail will be located downstream from, yet near, this avenue and adapted aesthetically to the existing structure. It will have a 260-meter central passageway, two 76-meter lateral passages and structures to approach it from both riverbanks, particularly long from the Novi Beograd side. The total planned length is 800 meters. The complexity of the traffic driving in downtown Belgrade makes it necessary to have part of the route underground. A 3,465-meter-long tunnel with seven underground stations will be constructed in the old part of the city, Stari Grad. There will be underground corridors at some points along the route to avoid several congested intersections. The total length of tunnels planned is 4,585 meters.

The Varoš Kapija Station is located at the exit of the tunnel and right before the bridge over the Sava. It will be one of the unique points of the line, as it will be visible from the opposite shore of the river, particularly when accessing the historic city center from the Branko Bridge. The station must be integrated with the most characteristic profile of this district of the city. It includes both the Kalemegdan Fort, close where the Danube and Sava rivers cross each other, and the Orthodox Saborna Crkva Cathedral.

Jobs entrusted to Ineco

Ineco has also been working on better defining the rolling stock and assessing the specific conditions for the section and for the city of Belgrade. In accordance with the forecasts made during preliminary works, the fleet should have 46 mobile units accommodating 300 passengers each.

Among the jobs entrusted to Ineco as part of the project are the definition of the financing model for the investments required both for constructing the infrastructure and for material procurement. It is also designing the management model for the operation of the light rail. A permanent office was opened in Belgrade for works execution that was to remain in place through mid-2010.

In addition to in-house consultancy experts, railway, geology and tunnel, infrastructure and track, railway facility and system, conventional line, material and technology specialists have all taken part in the project –a multidisciplinary team that demonstrates Ineco's skill in providing the proper technical personnel for the job at all times.

THE SAVA RIVER AND THE CITY

The Sava divides Belgrade into two very different regions, both with respect to the urban planning model and land use model. The large transport demand between both banks turns the existing bridges into veritable bottlenecks. The new light rail line will substantially decrease traffic problems.

Belgrade is the most populated city in the Balkans, as well as one of the most ancient.f The first settlements date back 7,000 years ago, although it would be the Romans who founded the city of Singidunum in the 3rd century BC.

Desert train

Ineco configures the country's rail plans

Published in itransporte 5

There is no railway in Kuwait. Private vehicles are responsible for 99% of mobility. However, in a country where automobile and petrol prices are absurdly low compared to the West, forecasts reveal that the road transportation system will collapse within 10 years if no alternatives are provided to meet increased demands.

After fully overcoming the Gulf crisis, Kuwait has experienced population growth above 3.5% annually, one of the highest rates in the world. This situation reflects the return of expatriates after the war and the constant inflow of immigrant workers towards one of the principal petroleum exporting nations. But not everything is petroleum. The capital is also one of the most important financial and business centers in the Middle East.

Kuwait's population is almost 3 million inhabitants, distributed across a metropolitan area of approximately 80 km². Nearly 35% of inhabitants are Kuwaitis, while the remaining 65% is comprised of residents from neighboring Arabic countries, Europeans and a large workforce from Pakistan, India and the Philippines.

The alternatives outlined by Ineco engineers are based on two innovative projects: on the one hand, the construction of a national railway to connect Kuwait to its neighbors Irak, Saudi Arabia and other countries in the region, and, on the other, the creation of a subway network in the metropolitan area. There are plans for 244 kilometers of railway lines to link the country's northern border to Iraq and the southern border to Saudi Arabia. Lines will also run from the metropolitan area of Kuwait City to the new cities that the Government plans to erect in upcoming years to absorb demographic growth.

Along with the track sections running to marinas and a possible connection to the west, the rail network would be 505 kilometers. In turn, the subway system will have four lines and a total length of 165 kilometers. ✱

NEW SUBWAY NETWORK

On this picture, the project for a future subway network in Kuwait City, that will link the downtown area to the airport, the marina and the mosques.

'Kuwait Railway Master Plan', an original project

In 2007, Ineco finished two master plans for the Kuwait Ministry of Transportation and Communications. The objective was to configure the country's entire rail system. The two plans are the Kuwait Rapid Transit Master Plan and the Kuwait Railway Master Plan. The first covers the metropolitan region for the subway, while the second develops the strategy for the future national network, both for freight and passenger transportation.

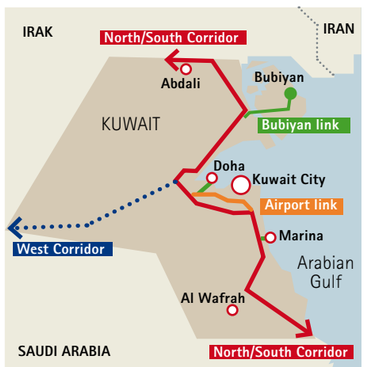
A committee was set up among the Government of Kuwait to execute the two studies, led by the Minister of Communications and the undersecretaries of all administrations involved in the development of these infrastructures (Ministry of Public Works, Municipality of Kuwait, Directorate General of Roads, Directorate General of the Environment, Public Port Authority and the Directorate General of Civil Aviation).

After an initial analysis, the strategic objectives were outlined that must be followed in each area. This joint planning of all rail system designs will lead to excellent synergies.

Why this new network?

- **It is a modern, quick, safe and sustainable transportation system.**
- **It will link the new urban centers and their outskirts to Kuwait City.**
- **It will put Kuwait in a privileged position to link to its neighbors in the Gulf and its future rail networks.**
- **It will make the marinas of Kuwait into international cargo distribution centers.**

The subway network will have four lines and different sections will be built in parallel to lead to the marinas, the airport and, possibly, the western region of the country.



THE CITY

The Kuwait Government will implement a public transportation system to improve communications between the new urban hubs and their outskirts through a fast, modern and safe system. Calculations forecast that close to 11% of citizens will use the future rail network.

THE FUTURE

The fact that the majority of citizens (65%) residing in Kuwait City are from neighboring Arabic countries has led the Government to readdress communications issues. There are plans for 244 kilometers of railway track that will link Kuwait to Saudi Arabia (south) and Irak (north).

A modern rail system

- **Double tracks to increase security and allow more traffic.**
- **Slab tracks with the highest performance and quality to reduce maintenance costs.**
- **Mixed traffic (passenger and freight) to maximize use of this new infrastructure.**
- **Electrified network permitting the implementation of the latest high-speed technologies.**

These requirements will comply with the specifications of the Arab Countries International Railway Agreement (Arab MASHREQ).

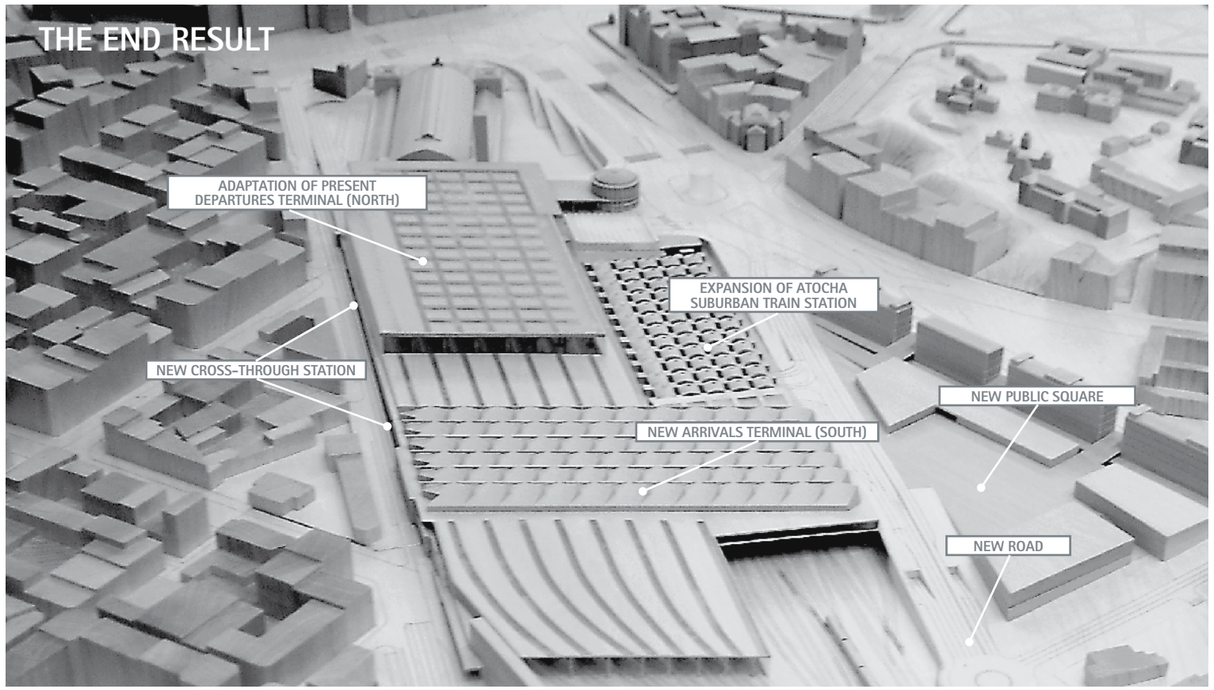
- **Maximum speeds of 350 kph for passenger trains and 120 kph for cargo trains. High-security systems (ERTMS Level 2).**
- **Maximum cargo capacity according to modern standards, in line with the viability study of Bubiyan Island.**

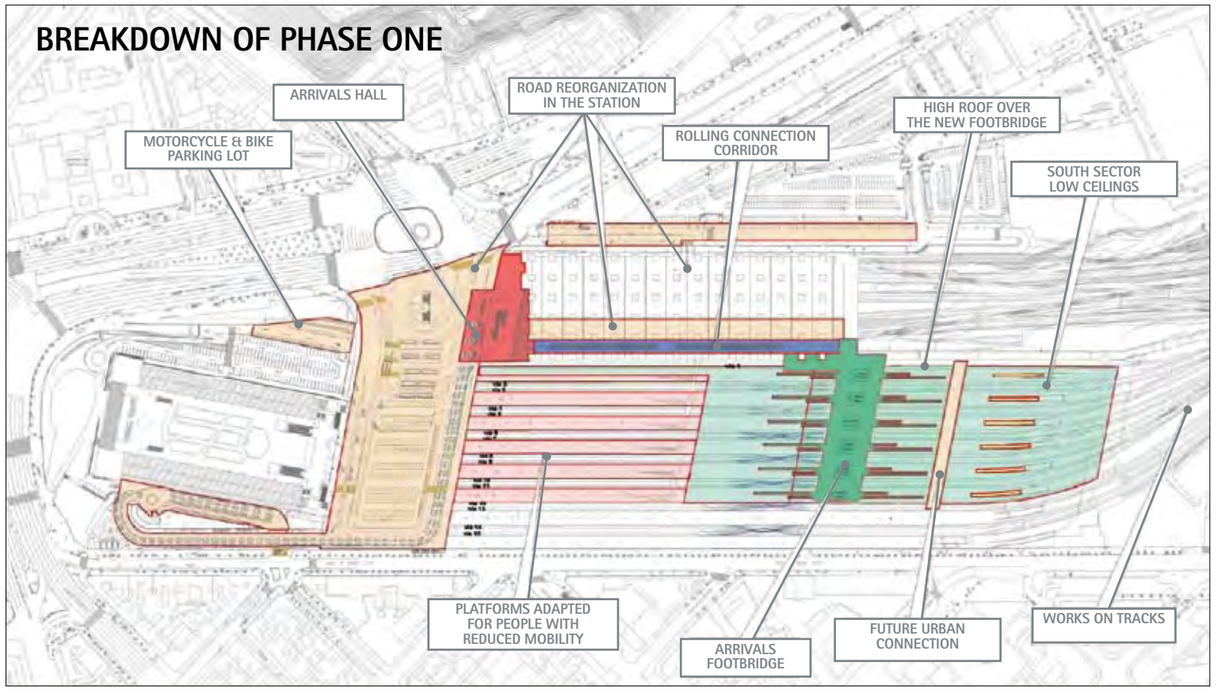
The main objective of using the rail network is for it to be more profitable than using private vehicles. Automobile and gas prices in Kuwait are astoundingly low. For this reason, to maximize the use of public transportation by train or subway, travel times must be less than by car.

Atocha doubles its size

Phase one of the expansion project

Published in itransporte 18





Madrid's historic station will double its spaces to become the high-speed unifying hub of Spain. Ineco participates in the planning and development of the project's different phases.

The present-day Atocha Station complex, in the heart of Spain's capital, is the nerve center for the Spanish rail network (high-speed, medium and long distance, and Madrid suburban trains). The building also holds the status of being an important urban fixture due to its size, central location in the city framework and the enormous flow of passenger traffic it accommodates.

Built over the remains of the former Mediodía Station at the end of the 19th century, it was remodeled and expanded for the first time between 1985 and 1992 for the Universal Expo in Seville and the opening of the first Spanish high-speed line from Madrid to Seville. These works quadrupled its capacity. This is how the current railway complex was created. In addition to reviving the old warehouse designed by a disciple of Gustave Eiffel, a modern Cercanías (suburban trains) terminal was built by world-renowned Spanish architect Rafael Moneo, who is also in charge of the current expansion. A passenger interchange was also constructed to connect it to the subway network, buses and taxis. The third key element of this initial expansion was the Puerta de Atocha Station, with the first high-speed line in Spain.

Today, the high-speed network continues to grow and has made the new expansion necessary. It will convert the Atocha complex into the unifying hub for the new lines and will entail its radical transformation. Train movement in each direction and every day will jump from the 128 current services to over 212 on the horizon by 2025. The number of annual travelers will double in this same period. For this reason, the Spanish Government, through the railway infrastructure management entity Adif, started up the comprehensive remodeling project at the end of 2008.

Ineco is playing an essential role in this project, in charge of the design and coordination of the first phase of works. The architectural and conceptual design is being done once again by Rafael Moneo. His innumerous →

Notable increase in capacity

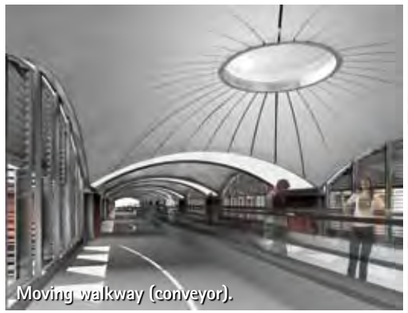
Thanks to the comprehensive development of the new railroad complex, designed by architect Rafael Moneo, Atocha will soon be equipped to welcome transit of up to 36 million travelers per year. This figure represents a 100% increase in annual capacity.

NEW CROSS-THROUGH STATION_ The construction of a new cross-through station at Atocha is also planned for future phases of the project. It will run under street Méndez Álvaro and tracks 14 and 15, and will share halls, accesses and services with Puerta de Atocha. There will also be 4 cross-through tracks of 'International' (UIC) gauge (1,435 mm) and two 400-meter-long platforms, with natural lighting and ventilation.

FUTURE RAILWAY OPERATING MODEL AT PUERTA DE ATOCHA_ The current single terminal, in which arrivals and departures converge, will be transformed into a double terminal: a departures hall (north sector) and arrivals halls (south sector), with separation of traveler flows. There will be 15 tracks of 'International' (UIC) gauge.

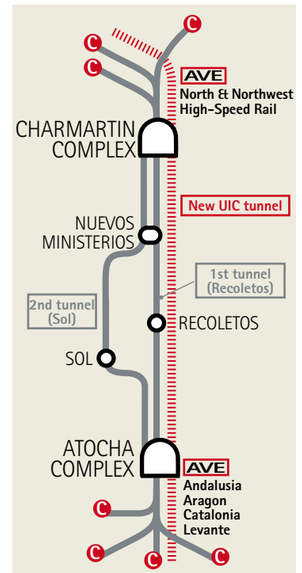
The Spanish Ministry of Development plans to invest a total of €520 million in transforming the station. Train movement in each direction and every day will jump from the 128 current services to over 212 on the horizon by 2025.


Future footbridge and arrivals hall.


Moving walkway (conveyor).


A different view of the arrivals hall.


New arrivals hall.



The high-speed tunnel between Atocha and Chamartin is already under construction. The total budget is €206 million.

→ awards include the 1996 Pritzker Architecture Prize and the 2001 Mies Van der Rohe Prize. He is the artist responsible for the expansion of the Prado Museum in Madrid, the Kursaal Palace in San Sebastian, the Stockholm Museum of Modern Art and a slew of other works throughout the world.

Since the 1970s, Madrid's rail system has connected the main railroad hub of Atocha, in the south of the city, with Chamartin Station, in the north, via a tunnel that traverses the entire city. It was first expanded in 2008 with a second underground network for Cercanías services. The future system will be completed with a third tunnel allocated to the new high-speed lines, which will also run under the city center.

Double passenger terminal. To assimilate increased numbers of travelers, a new arrivals terminal will be built and the existing one will be remodeled for departures. It will be finished off by reorganizing accesses and the surrounding urban services. Moreover, a new cross-through station will be created. Even Atocha Cercanías will benefit from this global initiative, as the station will be equipped with two more tracks and accessibility will be improved. Routes without stops will be established to facilitate transit for all users through the facilities. In short, this is a key initiative at a crucial hub for the city.

The objective of phase one works is to reorganize the flows of travelers and users of the station, as well as the flows of trains. This will increase their capacity to meet the demand for high-speed services. To do so, a new arrivals terminal will be constructed, according to the future operating model based on separating the arrivals and departures areas –currently concentrated at the same point– to optimize usage of the existing facilities. ✱

MOST RELEVANT INITIATIVES

- To construct a new footbridge and arrivals hall, as well as a moving walkway (conveyor) to connect them.
- To convert the present conventional-gauge (1,668 mm) tracks (from tracks 12 to 15) to 'International' (UIC) gauge (1,435 mm) for high-speed.
- To widen the platforms to facilitate mobility for disabled persons.
- To cover the south side of the platforms with a new high shelter.
- To reorganize the entire road network inside the station.

INECO'S PARTICIPATION

Adif, the Spanish rail infrastructure manager, awarded the expansion project to Ineco, which is working jointly with Rafael Moneo's architecture studio. In addition to scheduling all actions, drawing up the basic and construction projects for this expansion, as well as coordinating and managing the multidisciplinary team who has participated in drawing up the project.

A roof with personality

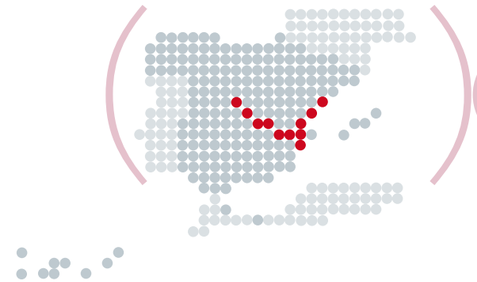
The new roof of the arrivals terminal, for which engineer Leonardo Fernández Troyano contributed to the design, has entailed a genuine challenge due to the enormous technical complexity. However, it will imbue the overall station with great expressive energy (see pictures in this double-page spread).

INTERCONNECTION POINT_ **After all actions have been finished, Puerta de Atocha will have been converted into the connection hub for the different high-speed corridors originating and terminating both in the north and south of the Iberian Peninsula.**

Taking care of the Eastern tracks

Safety and comfort for the Mediterranean and Levante corridors

Published in itransporte 20



The Mediterranean and Levante corridors are the most complex rail infrastructures in Spain. Long-distance, regional, commuter and freight trains travel on them, generating intensive cargo traffic. Ineco has been involved in maintenance works on the corridors since 1995.

Different types of superstructures and infrastructures coexist on the Mediterranean and Levante corridors, with different electrification, signaling and safety systems. This variety is related to the adaptation of many sections on the old routes from 160 kph to 200 kph. An extensive start-up schedule for the successive improvements executed has also contributed to this diversity and complexity. In short, the rail infrastructures on these corridors reflect the successive redrafting of objectives, which are increasingly ambitious, for rail relations between Madrid and the Spanish Mediterranean coastline.

The presence of Ineco teams in maintaining these corridors dates back to the final construction phase of the Mediterranean Corridor in November 1995. It took part in the work by the state operator Renfe of the track and detour of 200 kph section that the Spanish Ministry of Development constructed at that time. Given the specificity of the facilities built, Ineco participated in their adjustments and fine tuning since the start of the Euromed service (June 1997).

At present, under Adif guidance, Ineco continues to actively participate in maintaining the superstructure and infrastructure of the Mediterranean and Levante corridors, as well as the rest of the lines included within the Adif Eastern Conventional Network.

Since the original start up at 200 kph, corridor maintenance works have been based on the principles and techniques of what would later be called *maintenance according to condition*. Its essence compared to traditional cyclical maintenance is to provide a variety of solutions for the pathologies of different tracks. The main objective of this type of maintenance is to decrease costs and extend the useful life of materials.

The centrepoint on which the maintenance of the corridors has been sustained have been the dynamic and geometric auscultations of the tracks, as well as the ultrasonic auscultation of the rails. Interventions with heavy machinery in necessary cases have completed the basic mandates for preventive maintenance. Corrective maintenance, when occurring, has basically been due to structural defects in materials (almost impossible to detect), the end of their useful life and due to undesirable impacts and solicitations of rolling stock. *

Proper diagnosis

Successfully maintaining track geometry throughout the process of consolidating the embankments and transitional segments caused by passing loads. Proper diagnosis of the track parameters involved is essential for this, as well as the use of the suitable topography and heavy machinery. Controlling the frequency of hits and the ballast altitudes under the railroad ties in conflictive consolidations is absolutely imperative. This strictly determines the suitability of opening way to other actions related to the infrastructure or track dismantling. To do so, spreadsheets for each 2-km section are employed that permit easy identification of conflictive areas. The consolidation process for the embankments and transitional segments along the corridors has been impeccable in general terms.

The great advances that have taken place in technologies such as dynamic and geometric auscultations of the tracks or ultrasonic auscultation of the rails, along with experience rail topography and solvent technical analyses, were basic elements for properly diagnosing track defects and their suitable treatments.

INVENTORY OF THE LINES

Keeping the railroad line inventory and information about engineering structures updated guarantees movement safety. This essential work is done via an information system implemented by Ineco, with the contribution of an alarm system on the inspected bridges. Furthermore, completing the geo-referencing of the tracks and different facilities of all the lines on the Eastern Delegation contributes, among other things, to improving the 'mileage' and linking it automatically to instruments like SIGPAC or Google Earth.

The main objective of this type of maintenance is to decrease costs and extend the useful life of materials.

HIGH OCCUPANCY LINES_The Levante Corridor 1 links Madrid with the Spanish Mediterranean coastline. The Mediterranean Corridor 2 runs parallel to the coastline.

RESOURCE OPTIMIZATION

Real-time information on the works done with heavy machinery and their technical characteristics is fundamental for the overall management of the superstructure. To achieve this objective, there is a superstructure works information system (SITRAS). It was developed jointly with Adif (the state body that manages rail infrastructures) and implemented by Ineco, based on the work reports generated by the office's regional management and headquarters. The system also verifies the performance of heavy machinery, helping Adif to optimize resources.

RAILWAYS | **ETHIOPIA**① | Railroad restoration

From Djibouti to the heart of Ethiopia

A vitally important connection

Published in itransporte 15

The Djibouti–Ethiopia railroad is the only route that provides access from Ethiopia to the ocean, with a direct connection to the port through the Republic of Djibouti. Ineco and the Italian company SPT were in charge of the project management and the technical assistance.

With a population of over 75 million inhabitants, Ethiopia is a founding member of the African Union (AU), stablished the United Nations headquarters on the African continent and was one of the 51 original members of the UN. Scourged by wars, droughts and mass population movements, it lost all outlets to the ocean after Eritrea gained independence in 1993, becoming one of the world's 43 countries without a coastline. As a consequence of the multiple confrontations with Eritrea, Djibouti became the only outlet to the ocean for Ethiopian products.

The construction of the railroad between Ethiopia and Djibouti dates back to the end of the 19th century, when Swiss engineer Alfred Ilg convinced emperor Menelek II of the disadvantages of the 6-week journey by mule. The line's creation was replete with difficulties and internal conflicts due to financing issues. The first commercial trip was made in 1901, when the English and French were managing it. The opposing commercial interests of each nation drove the company into bankruptcy in 1906. Two years later, the The Imperial Railway Company of Ethiopia (often referred to by its French name Compagnie Impériale des Chemins de Fer Éthiopiens) was created, which managed to finally finish the line to Addis Ababa in 1917.

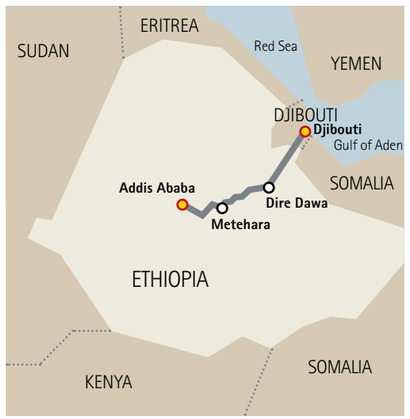
The railroad starts in the city of Djibouti at sea level and finishes in Addis Ababa at an altitude of some 2,800 meters. The restoration project encompasses 144 kilometers, including a large number of bridge repairs. Five kilometers of track cross over the Metehara Lake, for which the old track was dismantled and the new one constructed. The Addis Ababa station will see an increase in the number of users owing to this new railroad line. ✱

A shared project

Since 2007, Ineco and the Italian company SPT have been running project administration and supervising the works for restoring the line for CDE (Ethio-Djibouti Railroads). The works have been financed by the EU, which earmarked close to €50 million for the project in 2006. The Djibouti–Ethiopia railway is part of the Ethiopian Government plan to lay down 5,000 kilometers of track along seven different routes of economic importance. The picture above shows the panel of works depicting the construction companies and works supervisors.

THE RAIL ROUTE

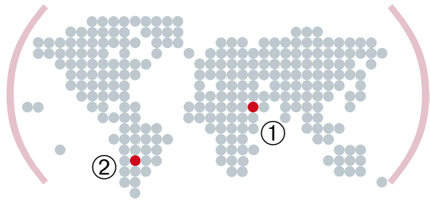
The single track 781 kilometers railway has a 1,000 mm gauge. It traverses densely populated areas and important industrial zones, including the capital of Ethiopia, Addis Ababa, and the cities of Dire Dawa (some 472 kilometers from Addis Ababa) and Metehara (in the Oromia Region). This is the only connection and outlet to the ocean for Ethiopia's 75 million inhabitants (see map to the right). The complete journey lasts more than 24 hours and the average speed of the train is 30 kph.



RAILWAYS | **ARGENTINA**② | Preliminary studies

The Jujuy train returns

Railway study in Argentina



Published in itransporte 2

In 2010, Ineco finished the preliminary studies required for the restoration of the line running between the towns of Salvador de Jujuy and La Quiaca, the only railroad link between northwest Argentina and Bolivia.

The rail section that connects Jujuy and La Quiaca runs through Quebrada de Humahuaca, the only valley declared World Heritage by UNESCO due to its great natural and cultural value. Sculpted over millions of years by the Rio Grande, the torrential river waters displace dangerous floods of mud, which have even buried entire villages.

The railroad tracks, constructed in 1907, have practically disappeared (the last train service was in 1993). For Rosino Cortés, project manager, this is a "unique and complex project". The actions being executed on the 122 kilometers of the ravine have the challenge of resolving the "tough conditions throughout the route, along with the environmental respect demanded of a specially-protected region". ✱

Extensive experience

Ineco's experience in adverse mountainous terrains was decisive in being awarded the study in 2006 by the Secretariat of Regional Integration of the Province of Jujuy (Argentina). Works were executed in two phases and finished in mid-2010. San Salvador de Jujuy is 1,259 meters above sea level, 1,623 kilometers from Buenos Aires. La Quiaca is located 298 kilometers to the north, on the border with Bolivia. It is 3,442 meters high and rests on an immense plateau on the Altiplano. The route is beset by large changes in altitude and the railroad must climb a hefty 1,000 meters in only 100 kilometers, with slopes exceeding 6%.
To perform the first diagnostic on infrastructures, a team of Ineco engineers and local topographers (including railroad project specialist Santiago Espinosa) had to travel the distance between San Salvador de Jujuy and La Quiaca either in SUVs or even bicycles, given the inaccessibility of the terrain. The inspection not only included the route, but also the facilities and buildings related to rail operations (stations, sidetracks, storage warehouses, etc.).

Great routes to the future

The aim of the Trans-European Networks is to connect all regions of Europe

Published in itransporte 16

The Europe of the future will be woven together by a network of supranational routes that shape a complex mesh. These are essential for the development and good operation of the single market, as they guarantee the free movement of goods, people and services.

The concept of a multiple modal goods transportation corridor is linked to the Trans-European Networks (TENs) that appeared at the end of the 1980s in response to the single market proposed at that time. The aim of the TENs is to connect all regions of Europe via a modern infrastructure that goes beyond the simple juxtaposition of the national networks. The priority objective of European transportation policy is to create conditions that guarantee the efficiency of trans-European transport modes. Underlying objectives consist of adopting a common initiative to resolve problems whose solution is less rational if done individually for each member state, region and city. *

The Øresund combination train-road bridge is the longest in Europe and connects Copenhagen to the Swedish city of Malmö.

Pan-European corridors: beyond just the EU

Expansion to Central and Eastern European countries reinforces the importance of the TENs by extending its coverage to the entire European continent. Furthermore, effective connection to the networks in third countries located further east and south represent a factor for balance and economic development by establishing connections between the main EU hubs and non-community countries. The 10 PAN corridors were defined in the transportation conferences held in Prague (1991), Crete (1994) and Helsinki (1997).

RAILROADS A PRIORITY

Out of the 30 priority projects identified by the Decision 884/2004/CE (sse map on the opposite page), 18 are for railroads and two are for inland transport and sea navigation. In this way, preference has been given to the transport methods that are most respectful to the environment. The European transport policy clearly states that the railways as an environmentally friendly transport mode should become an alternative to congested roads. They have to, however, provide customers with a reliable, high-quality and safe travel path, which is the purpose of the unfolding of the ERTMS.

Trans-European Networks: Europe in the 21st century

The TENs encompass three activity sectors: TEN-Energy (TEN-E) –that cover the electricity and natural gas sectors– TEN-Telecommunications (ETEN) and TEN-Transportation (TEN-T), including road and rail transportation, navigable routes and seaports, as well as the high-speed rail. Intelligent transportation management systems are also part of this category, as well as Galileo, the European satellite radio navigation system.

TEN-T directives define EU priorities by placing the network label on specific routes. This centers EU financial assistance on the projects with the greatest added value for the community. Each corridor is made up of a series of elements, such as infrastructures, systems and services prone to new development, expansion and improvement projects. They will contribute to increasing the capacities and interoperability of different passenger and freight transport modes. The member states are responsible for funding and executing the projects. Inclusion of a corridor gives them access to TENs funds, as well as other sources of European financing. The EU proposes that each member participates in at least one international corridor by 2012.

The Trans-European Network label lets transportation corridors benefit from EU financial support. A large number of projects will benefit from the community's budget via the TENs budgetary line, the European Regional Development Fund (ERDF), the Cohesion Fund, the European Investments Fund (EIF) and from structural funds.

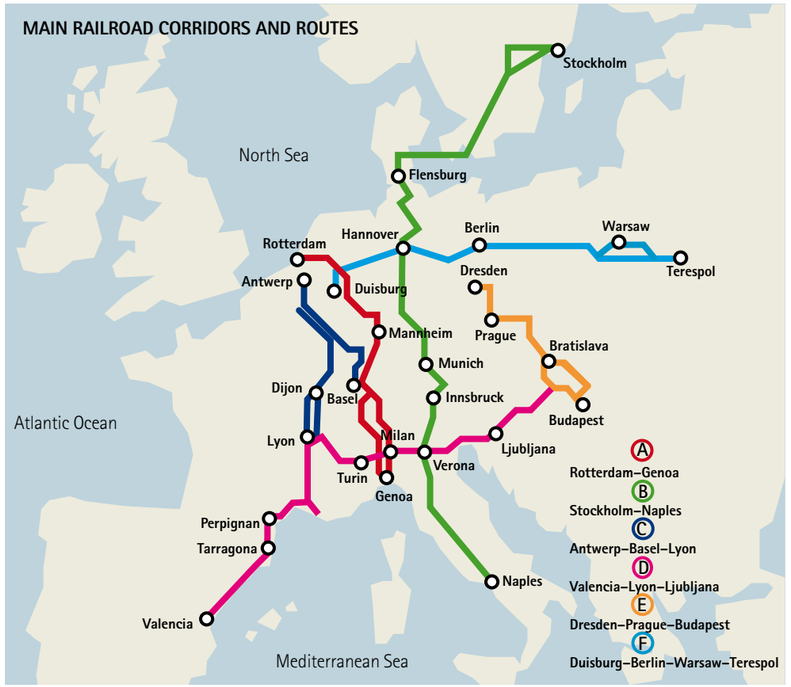
The European Investment Bank (EIB) also contributes to the financing of these projects.

To harmonize ERTMS implementation on railway corridors a coordinator was appointed, who proposed ERTMS deployment over six corridors.

➔

ERTMS: The six longest goods railroad hubs

The unfolding of the European Rail Traffic Management System (ERTMS) represents an important European industrial project, like Galileo in the sphere of satellite navigation. Directive 96/48/EC is an essential component for the interoperability of the EU priority rail projects, which is derived from treaty provisions related to the Trans-European Networks. Title XV, articles 154, 155 and 156, establishes a legal framework that requires the use of the ERTMS since November 2002 for all new high-speed lines on the Trans-European Network or when they renew signaling. For conventional railways, similar requirements are applied. On March 17, 2005, the European Commission and the rail industry (manufacturers, infrastructure managers and rail operators) signed a Memorandum of Understanding (MoU), establishing the principles of a strategy for the correct deployment of ERTMS rail traffic in the EU within a 10 to 12-year period.



€500 million for the deployment of the ERTMS

In the 2007-2013 TENs budget, €500 million were earmarked for facilitating the deployment of the ERTMS both on-board and on tracks, up to a maximum of 50% of the eligible project cost. Corridors A, C and D (see map above right) must be completed by 2015-2017. The other three by 2020. Corridor A is the most advanced: it should be finished by 2012, except the section between Oberhausen and Mannheim (planned for 2015). Corridor D was initially going to start in Barcelona and finish in Ljubljana. Then it was extended until Valencia, including access to the ports of Valencia and Tarragona, and the next extension from Ljubljana to Budapest, where it will link to Corridor E.
The objectives for Corridor A are to double the transported volume by 2020, reducing transportation time by 20%. In absolute terms, this is equal to 28 billion tons annually transported by railway and taken off roads. Expressed differently, it is equivalent to trucks with 27-ton loads departing every 37 seconds, 24 hours a day every day of the year along the 1,300 kilometers of the corridor.

TRAFFIC CONSOLIDATION AND OPTIMIZATION

Different Ineco departments are actively participating in a range of projects that are closely related to the Trans-European Networks, particularly with regard to technical and operative interoperability. Several projects stand out that are aimed at consolidating ERTMS specifications (EMSET Project, pilot line Albacete–Villar de Chinchilla) or aimed at harmonizing ERTMS operating rules (HEROE Project) or optimizing traffic in the main European corridors by applying the ERTMS (OPTIRAILS and OPTIRAILS II projects).

What is 'interoperability'?

Moving towards the convergence of the European rail network

Published in itransporte 5

In order for trains to travel indistinctly over any section of the European network, works must be done that are aimed at integrating all the different rail technical and operative systems existing in the EU. This is interoperability.

Despite the lack of interoperability, nobody questions the advantages of rail transportation. Commuter trains move millions of people every day in big cities. But transportation by rail could offer more services than it provides today, which entails eliminating the barriers that prevent sharing and integrating existing networks via their technical and operational harmonization.

Convergence towards integration and interoperability of the rail networks is not a simple task. For every service category (passengers and goods on high-speed and conventional lines) there are similar convergence processes. These include the publication of the appropriate European Directive that defines the objectives and the legal framework for each category; transposing the Directive to each state after adapting the legal framework that is affected; publication of the pertinent technical specifications for interoperability (TSI) and European specifications, and, finally, application of the TSI to infrastructures and trains in each country.

Interoperability highlights the EU desire to revitalize the railroad as an efficient and safe mode of transport via the creation of a single trans-European rail network. This solution will increase efficiency, reduce costs and provide improvements and more varied passenger and goods services. This qualitative and quantitative leap will allow rail to compete with road traffic and aviation under the best conditions. ✱

Advantages

■ Rail operators will increase their market potential. With the disappearance of technical and operational barriers, travel times can be reduced, using their material resources more efficiently and increasing the range of services offered.
■ European manufacturers can offer the same product in each country, promoting economies of scale that will subsequently lead to lower costs, greater competition and a wider range of goods on offer.
However, there are not only advantages. This convergence is not only a matter of time and money. It is also dependent on knowing how to properly plan the transition, heeding the implications it may have on aspects related to safety of all train journeys. This entails changing from one country-wide operational setting with different legislation and standards to another in which the rules of play are agreed upon at a European scale.
Spain started convergence towards interoperability long before a community legislative framework existed, introducing UIC gauge when constructing its first high-speed line between Madrid and Seville in 1992.

INECO'S INVOLVEMENT

Ineco has participated both nationally and at a European level in introducing rail interoperability, supporting the Spanish Ministry of Development, Adif and the operator Renfe at all times. The great experience it obtained by participating in different European projects (such as ERTMS/ETCS and TEN-R) led to its advantageous positioning in different projects and works that the Government is promoting.

Interoperability in the aeronautics sector

The main international specialized body is the International Civil Aviation Organization (ICAO), an agency of the United Nations founded in 1944. At present, it has 190 contracting states and is responsible for watching over the safe and orderly development of all issues related to international civil aviation. To do so, the ICAO draws up and maintains a series of standards that constantly change, known as Standards and Recommended Practices (SARPS). These deal with all technical and operational matters of international civil aviation.
There are also procedures for air navigation services (PANS) and supplementary regional procedures (SUPPS).
At a European level, EUROCONTROL (European Organization for Air Navigation Safety), with 38 member states, has the fundamental objective of developing a common ATM (Air Transit Management) System in Europe. This involves states, airlines, airports, military entities, industry, etc. In short, any user of air space.

Seven Latin American airports checked

Airport infrastructure test

Published in itransporte 12

A thorough study conducted by Ineco for the Andean Development Corporation (Corporación Andina de Fomento, CAF) performs an in-depth analysis of the Andean Community's main airports. The project investigated the infrastructures, airport processes and regulations at each facility.

Passenger demand will grow by 6.6% per year in Latin America for the next 20 years, according to data published by the International Civil Aviation Organization (OACI), The Air Transport Association (IATA) and Boeing Market Forecast. This increase will only be surpassed by China, with an 8.8% growth rate. To adapt to this situation and be able to handle challenges related to air transport in some of the countries in the Andean region (Colombia, Venezuela, Peru, Ecuador and Bolivia), CAF hired Ineco in February 2007 as an expert consultant in all fields related to air transport.

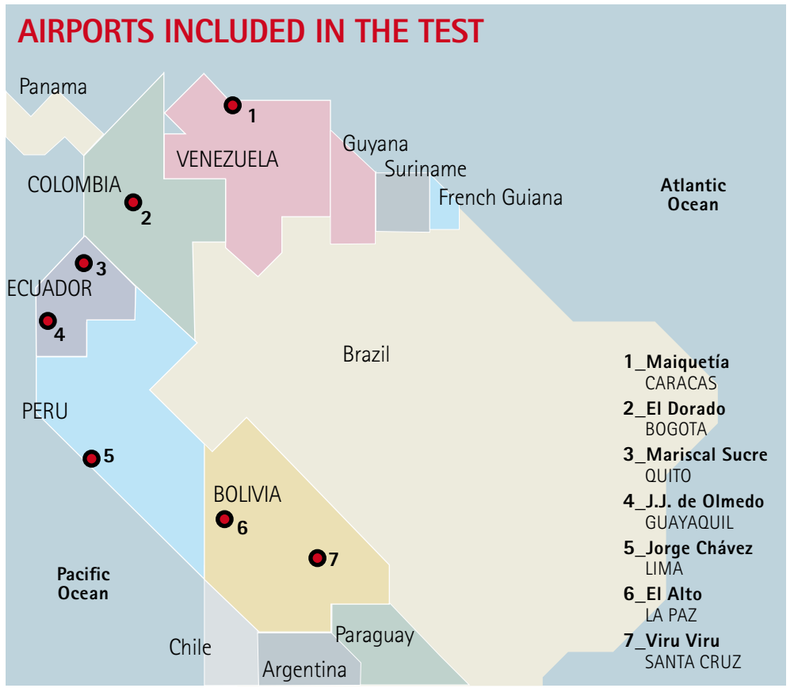
The project, financed by the Spanish Ministry of the Economy and Finance, analyzed infrastructures, airport processes and regulations at seven regional airports: Maiquetía (Caracas), El Dorado (Bogota), Mariscal Sucre (Quito), José Joaquín de Olmedo (Guayaquil), Jorge Chávez (Lima), El Alto (La Paz) and Viru Viru (Santa Cruz).

A multidisciplinary team worked in the different countries, determining the current situation of each airport and their regulatory and institutional bodies, as well as analyzing the economic and environmental situations.

Study results outline drawing up a development plan for each airport, highlighting investment needs. To develop the Evaluation Program of the Main Airports in the Andean Region, the infrastructures, facilities and institutional framework of each airport were completely reviewed.

In a second stage, quality surveys were conducted of passenger services, airline companies and cargo companies. To finish, spokespersons for the airport logistics chain were interviewed in the different countries. These included airlines, chambers of commerce, town councils, airline company associations, handling and cargo companies, tourist offices, customs houses, involved administrations, air navigation providers, airport operators, etc. This was done as an essential step to complement and clarify the proposed initiatives.

All of this information was used to perform a competitiveness analysis for each airport and to identify detected bottlenecks and areas for improvement. ✱



COLOMBIA

El Dorado (Bogota)

With 9.7 million passengers and nearly 600,000 tons of cargo transported, this airport has the greatest volume of movement of all those analyzed. Located some 15 kilometers west of the city center, El Dorado is the nation's primary international gateway, accounting for 49% of the total air traffic in the country.

Access problem

The only road linking Maiquetía Airport to Caracas crosses El Ávila mountain range, which towers in the northern region of the largest city in Venezuela. This area has imposing geological difficulties that have even forced the airport's closure at times. The search for a second road is absolutely essential. Based on a survey carried out by more than 30 international airlines, Maiquetía is the fifth most expensive airport among 32 air terminals in the region, with an average cost of $650.

Access road to Maiquetía Airport, Caracas (Venezuela).

A tough location

Mariscal Sucre Airport–named after Venezuelan born Antonio José de Sucre, a hero of Ecuadorian and Latin American independence–, is located in the center of Quito, forcing its replacement by a new airport that should be up-and-running in 2011. This is the only solution for absorbing forecast traffic growth and increasing safety parameters for all aircraft operations. At 2,800 meters, it is one of the world's highest airports. Ecuador's main airport serves approximately 2.5 million passengers a year.

Mariscal Sucre Airport, Quito (Ecuador).

The complicated mountainous terrain and great distances make air transport fundamental in order to develop these countries.

PERU

Jorge Chávez (Lima)

The Peruvian capital's airport moved more than 8.8 million passengers in 2009, a growth of 6% over the previous year. The concession is held by LAP (Lima Airport Partners), which believes that passenger flow in 2010 will reach nearly 9.05 million for a growth of 4% to 5% over 2009.

VENEZUELA

Maiquetía (Caracas)

It is the only airport whose management is not under concession. Also known as Simón Bolívar International Airport, it reports to the Autonomous Institute for Maiquetía International Airport (IAAIM). It has two terminals which look after approximately 7 million passengers annually.

ECUADOR

J.J. de Olmedo (Guayaquil)

It moved 3.2 million passengers in 2007 and concession is held by TAGSA, which is supervised by the Guayaquil Airport Authority.

Mariscal Sucre (Quito)

Replacement by a new airport is underway, whose construction is being done by QUIPORT.

Japanese design

The design of Viru Viru was executed by Japanese engineers in the 80s, with a totally symmetrical airfield structure and enough space to grow as much as necessary. The altitude of the airport is 600 meters, so that there is no type of weight restrictions. Viru Viru is able to handle even the largest commercial jets, with a 3,500-meter long runway. Despite the fact that Santa Cruz is only the second largest metropolitan area in Bolivia, its airport became the most important in the country after it opened.

Viru Viru Airport, Santa Cruz (Bolivia).

BOLIVIA

El Alto (La Paz)

The concession is held by SABSA, as are the country's other two main airports in Santa Cruz de la Sierra and Cochabamba.

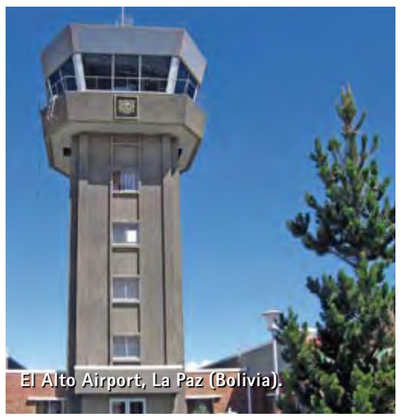
Viru Viru (Santa Cruz)

It moved close to 1 million passengers in 2007. SABSA is also in charge of its management.

Airports of the Andean Sub-region (ASAND) objective: to improve infrastructure management

Latin American airports have efficiency problems that make their function as trade promoters and connection points difficult for the integration of countries in this region. The complicated mountainous terrain and great distances make air transport a fundamental transport mode in order to develop these countries. To change the situation and foster this development, Latin American authorities need a preliminary study of the situation in each country that will help determine the most suitable strategies in each case. Article 104 of the Cartagena Agreement of 1969 established the design of joint initiatives as an objective to strengthen infrastructures and services that would favor the sub-region's economic integration. Pursuant to this article, the Committee of the Andean Community adopted decision 619 on July 15, 2005 in Lima. Its title is *Standards for the Harmonization of Rights and Obligations of Users, Carriers and Air Transportation Service Operators in the Andean Community*. It was approved by the Andean Aeronautical Authorities Committee.

The content primarily deals with users' and air carriers' rights and duties. Out of all the common sites where these rights and duties are reconciled, everybody agrees that the airport is undoubtedly the most important. Thus, CAF (the Andean Development Corporation) took the initiative to analyze airport behavior in this Andean sub-region. This is in line with its statutory goals, which include sustainable promotion for the region's economic development.
CAF assessed that improving resource management is the key piece to fully profit from the actions aimed at the region's social development. These must be applied with the greatest equity possible and have a suitable financial balance.



El Alto Airport, La Paz (Bolivia).

CONCLUSIONS

The primary objective of this ASAND (Airports of the Andean Sub-region) study is to deepen knowledge about the basic elements that comprise all aspects of airports' production chains. This is so that they can be optimized and the weaknesses can be sought out in order to promote improvements that lead to the successful application of transportation policies enacted by the Andean Community.

A plan for the future of tourism in Jamaica

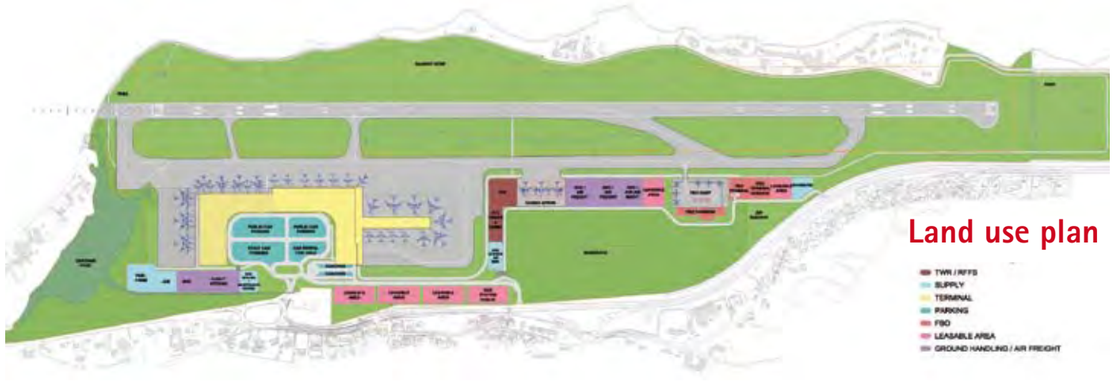
Ineco has drawn up the Master Plan for Sangster International Airport

Published in itransporte 24

The Master Plan drawn up by Ineco analyzes the airport impact on the national economy, with expected growth in demand. It puts forward actions over the next 20 years to strengthen its position as the 'entry door' to one of the destinations with the greatest potential in the Caribbean.

Tourism contributes 27% to Jamaica's GDP and accounts for 276,000 jobs (24% of the national total). The Sir Donald Sangster International Airport, located in Montego Bay, is one of the great engines of Jamaica's tourist industry. Alone, it employs 4,000 staff and contributes $18.1 million to the Jamaican economy.

MBJ Airports Limited, the private consortium that manages the airport with a 30-year concession, commissioned Ineco in 2008 to draw up a Master Plan that would enable more rigorous forecasting of growth in demand while ensuring that airport capacity is in line with that demand in the short, medium and long term. The Plan took an integrated and overall perspective, with a time horizon through 2028. This document analyzes the airport's economic impact and its relationship to the surrounding area. It also forecasts future growth in traffic and included proposals for the development of infrastructures with different alternatives in terms of execution, along with corresponding cost estimates. ✱



Land use plan

4.7 million passengers in 2028

The results are consistent and indicate that the overall average annual growth in traffic at Sangster for the next 20 years will be 1.7%. This takes account of the zero growth for the upcoming five years due to the global financial crisis. In the medium term (2013 to 2018), average growth of 2.25% is expected. Lastly, for the final 10-year period, three possible scenarios were defined, which would develop depending on the different factors included in the Master Plan. The high scenario –which would mean an average annual growth of 3.9%– would arise if the airport followed an expansion path that is similar to the reference airports studied, in particular if markets, such as the Asian, could be opened up, while maintaining existing markets. On the other hand, the low scenario –based on no improvement work or development of tourism– forecasts an average growth of 1.81%. The scenario considered most likely, however, sits in between: an average growth of 2.22% (4.71 million passengers a year in 2028).

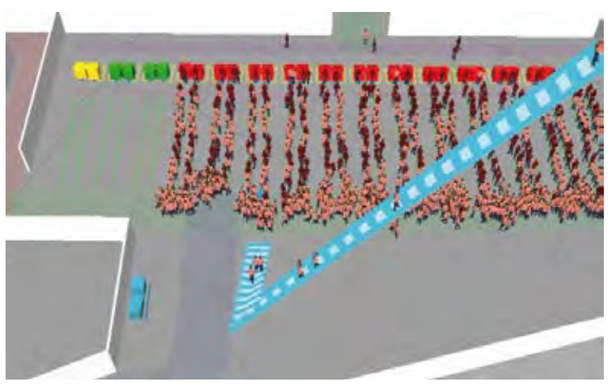
DEVELOPMENT ALTERNATIVES

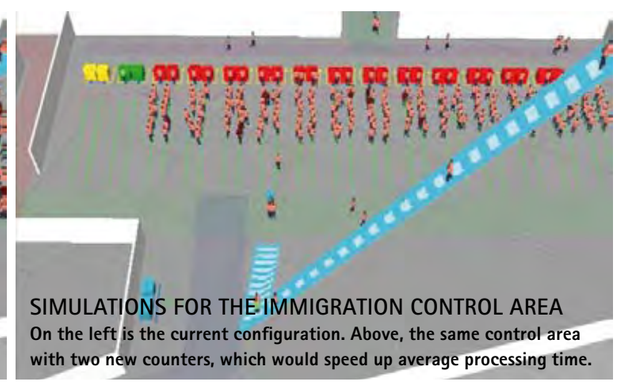
Some of the proposals included in the Master Plan are: the relocation of the control tower to avoid limiting the airport's future development and lengthening the runway by 408 meters. The total length would be increased from the current 2,662 meters to 3,130 meters and a RESA (runway end safety area) would be installed at the 25 header. This entailed moving the 07 threshold and purchasing 8.7 hectares of land. Sangster is very close to Montego Bay and parallel to the coastline, surrounded by buildings and areas of high environmental value.

Traffic analysis and forecasts

The Master Plan took as its starting point the current situation with regard to airport activity, including a detailed analysis of traffic. A number of factors were taken into account in preparing the Plan: the historical development of the airport between 1978 and 2008, the type of operations, aircraft and operators, originating markets and seasonal factors. The document notes the influence of the main operator, Air Jamaica (with 40% market share), the importance of the United States as an originating market (70% of the total), and the fact that January to April shows the greatest levels of activity.

Having looked at the current situation, the most important factor in determining the future image of the airport –and, therefore, the activities required to ensure that its capacity is adequate– is the traffic forecast. In the short term, the Plan follows a statistical model based on two variables: the growth of U.S. GDP between 2009 and 2011 (–0.9%, 1.9% and 3.1%) and the activity of Air Jamaica. In the medium and long term there is greater uncertainty, so three analysis methods were used: first, applying the econometric model used for short-term forecasting; secondly, trend line; and thirdly, benchmarking. As part of this, airports with characteristics similar to Sangster were used as reference: being an island, international traffic and competition from other nearby destinations.





SIMULATIONS FOR THE IMMIGRATION CONTROL AREA

On the left is the current configuration. Above, the same control area with two new counters, which would speed up average processing time.

Comprehensive planning

Ineco has extensive experience in drawing up master plans for airports. These, in line with International Civil Aviation Organisation (ICAO) guidelines, represent a planning tool for the maximum development of an airport structure, bearing in mind both aeronautical and non-aeronautical aspects (environmental, social, commercial, integration of the territory and others).

Taking the current situation as their starting point, master plans forecast growth requirements in the short, medium and long-term (over a period of 5, 10 and 20 years). Although flexible and subject to adjustment, this comprehensive planning is essential for ensuring that airport infrastructures are ready to meet forecast demand as well as facilitating the process of decision-making. At the same time, it gives the whole airport community an overall perspective of the development of the airport, in one single document.

Sangster Master Plan includes distribution of information as part of its planning. Accordingly, Ineco's team started working in December 2008 on a consultation process and contacting agents involved in or connected to the airport's activity. These included Jamaica's airport and civil aviation authorities (JAA and JCAA), the national tourist board (JTB), its client MBJ Airports, representatives from the Ministry of Finance, immigration, airlines, tourism operators, handling agents, hotels and the local Chamber of Commerce. The document was presented to the airport community at a public meeting in May 2009.

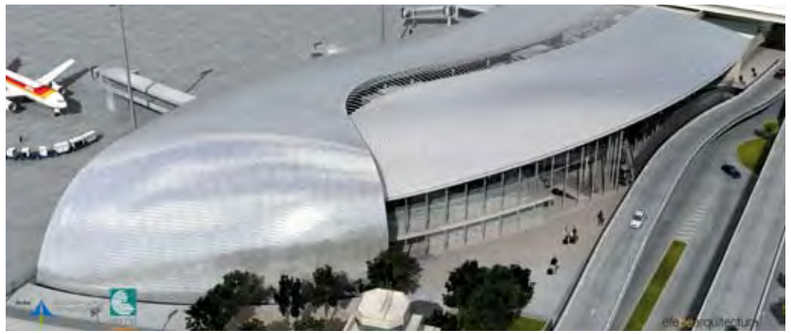
AERONAUTICAL | **SPAIN**① | New terminal building

New 26,000 m² area

Additional space for domestic flights in Valencia

Published in itransporte 13

Due to the increase in passenger numbers in recent years, Valencia Airport is to have a new terminal for domestic flights. Working with architectural studio Efebearquitectura, Ineco has prepared this design for Aena.



Safety and coordination with the other areas and infrastructures has been one of the priorities.

Valencia airport recorded traffic of almost 6 million passengers in 2007, a 19% increase compared to 2006. In order to cover increased demand, plans include expanding the passenger building by constructing a new terminal on the east side to handle domestic traffic.

The project is for an infrastructure that supplements what is there already, both in terms of the current and regional buildings. Key to this refurbishment is the compromise between the architectural, operational and business aspects of the airport. The aim is to enhance its use and make it attractive to concessions, while also providing the necessary facilities for airport staff and the companies that operate there. Safety and coordination with the airport's other areas and infrastructures have also been a priority for this project.

The T2 Terminal will connect with the current building on the west side so that spatial communication is open, with continuity of the departure and arrivals lounges being maintained, as well as allowing a fluid flow between passengers and other users of the airport.

The envelope structure of the new building enhances the sense of continuity with the present and regional terminals, providing a finishing touch to both buildings. Removing the dividing wall of the T1 Terminal gives a fluid, organic and continuous look. Different skins produce the transition from the current building to the departure gates area, which will determine the final area via a large double-height volume defined by the glass curtain wall and an aluminum skin. This will include the necessary space for departure halls, separated by a metal screen. The way that the roof curves down to the ground gives the perception of a wider space, since the whole building and the surroundings are on display.

Aesthetically, the new building will be a continuation of the regional aviation terminal, using the same materials. However, it will incorporate solutions that strengthen the existing architectural concept. ✱

PARALLEL PROJECT ACTIVITIES

- Adapting the airside ramp and urbanization works.
- Construction of a hangar for Spain's National Traffic Authority (DGT) of approximately 2,000 m² with capacity for four helicopters.
- Construction of a number of exit roads from the airport onto the national Manises Highway.

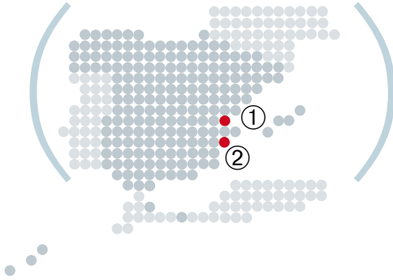
Thanks to the design and functional solutions, the new terminal building will ensure that the new structure fully integrates with existing structures.

AERONAUTICAL | **SPAIN**② | New Area Terminal (NAT)

Preparations for 2020

Expansion of Alicante Airport

Published in itransporte 7



The NAT will cover a total area of 333,500 m².

New air bridges.

Parking extension.

The objective of the work is for Alicante airport to become one of the main 'entry gates' for international tourism in eastern Spain. Ineco is involved in this process, which will expand the current airport capacity to 20 million passengers per year by 2020.

A multi-disciplinary Ineco team for Alicante Airport is responsible for providing technical support, control, monitoring and supervision services for the expansion works that will increase capacity from the current 9 million a year to 20 million passengers by 2020, a 122% increase. Traffic has doubled during the last decade and today 80% of the airport's flights are international. Along with Valencia Airport, Alicante is the port of entry for foreign tourism to the east of Spain.

The Alicante Airport expansion work was approved in 2001. It started with the apron being expanded, traffic islands being paved and the new provisional passenger processing area (currently T2) being constructed. The terminal came into service in 2007 as soon as New Area Terminal (NAT) work was concluded. This is the most important of the works, which include the extension of the apron and taxiway, and improvements to the electrical system, which will be changed from the current 3 kV to a 20 kV distribution.

The NAT project covers the construction of a new processing building which will have a total of 28 boarding gates, enabling 16 aircraft to be handled via 14 air bridges, two of which are double. The existing parking area is also being extended and once finished will have two modules, with capacity for over 4,200 cars. Between this and the processing building a 13,000 m² 61-bay bus station is also planned, as well as access to the future railway station. ✱

AERONAUTICAL | **KENYA** | International consulting

‘Smile. You’re in Kenya!’

Review of the expansion and upgrading project of Nairobi´s international airport

Published in itransporte 18

The Jomo Kenyatta International Airport in Nairobi (Kenya) is the eighth largest in Africa by annual passenger volume (more than 5 million in 2009) and the second in air cargo volumes (over 275,000 tons per year). In Spain, only Madrid-Barajas manages a higher volume of air freight.

Nairobi airport is the true gateway to Kenya, as it manages 80% of international passenger traffic and 90% of air cargo. In the last five years, it has experienced a big increase in traffic, largely due to the liberalization process of the air transport sector in Africa –which started with the Yamoussoukro Decision in November 1999. This situation put pressure on the airport manager, Kenya Airports Authority (KAA), so it decided to review the expansion project it had planned and whose first phase was completed in 2008. The KAA decided to review the project’s functional viability when faced with the latest demand forecasts.

New terminal model

After drawing this conclusion, the design of a new terminal model was deemed urgent, served by a single runway, but expandable to the future concept of two parallel runways, as planned by the airport’s Master Plan. With respect to recommendations about operational safety undertaken by the Aeronautics Systems Division, 14 potential risks were identified and the appropriate mitigation measures were proposed. The Ineco team was congratulated by Erastus K. Mwongera, KAA President, for the outcome of the work and their commitment to the client, their seriousness and compliance with all deadlines. All these factors led to successfully finishing the work and the company’s presentation with top credentials in a market that will bear fruit in the near future. Yes, so we are smiling, we are in Kenya.

This review was awarded to Ineco in February 2008. Works included a forecast of traffic demands through 2030; computer simulation of passenger, luggage and aircraft flows; assessing and proposing recommendations for optimizing capacity and functional viability, economic-financial assessment, and architectural and operating safety recommendations for the expansion project.

After the new demand forecast was estimated, based on an ARIMA model, and the flight programming for a typical traffic day for the years 2014, 2018 and 2024 was done, airspace and airfield simulations were made using the SIMMOD program. Passenger and luggage management in the terminal was simulated using the WITNESS planning tool.

The analysis of simulation results, along with the experience of the working team, resulted in a series of recommendations that modified the project. These changes were primarily related to handling international-international traffic, as well as designing the aircraft apron. A complete review of the baggage handling system was also proposed (the weakest point of the project).

By implementing the recommendations outlined by the company, the general conclusion was that the proposed expansion could handle demand of up to 9 million passengers per year. This level is deemed reachable by about the year 2018. With respect to airspace/airfield, the existing procedures limit capacity more than airport infrastructures. Thus, improvement initiatives would allow greater advantage to be taken of the single existing runway. ✱

SECTOR LIBERALIZATION

Air transport on the African continent is facing a vital process for guaranteeing its competitiveness in the medium and long term. Sector liberalization started off with the Yamoussoukro Decision, whose official name is the Decision on the Implementation of the Yamoussoukro Statement on the Liberalization of Access to Air Transportation Markets in Africa. It was adopted in November 1999 at the conference of African ministers responsible for civil aviation in the city bearing the same name (Yamoussoukro) in the Ivory Coast, under the auspices of the United Nations Economic Commission.

Updating proposal.

1_New Arrivals building
2_Interconnecting buildings
3_Improvement of units 1, 2 y 3
4_New unit 4. Domestic flights
5_New parking lot

AERONAUTICAL | **SPAIN** | Technical assistance

EMAS: emergency braking

First installation in Europe

Published in itransporte 17

Madrid-Barajas is the first airport in Europe to install the EMAS system, which uses porous concrete blocks to help slow down aircraft in the event of an emergency at the end of the runway. Ineco ran the project and provided technical assistance for the control and monitoring of the works.

The construction of the new braking areas on runways 33R and 33L has given Madrid-Barajas Airport a system to slow down aircrafts in the event of an emergency, thus avoiding a worse incident as a result of coming off the runway. When the wheels enter the EMAS (Engineered Materials Arresting System) zone, they sink into the porous concrete blocks, the aircraft loses energy and gradually slows down to a complete stop within the safety zone (see picture to the right). This avoids damage to the fuselage and landing gear.

The EMAS system was installed in 2007 in the end safety area of each runway, in line with the airport’s Master Plan and Ineco’s design. Ineco was also responsible for checking and monitoring the works.

How it was installed. The EMAS solution was installed within the runway end safety area (RESA), approximately 10 meters from the LOCalizer antenna. The first step was to prepare the ground to ensure that it had sufficient load-bearing capacity. It was then built up with two layers: the lower one is a 12-22 centimeters thick *high modulus* hot mix asphalt layer, and the upper one is a wearing course type T-30 (Spanish specifications) gap graded mix with polymer modified bitumen, ranging in thickness between 5 to 10 centimeters.

COURTESY OF PORT AUTHORITY OF NY AND NJ

Given the importance of drainage to ensure the effectiveness of the system, two different drainage systems were installed on each side of the runways: on the 33R, a pipeline system was used; and on the 33L, a North American drainpipe was used. The main requirement under this standard is that there cannot be more than a quarter-inch difference in level between two points of the platform.

According to Federal Aviation Administration (FAA) data, EMAS is currently installed on 44 runways at 30 airports in the United States and there are plans for it to be installed on a further 10. There’s also an airport in China where the EMAS system was installed in 2006. ✱

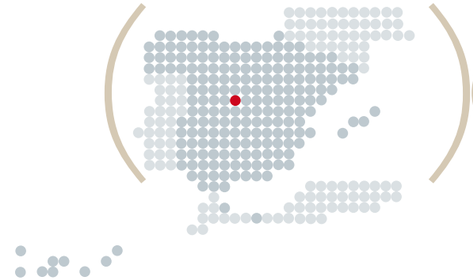
SAFER RUNWAYS

This new EMAS technology, developed in the United States in the 1990s, was supported by the FAA in order to improve runway safety. EMAS came about through work done jointly between the University of Dayton, the New York and New Jersey port authorities and the American firm ESCO (part of the Zodiac group). The first trial was conducted in 1996 with a Boeing B727, although the first time that the system was used successfully in a real-life situation was three years later, when a SAAB 340 came to a halt without suffering significant damage.

Railway tunnels in Spain

Major projects

Published in itransporte 6



Modern societies are characterized by the high level of complexity and specialization of their transportation systems. This has meant that tunnels are the solution for many projects and, consequently, there has been a big development in the technologies used on underground work.

Large tunnels are under construction all around the world. Spain is no exception and, in fact, is in a prominent position in terms of this type of construction work. This is due mainly to the country's geographical position and the economic development of past decades. Spain has already finished the construction of two of the longest railroad tunnels (Guadarrama and Pajares), as well as many shorter tunnels used on high-speed lines.

Tunnel construction in Spain is being closely watched internationally. Yet we should not forget the highway construction work that was done in the 1980s and 90s involving many large-section tunnels, the water projects with long small-section tunnels (constructed in mountainous areas with limited access) and the complexity of offshore sewage outfalls. Those years of intense activity have meant that there is a wide range of specialized professionals and companies able to run a large number of highly-complex subterranean projects.

Ineco is one such company, particularly in the rail industry, for which the company has developed projects since its early days. Ineco's most recent work has been related to site management and technical support on the Guadarrama and Pajares tunnel projects. ✱

Works in the Guadarrama tunnel.

Prefabricated voussoir.

Guniting process.

Projects of all kinds

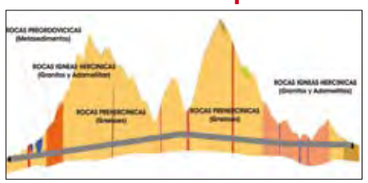
Spain occupies a prominent position globally with regard to underground construction projects. The table below lists the 12 longest tunnels in the world. A range of different techniques has been developed that have been applied to underground civil engineering works. However, it is tunnel-boring machines (TBM), such as the one shown in the big picture to the left, that have undergone the greatest degree of development during the last decade.

LONGEST RAILROAD TUNNELS	
1 **Gotthard** (Switzerland)	57,072 m
2 **Brenner** (Austria-Italy)	55,000 m
3 **Seikan** (Japan)	53,850 m
4 **Mont D'Ambi** (France-Italy)	52,110 m
5 **English Channel** (UK-France)	50,450 m
6 **Lotschberg** (Switzerland)	34,577 m
7 **Korlam** (Austria)	32,800 m
8 **Guadarrama** (Spain)	28,377 m
9 **Taihang** (Japan)	27,848 m
10 **Hakkoda** (Japan)	26,455 m
11 **Iwate** (Japan)	25,810 m
12 **Pajares** (Spain)	24,667 m

Ongoing development in construction techniques

Building large tunnels is no longer done using traditional and dangerous techniques. These days, highly industrialized and safe processes are used. However, not all underground work is the same, nor is it easy to standardize.

INSPECTION TECHNIQUES_Geology is a fundamental inspection technique. This means understanding the structure of the terrain from surface level and making visual inspections of any samples that can be obtained at depth. There are sophisticated prospecting methods, but conventional geology is always necessary.



MODELING THE PROCESS_It is important to contrast real situations with those anticipated in the construction specifications. For this purpose, calculation programs are used that perform highly-accurate simulations of behavior inside and around the tunnel.

OPENING OF GALLERIES_The opening of galleries that are secondary to the main section of the tunnel tend to be done using conventional excavation techniques.

GUNITING_The process of spraying liquid cement onto tunnel linings makes the excavated area safe from minor landslides.

SAFETY MEASURES_In the event of a potential evacuation, long tunnels present a safety problem. Properly managed exit routes and sealed self-rescue chambers are important measures that must be maintained in optimal conditions throughout the duration of the work.

A-LA-CARTE DESIGN

Tunnel-boring machines (TBA) are only effective when the site to be worked on is well known and the machines are designed in accordance with the site's characteristics. In some cases, conventional excavation methods are the most appropriate.

ON-SITE VOUSSOIRS

There have been major developments in propping techniques, like projecting concrete without the need of formwork but with adequate resistance. Prefabricated voussoirs enable highly-industrialized processes to be applied when tunnel-boring machines are used.

INECO'S ACTIVITIES

HIGH-SPEED RAILWAY LINE	LENGTH	NUMBER OF TUNNELS	Basic studies	Design construction	Project supervision	Architectural management	Support to architectural management	Supervision and coordination
Madrid-Cordoba-Seville	471 km	14	✱	✱				
Cordoba-Malaga	150 km	7		✱	✱		✱	
Bobadilla-Granada	112 km	4		✱				
Madrid-Zaragoza	327 km	19				✱		✱
Zaragoza-Barcelona	315 km	24				✱		✱
Barcelona-French border	132 km	16				✱		✱
Madrid-Valladolid	200 km	5	✱		✱	✱	✱	✱
Murcia-Almeria	33 km	5			✱			
Vitoria-Bilbao	60 km	65	✱		✱	✱		
Leon-Asturias (Pajares Bypass)	50 km	12	✱		✱	✱	✱	
Medina del Campo-Ourense	350 km	59	✱					
Ourense-Santiago	82 km	26		✱		✱		✱
Madrid-Valencia	430 km	20	✱		✱	✱		✱

Under the Cantabrian mountain range

A challenge for Spanish engineering

Published in itransporte 16 and 24

The full opening of the first Pajares tunnel in 2008 was a significant step in this enormous project that will allow the high-speed train to travel underground for 25 kilometers.

After the tunnels under Pajares had been excavated, waterproofing and platform works were executed, along with safety, track and electrification installations. Ineco teams worked with Adif in different areas: site management, technical assistance and geological/geotechnical consultancy, hydrogeological study of the mountain mass, environmental management, and the Pajares Tunnels Information Centre, set up to organize visits. This center also includes the team responsible for computerized inventory and for supervising the standardization of *As Built* projects, for the purposes of subsequent line maintenance.

Once the project is completed, it will enable the new Leon–Asturias high-speed line to pass through the Cantabrian Massif. It will have a double track throughout and will reduce the current route from 83 kilometers to 50. ✱

AVANT-GARDE TECHNOLOGY
Eleven construction companies working together under four joint ventures were involved in this complex project, together with two site managers and the Ineco platform, geo-technical and environmental specialists.

PICTURES BY PABLO NEUSTADT

Three priority objectives: technology, safety and environmental protection

For Ineco engineers, the dual-tunnel configuration and the galleries were very important due to safety reasons. This means that if there is an incident in one of the tunnels, the other can be used as an ancillary route and for evacuation. Other fundamental safety measures are also provided, such as preferential stopping points to facilitate the evacuation of people. From a geological viewpoint, the Pajares Tunnels cross an area of the Cantabrian mountains where there is a high degree of variety in terms of rocks. These include almost every type of carbonate and siliciclastic material. The technicians point out that the mountain maximums (distance between the tunnel key and the surface) are in the section of the tunnel under Cueto Negro (1,005 meters).

Tunneling machines. The work for the stretch was tendered under four different lots. Lot 1, La Pola de Gordón-Folledo (Leon); Lot 2, Folledo-Viadangos (Leon), and Lot 3, Viadangos (Leon)-Telledo (Asturias), in the East Tunnel; Lot 4, Viadangos-Telledo, in the West Tunnel. The tunnel drilling and lining was done using five tunneling machines. Four of these were single-shield and the other was double-shield, approximately 9.5 meters in diameter. Manufacturers were NFM-Wirth for Lots 1 and 3; Duro Felguera, Mitsubishi and Robbins for Lot 4, and Herrenknecht for Lots 1 and 2, the latter being the double shield. The machines excavated and fitted a lining of rings made up of seven reinforced concrete voussoirs that were pre-manufactured on site. Each of these rings is 1.5-meter long, 50-centimeter thick and 8.5-meter interior diameter, with 40, 50, 60, 75, 80 y 110 MPa resistance to cope with land thrust along the stretch of the tunnel.

When the line goes into operation, it will represent a reduction of some 33 kilometers between Leon and Oviedo.

Five tunneling machines

Excavating the Pajares tunnels required five tunneling machines. In the East Tunnel, three TBMs were used: a NFM-Wirth in the southern part (Lot 1), a double-shield Herrenknecht in the central stretch (Lot 2) and another NFM-Wirth in the northern part (Lot 3). These machines enabled the tunnel boring to progress at 600 meters a month.

MOUTH_This method of using tunneling machines requires an extensive facilities zone outside the tunnels. This includes tracks for trains in production to run along, workshops, an electrical substation, stocks of rings and different materials, an area for downloading excavated material and so on.

VOUSSOIRS_Tunnel props were also manufactured on site, with one voussoir manufacturing plant per Lot. Each lining ring consists of seven 50-centimeter-thick voussoirs, with resistance varying between 40 and 110 MPa. The rings were then transported to the TBM where they were put in place to fully finished each section.

WASTE MANAGEMENT_All material extracted during excavation work is transported to controlled inert waste depots. At the northern end (Asturias), the Environmental Impact Statement required that transportation between the set of tracks and the depot be done via transporter belts, thus avoiding trucks travelling on the road.

EXCAVATION FRONTS_Excavation of the Eastern Tunnel was tackled from three different fronts: Lot 1 excavated 9.9 kilometers from the southern mouth, Lot 3 excavated 10.3 kilometers from the northern mouth and Lot 2 excavated a central stretch of 4.4 kilometers.

BASIC TUNNEL DETAILS

The Pajares Tunnels are part of a longer project called the Pajares Bypass. There is a total of 50 kilometers of high-speed line enabling the current distance to be reduced by 35 kilometers.
Two single-track tunnels.
Total lenght of each tunnel: 24.6 kilometers.
Continuous lengthwise slope of 16.8 millesimals, down towards Asturias.
Circular section: 8.5 meters diameter.
Total area: 52 m².
Connecting galleries: each 400 meters.
Distance between the axes of both tracks: 50 meters inside the massif.

Technical support to Adif

GEOLOGY_Management and coordination of the geological cartography, along with the necessary prospecting work.

GEOTECHNICAL_Advising project management on resolving geotechnical incidents.

CONSTRUCTION METHOD_Technical review of the processes of execution.

SURVEYING_Review of topographical and geodesic criteria. Checking alignment data.

INFORMATION SYSTEM FOR UNDERGROUND WORKS (SIOS)_A suitable tool for managing the volume of information required by a project of this magnitude.

Ineco's work

- **Direction of works.**
- **Environmental management of the works carried out under joint venture with Euroestudios.**
- **Geological/geotechnical consultancy during the excavation: teams of advisers in the areas of geotechnics and tunnels, machinery and structures.**
- **Hydro-geological study of the massif.**
- **Technical assistance, control and monitoring of the four project lots under joint venture with Geoconsult.**
- **Information Center for the Pajares Bypass.**

First complete hydrogeological study of Pajares

Pioneering work by Ineco

Published in itransporte 24

Adif has entrusted Ineco with the hydrogeological study of the Pajares Tunnel project. The company will be following through the initial stage to monitor the region for several years once the tunnel is in operation.

The complete hydrogeological study of the Pajares Tunnels is the first of its kind in this geographical region. The study is also innovative: in such a large-scale project, it is very unusual to study more than just the effect of ground water on the construction and operation of the tunnels, but also, in this case, the impact of the tunnels on the groundwater was also be investigated. In this sense, the work is pioneering and is already being planned or undertaken in other stretches of the Spanish high-speed railway system.

After a series of incidents in which considerable amounts of water seeped into the tunnels during their construction, Adif entrusted this complex study to Ineco. The one-year study covers an area of 209.6 km^2 surrounding the alignment of the tunnels, which are situated in the Cantabrian mountain range. From a hydrographical point of view, the zone is situated between the Duero Basin and the Northern Basin. Despite the fact that the region does not have any large hydrogeological features, it does contain various ground water systems (the study, in fact, described 20 different systems) with a modest storage capacity and generally reduced permeability. The ground water resources are, however, used quite widely. ✱

Most important conclusions from the study

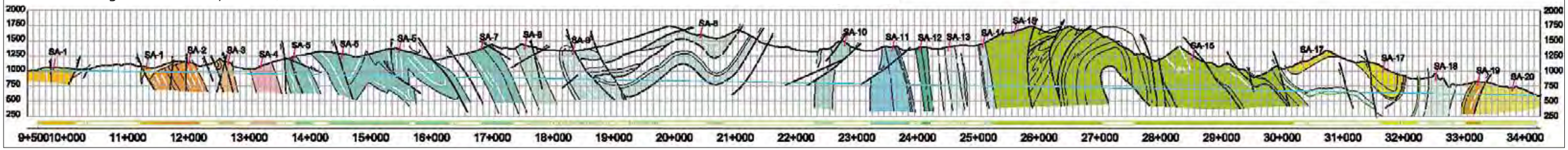
1. WATER FLOW AND CURRENTS

Most of the water flow occurs in areas in the tunnel in contact between different geological formations, i.e. when moving from aquifuge to aquifer. Joints from layers of rock of different age and geological significance are also a source of water. A third factor which must be taken into account is the powdering of the so-called Barrios Quartzite to sand masses. Another geological factor present in the region is karstification. It should be remembered that large karstic underground caverns can form on the continent in a saturated area, i.e. a region under the water table. Karstification is sizeable in some areas and with some formations, and was the reason for the first major water problem encountered during the building of the tunnels. Furthermore, karstic cavities, as the preferred route of water, are responsible for the rapid drop in ground water levels observed by the passing tunneling machines in some calcareous regions, for certain sinkholes leading the water from streams directly into the tunnels and the impact of the tunnel on aquifers several kilometers away.
Most of the sudden water problems were encountered in fractured, karstified regions or due to the influence of the tunnel on aquifers, which were sometimes situated quite far from the alignment.

3. HYDROLOGICAL IMPACT

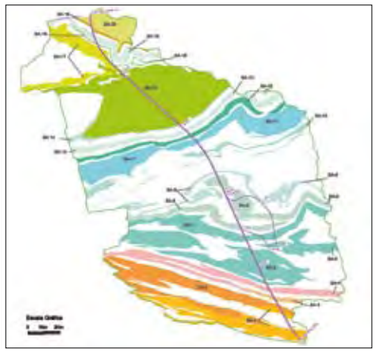
The hydrogeologic impact can be summarized as a general and dramatic drop in the groundwater level for all the aquifers crossed. The aquifers have sometimes been changed to flow towards the base of the tunnels, certain natural springs and outlets have reduced flow to the surface, including some which provide local towns with drinking water, and the reduction in flow of some rivers.
The experience gained throughout the whole project is something which can be used in the future, due to its complicated geological and hydrogeological structure. In the past, similar studies used to be based on the possible influence of groundwater on the construction of tunnels and possible difficulties during the project, rather than the effect of the tunnel on aquifers. However, the Pajares Tunnels have proven that more detailed studies are required for complicated projects. This hydrogeological study was one of the first, if not the first, such study in Spain with these characteristics. Adequate knowledge of the effect of water on tunnels and the impact those tunnels might have on the surrounding area can be gained with hydrogeologic studies. It would be interesting to include such a study in all tunneling projects, even if this is not the current regulation, especially in regions where the groundwater can refill the aquifers only very slowly and such considerable drops in the level of the water table might be caused. Hence, the impact of construction work can be evaluated beforehand.

East Tunnel groundwater systems (South-North)



HYDROGEOLOGICAL PROFILES OF THE TUNNELS

In the image above, one can see a profile of the path of the tunnel (blue line) as it cuts through the rock. In the study, up to 20 different groundwater systems were described, despite the fact that there are no large water resources in the area. This groundwater plays a very important role in the smaller towns throughout the region. The map to the right shows the 20 groundwater systems surrounding the Pajares Tunnels (the tunnel alignment is also shown).



2. CHEMISTRY OF WATER

What most stands out from the chemical tests on the groundwater is that the samples generally contained a very low composition of dissolved minerals. This is due to the extremely fast flow of the water underground, with minimal contact time (contact between the water and the rock). One exception which should be mentioned is a region with a high rate of dissolved sulphate (dry residue of 2 g/l) detected in one flowing well. The existence of this water, which attacks concrete, meant that archway structures made of sulphate-resistant concrete had to be used for some sections of the tunnel, something which had not been anticipated in the project.
The hydrochemical study concluded that the water with a high percentage of dissolved sulphate was due to the existence of a deep fracture which let sulphate-bearing water rise to the surface.

4. AUTOMATIC HYDROGEOLOGICAL CONTROL

The hydrogeologic control is intensified during the summer months and new studies are to be performed on the rivers and surface water. The installation of an automatic hydrogeologic control network inside the tunnels will allow the constant, precise flow of water taken from each aquifer system through which the tunnel passes, and the hydraulic pressure exerted on the tunnel to be established. A series of sections of the tunnel were equipped with instruments for making the measurements and controlling the groundwater level. The instruments can measure the exact water flow through the tunnels and therefore the level of water seepage; this information will be used to measure the water level around the tunnel. The control network, particularly that in the tunnels, will be necessary for the evaluation of the effectiveness of any future corrective measure aimed at alleviating problems.

Emergency measures to improve traffic

Transport plan for the Romagna region of Forli

Published in itransporte 7

The study, commissioned by the Forli (Italy) City Council, covers a detailed analysis of each mode of transport on offer, how they align with existing demand and forecasts traffic flows, both for passengers and freight. It also considers its evolution over time, taking account of immigration and birth rates.

This work, which was carried out by Ineco and the Italian companies Sintagma Metropolitana Milanese and Systematica, underlines the huge importance of integrating different transportation systems (rail, subways, road and sea) to serve a constantly developing population of more than 335,000 inhabitants with a high cultural level.

The objectives of improving traffic and local infrastructures include giving a boost to emerging industrial activity and helping improve citizens' quality of life within a framework of environmental protection, while enhancing its enormous cultural heritage. However, the work plan does not cover only the short and medium term (from 2012 to 2015), but also a more ambitious, longer-term timeframe in which the region, due to its geographically strategic position, becomes an essential stepping stone for connecting to the major trans-European routes through Venice and Modena.

This particular land configuration has meant that local authorities are seeking an integrated solution for all forms of transport between the cities, which are about 20-30 kilometers apart and with low population densities. In this context, accessibility and mobility are two decisive factors in increasing competitiveness. This is the case with sea transport at the Port of Ravenna, one of Italy's most important after Genoa, and a competitor to Trieste, Livorno and Venice.

At 14 kilometers long, with 18 terminals and major transportation and loading activity, Ravenna is a key hub for distributing construction materials and agricultural and metallurgical products to nearby regions. The heart of the port area is currently undergoing a major transformation. The preliminary draft plan to locate the nautical leisure district in this area was already presented and will attract a significant range of operators. In seeking a suitable strategic platform, the proposed multi-modal model looks line by line at the type of vehicle used (capacity, speed and consumption), infrastructures, times of day, waiting times, cost effectiveness and potential interactions.

A detailed public and private transportation network is being constructed, including pedestrian and bicycle options, with all their possible connections. ✱


Forlì train station.


Forlì Airport.


Port of Ravenna.

Some details of the transport plan

> FORLI AIRPORT

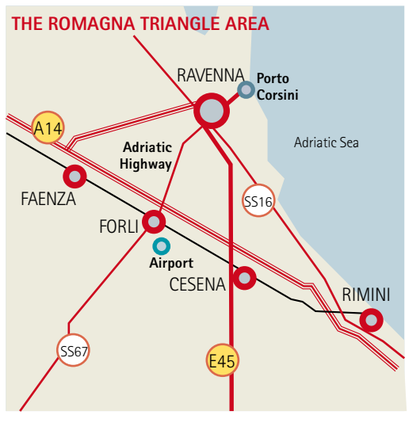
The Forli Airport, also known as Luigi Ridolfi Airport after a famous Italian aviator, is located 4 kilometers south of the historic city center and has undergone significant growth in recent years, partly due to the growth of low-cost airlines. The study raises the need to develop a common strategy with the other regional airports and establishes a series of medium and long-term commercial agreements with these companies, such as the Italian Windjet, the largest operator at the Forli Airport.

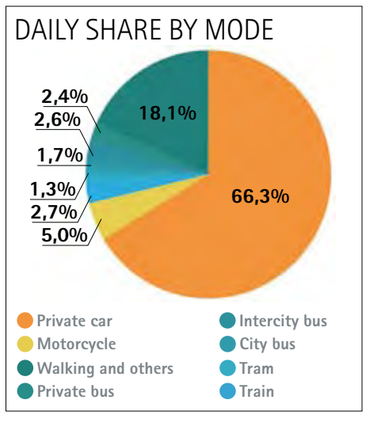
> REGIONAL ACCESS

While not directly affected by the European transport corridor, the Romagna triangle area (form by the cities of Forli, Cesena and Ravenna) has a high level of infrastructure density that is complex and specific, with much of it of national interest. In parallel with the development of the Trans-European Networks (TENs), this infrastructure is expected to take on an important role in connecting both the existing and planned major logistics centers within the network. The area studied is bounded by the crossroads of the infrastructures between the major road hubs of the A14 and the E45, together with the Emilia Highway and the highway link to Ravenna (in the direction of the A14). This analysis creates an access system that becomes a new multi-modal network connection element.

> PORT

For Ravenna, the transformation and regeneration of the city dock represents a decisive part of its urban planning, along with the capital's green belt.





AN AWARD-WINNING PROJECT

The project received the 'Urbanistica' Award from Italy's Department of Public Works under its S.I.S.TE.M.A (Sviluppo Integrato Sistemi Territoriali Multi Azione) scheme. Forli City Council's initiative was selected from almost 100 national projects that were put forward for the award, which was presented in Venice at the opening of Urbanpromo 2007. The event was attended by representatives from the Sintagma-Ineco-MM-Systematica joint venture, recognized for its work in designing the project along with members of Forli City Council who promoted the project.

Rabat, ticket to 2020

New urban transport Master Plan

Published in itransporte 20

The economic and social development of Rabat will not be possible without a transport service that the inhabitants of neighboring cities can access. Ineco conducted a study that offers mobility solutions and development opportunities in a rapidly growing region.

Ineco conducted an urban transport study in Morocco financed by the Spanish Government through the FEV (Fondo de Estudios de Viabilidad of the Fondo de Ayuda al Desarrollo) fund. The result is a strategic plan that offers a whole range of specific solutions to the overall problem of organizing and planning the transport system in the city.

The aim is to contribute to the economic and social development of a region where the majority of the population has no access to public transport. Rabat's aspiration to become a modern capital city that drives the country's economy cannot be achieved without the development of two neighboring cities, Salé and Temara. Together, they represent two thirds of the total population of the urban area.

The *Rabat-Salé-Temara Urban Area Transport and Traffic Master Plan* offers an integrated perspective of the region's transport, planning and socio-economic development. Its aim is to define interventions that adequately meet the population's mobility requirements taking a timeframe up to 2020. By then, the population is forecast to have grown from the current 1.9 million to 2.6 million. The study will therefore be used as a strategic planning tool, not just for defining the guidelines for the activities, but also for guiding the program of investments.

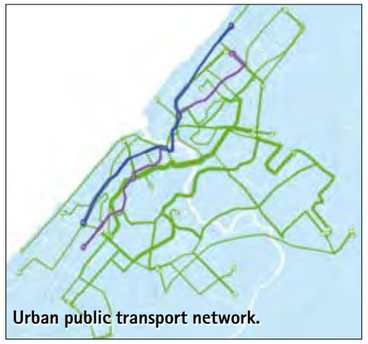
The study's extensive database and analysis of the current situation will enable future requirements and investments to be identified in terms of urban planning and transport, so that it effectively meets the economic, social and environmental development needs of the region, thus reducing social and territorial inequalities.

The major contrasts that exist between the more developed areas of Rabat and the marginality of the vast majority of the rest of the population means that, if the proposals put forward are to be successful, there needs to be a consensus among the different branches of Government and an awareness among authorities when considering priorities for projects. There is also a need to show that they act as catalysts for the local population's social, economic and human development. ✱

OBJECTIVES ACHIEVED

The specific objectives achieved in developing this study consist, on the one hand, in presenting proposals for creating an inter-modal public transport network: bus, subway, tram, suburban train, pedestrian areas, cycle lanes and so on. These include suggestions about how to plan and manage these modes of transport in order to improve economic and social returns. On the other hand, private transport management and traffic is handled with proposals for specific works to be carried out on the road network together with ideas for re-planning urban traffic and the availability of both public and private parking.

Rabat main train station.



Urban public transport network.

Expected load of the road network by 2020.

Basis of the plan developed by Ineco

The 'Rabat-Salé-Temara Urban Area Transport and Traffic Master Plan' is structured into 14 chapters and covers a total of 53 programs and 197 actions, with planned deadlines and appropriate budget estimates, for execution between 2009 and 2020. We highlight the following proposed activities:

SETTING UP A SINGLE TRANSPORT AUTHORITY FOR THE URBAN AREA _One single voice for making decisions is absolutely necessary.

LEGAL FRAMEWORK_Regulating the taxi industry, regulating freight distribution, applying environmental regulations.

CREATING AN INTEGRATED PUBLIC TRANSPORT NETWORK_Pedestrian network, bicycle network, urban and suburban bus network, tram network, light-rail subway line, metropolitan railway, transport interchanges, network of bus lanes, fare framework, creating public park-and-ride lots.

REGULATING PRIVATE VEHICLES_A road network adapted to future requirements; connecting Rabat and Salé in order to 'sew up the river breach that divides the two cities'; creating a hierarchy for the road system, working on the main intersections, introducing traffic-calming measures, '30 zones', specific traffic management program, regulating parking areas.

A total investment of 35.2 billion dirhams (around €3.2 billion) is planned for implementing the 14 programs. Of this, 11.5 billion is from private financing, 9.7 billion from public financing and 14 billion is from mixed financing. The viability of the proposals contained in the plan for an under-resourced population requiring this type of investment will depend essentially on the political will and courage of those in authority.

More than 6,000 household surveys

This plan is a highly valuable tool for strategic assessment and planning as it analyses a large quantity of data relating to the availability of transport infrastructures and services as well as demand for mobility. Local management organizations currently do not have this data, an essential tool for making an accurate assessment of existing transport problems and optimizing the relationship between resources invested and results achieved.

The main source of information for the study was the more than 6,000 household surveys conducted throughout the study area. This is the first time this work has been carried out in Rabat and it has generated some 300,000 items of data on urban mobility. Cordon surveys, screens and seating capacity on the bus network and at the main intersections were conducted, along with pedestrian and bicycle counts at various points.

The results of the different phases paint a picture of an unstructured urban area in terms of its public transport network and urban fabric, with authorities overlapping and those in charge suffering from a lack of integrated perspective.

A powerful tool

The study incorporates an essential tool for analyzing and planning the transport system. Using the EMME3 software package, a transport model was developed. Having established the forecast Origin/Destination matrices for 2020, different scenarios can be modeled and evaluated, both with regard to mobility behavior as well as transport infrastructures and services (the images above show different screenshots from the tool).

The study highlights the inadequacy of the system and waste in a region that has scarce access to public transport.

Can you spare a minute, please?

Ineco trains its fieldwork research teams

Published in itransporte 14

More than 7,000 home surveys in Morocco, 9,000 telephone surveys in Galicia (Spain) and nearly 200,000 annual personal interviews of Spanish airplane users are regular figures in demand research. This is basic and necessary work to develop planning studies and manage transport sectors.

Many consultancy studies –and some engineering studies– require quantitative research, focused mainly on obtaining better knowledge of the reality of the problem to be faced in developing them. They are generally measurements based on statistical inference theory, taken by direct observation and data collection or, most frequently, personal surveys. This research activity can be summarized along the following lines of action:

■ Capacity and other measurements: primarily aimed at detailed and precise knowledge of specific transport issues. Mobility and traffic and other issues are studied that are related to planning and management of all transportation modes, both passenger and goods, urban and interurban, etc.

■ Large-scale polls: execution of large-scale surveys and/or with complex methodologies. These include, for example, Home Surveys on Mobility (HSM) and stated preference surveys, among others.

■ Service quality: support for clients in different transportation sectors on service quality management, by assessing perception from the client/user viewpoint.

Other methods. Other types of measurement merit mention, which are aimed at analyzing somewhat more specific issues. Thus, an interesting study was performed about transit times in the baggage collection process in the new Terminal T4 at the Madrid-Barajas Airport.

Vehicular capacity studies are also frequent at intersections for analyzing road capacity and supporting traffic models. For the vehicular traffic study and in the framework of the Madrid-Northwest high-speed line study, vehicles were monitored by gathering license plates on video.

Without being objective or principle-based per se, the fact of performing these measurements with in-house resources and under the supervision and control of the same team performing the study, a multidisciplinary team has been comprised over time. This team is capable of tackling both studies with a set objective and fieldwork studies for supporting the execution of other studies, whether they are for consultancy or for other areas of the company. This team works in any city in Spain and is made up of specialists who receive specific training courses. ✱

WORKING SYSTEMS

Other methodologies are frequently used in the field of sociological research. Thus, focus groups are held for qualitative purposes in order to design questionnaire contents. A program is also being executed, called Mystery Shopping, to assess compliance with quality directives in Iberia passenger services.

New polling technology

Surveys by personal interviews (face-to-face) that were traditionally done using printed questionnaires are now being done with the help of pre-programmed mini-computers (CAPI system: Computer Assisted Personal Interviewing).

Although conventional methods are also employed for sending out questionnaires (post and fax), 'distance' surveys often use telephone interviews (CAT I System or Computer Assisted Telephone Interviewing) or e-mail. More recently, online surveys are performed, with the interviewee accessing the questionnaire via a link or personal hyperlink received via e-mail (CAWI System: Computer Assisted Web Interviewing).

Some projects

> MASTER TRANSPORT AND DRIVING PLAN

In the framework of executing the study for the so called 'Master Transport and Driving Plan for the Rabat-Salé-Témara Agglomeration' (Morocco), more than 7,000 Home Surveys on Mobility (HSM) were done via personal interviews in this metropolitan area (see pages 66-67). The survey questionnaires were also written in French and the Moroccan dialect of Arabic, and then conducted by a professional team of 150 interviewers, all of them residents of these Moroccan cities.

> COMPREHENSIVE TRANSPORT PLAN

As support in drawing up the study for the 'Comprehensive Transport Plan for Galicia' (PITGAL), a HSM was done using the CATI system in 9,000 homes in this autonomous region. To obtain this large sample size, over 80,000 contacts needed to be made and a total of 250,946 phone calls. The average conversation time to complete an HSM was 19 minutes. This represents 3,500 hours of telephone conversations (including surveys that were classified as invalid).

> MOBILITY IN AIR MODE

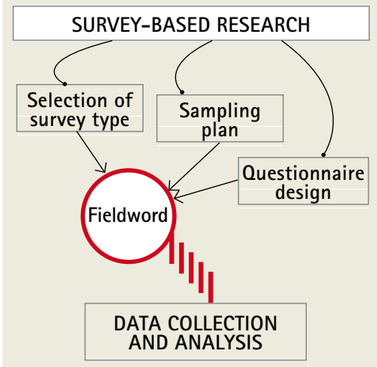
The EMMA (Mobility in Air Mode) survey has been conducted annually at all airports in the AENA network, using the CAPI system (some 90,000 surveys/year). Surveys were done at main airports in Spain.

> AENA AIRPORTS

Since 2002, different surveys for the AEQual study have been conducted at all Aena airports. Passengers were interviewed with print questionnaires and via the CAPI system (125,000 surveys/year) and airline agents via the CAWI system (700 surveys/year). The survey designs of Stated Preferences merit special mention that were programmed into the CAPI system. These results are used in analyzing modal competency. This methodology was applied, for example, in the market study and social-economic and financial profitability study for the Madrid-Northwest high-speed line and its effects on the conventional line.

> RENFE

Since 1990, yearly capacity campaigns have been done in Madrid Cercanías-Renfe hubs that mobilize a 600-strong regional team for several research days.



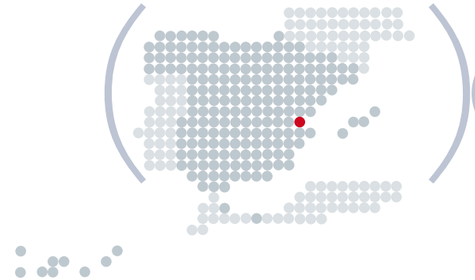
HOW IS A SURVEY CONDUCTED?

The outline to the left clarifies, in broad strokes, the execution process for research surveys. With regard to methods, different modes are employed depending on the planned objectives: location of the individuals to be interviewed, information to collect, sample size, research costs, etc.

Essential improvements to the port infrastructure

Works on the Port of Valencia

Published in itransporte 11



With the opening of a road traffic underpass below sea level, the Port of Valencia has substantially improved its communications, by connecting the northern area with the southern zone. Ineco's work on this project involved coordination and technical assistance.

Connecting north-south traffic forms part of the project Connection between Crossings for Inter-port Traffic and Reposition of the Berthing Line, put out to tender by the Port Authority of Valencia. This project, which ended in May 2009, arose out of the need to delimit the space for the Interior Harbor for the 2007 America's Cup and rerouting heavy traffic.

The rerouting and expansion of the berthing line between the East and West docks was completed in 2007, along with the extension of the existing passenger gangway to a new position, a traffic roundabout at the start of the root of the site, and cancellation and detouring of rail traffic across the metal drawbridge.

The new road traffic underpass was excavated as a watertight compound between screens of around 30-meter deep, anchored in a layer of clay and made up of two 150-meter-long ramps and a 240-meter covered area. A reinforced concrete bi-cellular drawer is positioned between both screens, with each tunnel or frame having a two-lane road. Once opened, this gave trucks direct access to the North and East docks, and separated heavy traffic from other vehicles coming into the passenger terminals.

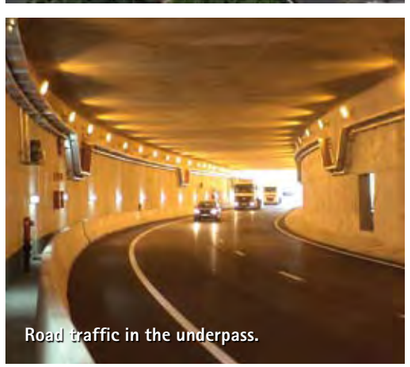
Ineco has also worked with the Port Authority of Valencia on the Extending the East Dock Project, providing technical assistance and coordination of health and safety. This work to extend the dock created an additional 20,000 m², which was used to free up parts of the area occupied at the time by the 2007 America's Cup. The area gained with the new East Dock is delimited by three stretches.

The first stretch involved extending the current dock to a length of 84.81 meters. The second segment, which runs perpendicular to the first, is 56.60-meter long. And from here, the third 184.66-meter stretch starts, in line with the west corner of the Scrapyard Dock (to be completed during a second phase, also involving Ineco), topped with a closing breakwater following on from the third section.

In calculating the bollards and guards, the design of the POST-PANAMAX container ship was considered (320-meter-long and 14.5-meter maximum draft). The structure of the dock is made up of three sections of light concrete casings, which have been strengthened on a bench consisting of an all-in-one core, with its base at -23 meters elevation. This entailed first dredging a thickness of about 7 meters of sandy clay.

Ineco's relationship with the Port Authority of Valencia came from its involvement in railway works within the port in 2004, when a new railroad access was constructed to free up the Valencia shore from the railroad infrastructures that crossed it. At the time, Ineco provided basic technical assistance for the project to adapt the rail network in the southern area to provide new access to the port. ✱

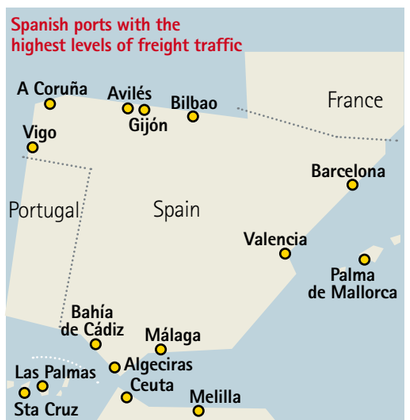
Traffic roundabout towards the underpass.



Road traffic in the underpass.

Valencia: a leader in container traffic

Spain is the EU country with the longest coastline (more than 8,000 kilometers). Its geographical position close to major ocean routes makes it a strategic country for international maritime transport and a logistics platform in Southern Europe. The state-owned Spanish ports and harbours system is made up of 44 ports of general interest, managed by 28 Port Authorities. In 2009, Spain's ports with the highest levels of freight traffic, according to Puertos del Estado (Spanish National Ports and Harbours Authority) were the following: Bay of Gibraltar (69.7 million tons), Barcelona (42.9 million tons), Valencia (57.7 million tons), Bilbao (32.18 million tons) and Tarragona (31.5 million tons). The Port of Valencia is the leader in terms of container traffic. Of the 11.7 million TEUs (one TEU represents the cargo capacity of a standard intermodal container, 6.1 meters long and 2.4 meters wide) recorded throughout Spanish ports in 2009, Valencia topped the list with 3.6 million, followed by the Bay of Gibraltar (3 million), Barcelona (1.8 million) and Las Palmas (1 million).

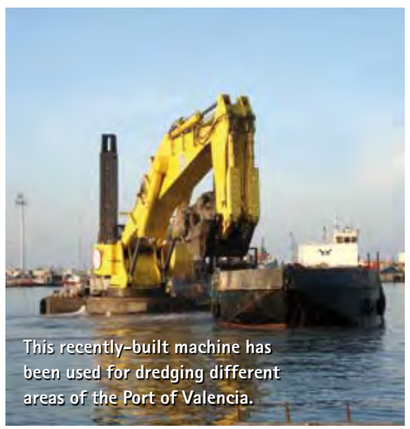


OUTSTANDING WORKS IN THE PORT OF VALENCIA

1_Expansion of the berthing line in the East Dock, which created an additional area of 20,000 m².
2_New entrance channel to the Interior Harbor for the 2007 America's Cup.
3_Interior Harbor for the 2007 America's Cup.
4_Príncipe Felipe's Dock and public container terminal.
5_Royal Sailing Club of Valencia.
6_Connection between crossings for inter-port traffic and reposition of the berthing line, a project ended in May 2009.

Expansion process

The Port of Valencia is currently going through an expansion process that will double its current size. It will involve the construction of a dam that will go 3.3 kilometers out to sea and will increase its surface area by 1,530,000 m², to add 301 hectares and surpass the Port of Hong Kong, the world leader in container traffic The port authorities have their sights set on 2015, when they aspire to become the main inter-modal logistics platform in the Mediterranean. More than 140 regular lines operate at the Port of Valencia.



This recently-built machine has been used for dredging different areas of the Port of Valencia.

Solutions for sustainable and efficient growth

Advanced approach and landing procedures

Published in itransporte 19

Airports suffer from ever greater capacity restrictions due to the increase in traffic. The European OPTIMAL Project, led by Airbus and with Ineco playing a leading role, proposes methods to improve operability in airport settings.

A high number of the largest international airports and hubs are now operating at maximum capacity for increasingly longer periods each day, with many of them even reaching their operating limits. Moreover, while aircraft have become less noisy and less contaminating in the last two decades, the increased number of movements in longer periods of the day and night have entailed increases both in disturbances to the population (particularly in terms of noise) and environmental impact.

For this reason, the use of many airports is highly-regulated by environmental policies and initiatives. Their aim is to limit these problems although, unfortunately, they often also restrict possible expansions to airport facilities and their operations. Forecasts reveal that this regulatory situation will extend over time to the entire ECAC (European Civil Aviation Conference) region. When it is applied, current traffic models may start to generate congestion in airports that, at present, do not have capacity problems.

In the future, the aforementioned environmental protection requirements are expected to become one of the most significant restrictions to traffic growth with respect to commercial aviation. If these restrictions are not managed suitably and in time, they could cause substantial local risk to sustainability, both with regard to airport expansion and traffic growth.

Processes and measures. At the request of ECAC transport ministries, EUROCONTROL (ATM) has developed the strategy for the years 2000+ (ATM2000+ Strategy), which describes the processes and measures that must be taken so that forecast demands can be met. Updated in 2003, this strategy fully coincides with the regional and global planning framework of ICAO's CNS/ATM. This means that airport capacity must be efficiently increased while respecting environmental sustainability and cost effectiveness, upholding or improving current security levels. To do so, the different players need to develop new advanced procedures, new operational concepts, new technologies and systems, both on-board and for assisting navigation and air traffic control systems.

With the aim of proposing and providing solutions and responding to future environmental regulations –particularly in terms of noise reduction, fuel consumption and emissions– and providing tools for all the parties participating in the different fields of air transport, the OPTIMAL (Optimised Procedures and Techniques for the IMprovement of Approach and Landing) Project was launched in 2004.

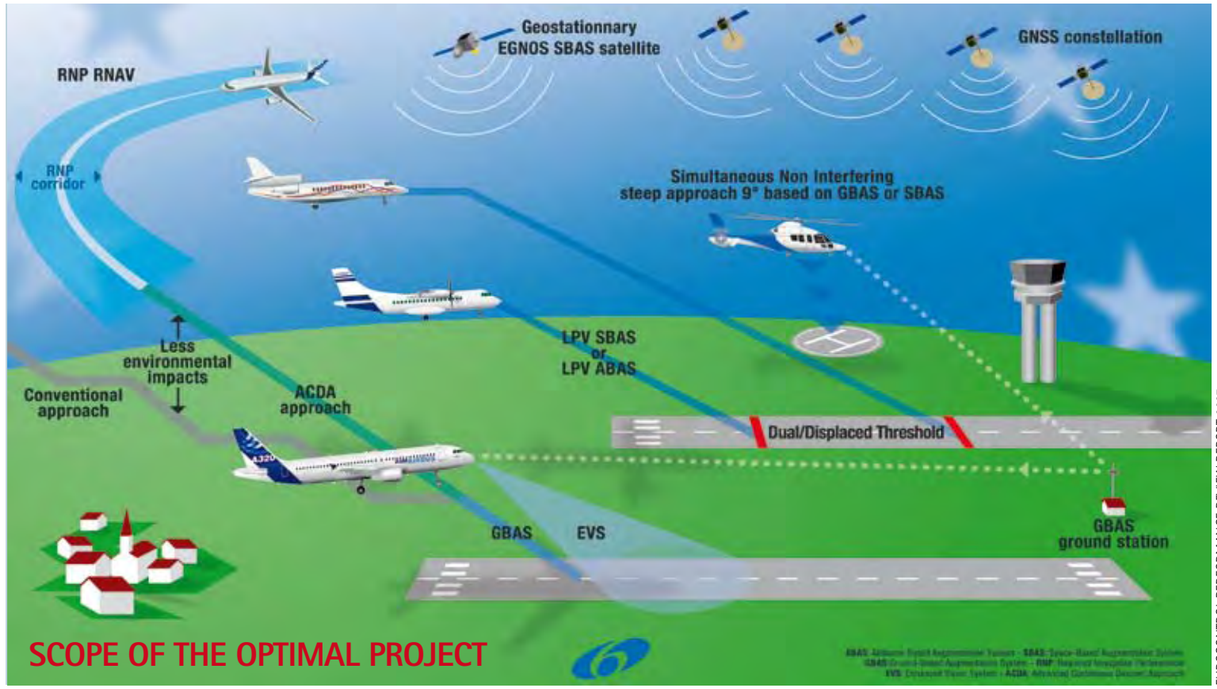
Ineco has played a leading role in OPTIMAL, actively participating and contributing in all its phases and coordinating one of the essential working packages for defining and developing new procedures for final approaches.

The goal is to attain the objectives set forth for the project of upholding or improving current security levels. In light of this, OPTIMAL

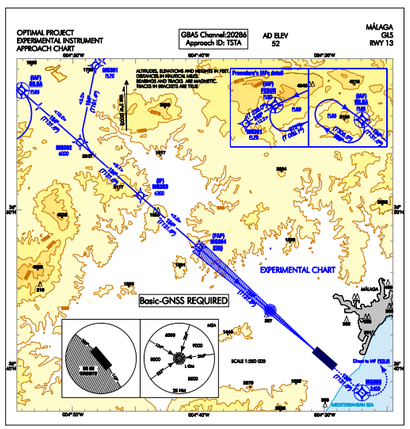
58-month planning period

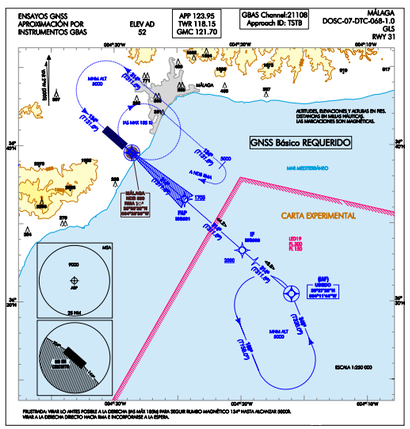
OPTIMAL was founded within the European Commission Sixth Framework Programme and has the aim of complying with the directives of the AT M2000+ Programme. It started in February 2004 and finished in December 2008. During these 58 months, OPTIMAL has covered the complete chain. The tasks ranged from defining operating concepts and the design, development and validation of completely new approach and landing procedures to the development of new functions that will allow these procedures to be managed, both on-board and for air traffic control and management systems. Within the scope of the project, a large number of flight simulations and tests were carried out in order to evaluate the operating capabilities and benefits of each procedure.

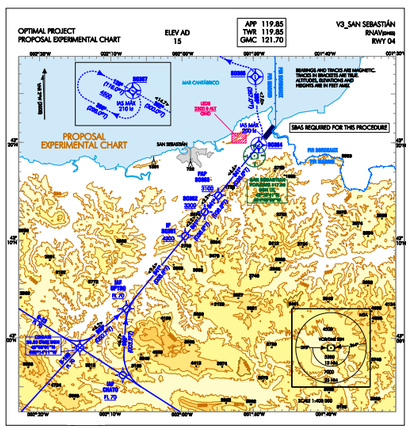
The lessons learned in OPTIMAL provide valuable information to other research projects in the field of air traffic management (ATM), such as SESAR, contributing to the achievement of its objectives in terms of increased capacity, reduced environmental impact, increased safety and improvement of the cost and efficiency of operations.



EUROCONTROL PERFORMANCE REVIEW REPORT 2007







SAMPLE CHARTS

The images to the left show some of the procedures analyzed in OPTIMAL. Specifically, here are several LPV and GBAS approach charts to the airports of San Sebastian and Malaga (Spain), designed by Ineco within the framework of the OPTIMAL Project.

Ineco has played a leading role in OPTIMAL, actively participating and contributing in all its phases, and coordinating one of the essential working packages.

➔ has proven that new procedures can be used that make the present precision navigation aids for approach and landing (ILS, MLS) more flexible. This can also be applied to new satellite-guided systems (GBAS, SBAS, ABAS), more precise navigation methods (RNP AR with RN P<0.3), improved on-board systems and improved ground functions to support air traffic control (ATC).

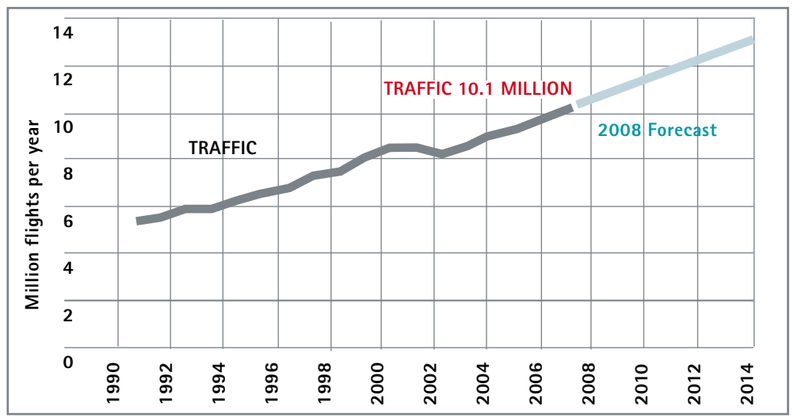
During project execution, the benefits obtained from new crew operating procedures (EVS) and flight operating procedures (A-CDA) were also proven beyond doubt. To mitigate operational restrictions (speed restrictions for faster aircraft, etc.) that are present in scenarios in which there is mixed air traffic comprised of fixed-wing aircraft and rotorcraft, the first project of its kind studied the behavior of IFR procedures for simultaneous approaches of both aircraft types (SNI).

The timeframe proposed for the operational implementation of the procedures developed in OPTIMAL is 2010+. Thus, it would contribute to reaching the objectives of increased airport capacity identified in ATM2000+ and in the ACARE Strategic Research Agenda. ✱

APPROACH BY EVS. Detail of the symbols used in the 'head-down display' during an approach executed in low-visibility environments.

Saturated skies

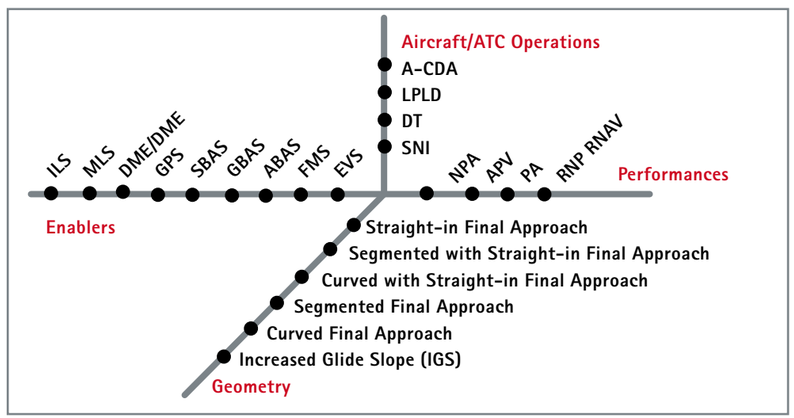
All forecasts show growing air-traffic trends in Europe in upcoming years. The largest airports already suffer from capacity restrictions, which translate into significant delays. At present, some 45% of AFTM delays originate in airports, causing frustration and difficulties, both for passengers and aircraft operators. The graph to the right depicts the evolution and forecast for increased air traffic included in the annual official statement entitled '2007 EUROCONTROL Performance Review Report'.



NEW ADVANCED PROCEDURES	4-AXIS GROUP	BENEFIT
Advanced Continuous Descent Approach (ACDA)	AIRCRAFT	Noise and emissions reduction
Dual / Displaced Threshold (DT)	OPERATIONS	Increased capacity, reducing separation due to turbulent slipstream
Enhanced Vision System (EVS)	ENABLERS	Improved visibility in approaches executed in low-visibility environments, providing a decrease in minimums for non-precision approaches
Localizer Performances Approach with vertical guidance based on SBAS or ABAS (LPV)	ENABLERS / PERFORMANCE	Increased safety on runways not equipped with LPV systems to aid in precision navigation Increased capacity and cost and environmental impact reductions during final approach
Ground Based Augmentation System precision approaches (GBAS)	ENABLERS	Increased capacity and cost reductions Improvement in efficiency and environmental impact
Required Navigation Performance Authorization	PERFORMANCE	Avoid sensitive noise areas, providing more precise guiding
Required approach (RNP AR)		Improvement in accessibility in an environment with obstacles Improved safety and capacity in complex airports at which simultaneous operations are executed or in environments where there are nearby airports
Microwave Landing System Approaches (MLS)	ENABLERS	Increase in capacity
Rotorcraft Simultaneous Non Interfering Instrument Flight Rules (SNI IFR)	OPERATIONS	Increased passenger capacity, letting helicopters land at airports with heavy traffic, using IFR procedures independently of fixed-wing aircraft traffic

PROCEDURES

There were many different procedures analyzed in OPTIMAL. The evaluation performed in the initial project phases led to classifying the procedures into four different groups: operations, performance, geometry and enablers. This classification is now known as the '4-axis' (see figure to the right).



Controlling our skies

Technology by Aena, a European pioneer

Published in itransporte 25

SACTA, an advanced Spanish air traffic control system, was implemented for the first time more than 20 years ago. Today it is used in all airfield control towers, all 'En-route' control centers (Area Control Center) and approach centers (Terminal Maneuvering Areas).

SACTA's (Automatic Air Traffic Control System) simultaneous implementation throughout Spain and its capacity to incorporate constant updates without interrupting operations has made the system a model and an example to be followed.

Since starting operations in 1990, SACTA has been updated 16 times (versions), in response to changes in traffic demands. New versions have included additional and advanced functions, new standards and means of avoiding technological obsolescence.

Ineco has worked with Aena (the public business entity for airports and air navigation) since 1998 on operational transition work for the system, as well as taking part in specification and testing activities. SACTA's role is to integrate, automate and improve air traffic control function processes and equipment to meet the objectives for increased capacity and safety required by users of air space. Having a single system for all control centers means that *En-route*, Terminal Maneuvering Areas (TMAs) and tower controllers have access to the same functionalities properly adapted to specific traffic characteristics. This applies to aircrafts that are cruising, climbing, descending, taking off and landing, as well as those moving on the ground.

Each SACTA version is designed in the setting of growing traffic demands and also to satisfy an increasingly-stringent European regulatory framework (Single European Sky) in which safety, standardization and interoperability are essential. The new functions and improvements included in the latest version (3.Z5) have been designed to be operational in two clearly different phases.

The first includes everything related to the architecture and technical aspects of the system, together with new features in the areas of processing and presenting radar monitor data

(periods of less than 2 seconds) and connection to new airside multilateration monitoring sensors (Wide Area Multilateration or WAM), as well as presenting these within control positions.

Another new feature is the change that enables full availability to be obtained for a different conflict alert function for *En-route* and air terminal environments, based on the traffic needs that they control. Improvements were also included in all horizontal areas of the system, such as dynamic simulation, system supervision, adaptation data and data processing.

The second phase involves putting into operation the additional functionalities of SACTA 3.Z5, grouped together under the name *Functional Configuration 2* (CF2). They have already been implemented at the Canary Islands Area Control Center (ACC) and implementation at the remaining ACCs was planned during 2010. This is one of the changes with the greatest impact for controllers in SACTA's history, given that it offers significant improvements and advances in terms of operating control positions. ✱

Testing room

The SACTA Experimental and Development Center (EDC) testing room at Aena headquarters in Madrid (Spain) has ATC servers, controller working positions and supervision positions. All testing prior to implementing each new system version is carried out here. Replicas can be created at the EDC, which are flexibly configured for testing the ACCs and TMAs in Madrid, Canary Islands, Palma de Mallorca, Barcelona, Seville and Valencia. This can be done for any airfield control tower in the country.

The transition to SACTA 3.Z5, a new version without interference

Final testing is done at the control centers in order to ensure successful implementation.

IMPLEMENTATION_Implementation of SACTA's operational transition to its new version 3.Z5 was done in the Canary Islands air navigation region. After verifying that it ran properly, it was then rolled out to mainland Spain and the Balearic Islands.

THE TRANSITION STRATEGY_It consists of three procedures: load testing, transition testing (roll back) and the transition procedure itself. Load testing checks the functioning of the system under conditions of maximum pressure in terms of the input interface (more than four times the peak load recorded in the previous year).

THE ROLLBACK TRANSITION TEST_After checking that the system works at the operational level it is rolled back to leave it in its original state, i.e. the old version. This is how the procedure is examined and how potential problems within the new version found during testing are fixed so that on transition day, two weeks later, process reliability is guaranteed. In order to provide support for these tests without affecting operational service, a significant improvement in transition testing was put into place. An environment parallel to the operational environment was set up at each center. It involved installing a replica of the control system on different, isolated equipment together with version 3.Z5. This was done without interfering either with the operational system or the control provided to aircraft via that system.

High-impact advances

NEW FLIGHT LABELING_Essentially, a label is the summary information about a flight that accompanies the presentation of the aircraft provided by the radar and viewed on the control position screen. This information has been considerably extended with 'Functional Configuration 2' (CF2), so that the controller has access to standard flight plan data without the need to look anywhere else but the screen.

OPERATING LEVELS_The way in which transfer flight levels can be planned, authorized and managed using labels has been redefined.

COORDINATION AND TRANSFER VIA THE SYSTEM_When an aircraft moves from a sector controlled by one controller to another sector, the conditions under which the transfer takes place need to be coordinated. CF2 incorporates new in-system silent coordination and message transfer. This increases the efficiency of the process and reduces the use of oral communication between controllers.

MANAGING HORIZONTAL, VERTICAL AND DIRECTIONAL SPEED RESTRICTIONS_New functionality for entering restrictions on the flight label via editable panels in the control towers and ACCs, through which the controller is able to modify the value of any of the restrictions associated with aircraft defined in the system.

ALERTS RELATING TO DANGEROUS AIRSPACE IN SPECIAL AREAS_An information field alerts controllers that an aircraft is close to prohibited or dangerous airspace.

Making the impossible become possible

High technology on the tracks

Published in itransporte 22

Due to the different track widths used on mainland Spain, gauge changers are essential if trains are to reach their destination. Ineco has worked jointly with Adif to develop a gauge changer that uses new technologies, providing maintenance services and maneuverability on high-speed lines. This article looks at the progress made with gauge changers throughout their history.

When high-speed lines started out, all new infrastructures were designed and built to international width. Spain has three types of railway gauge: *Iberian* (1,668 mm), *International* or UIC (1,435 mm) and narrow (1,000 mm). Thus, a mechanism was needed that would allow trains to travel on different gauges in order to reach their destinations. This flow across the networks is made possible thanks to gauge changing facilities.

Automatic gauge changers enable trains to transfer from *Iberian* gauge tracks to *International* gauge tracks, or vice versa. These systems work by varying the distance between the wheels without the axles or bogies having to be changed. This is done automatically, as the train passes through the facility.

As the train passes through the gauge changer, the weight is taken off the wheels of the train and the coach is supported on raised lateral tracks. Once the weight has been taken off the wheels, the bolts that prevent any lateral movement are released. As the train wheels roll, the tracks converge or diverge, moving the wheels to their new position. They are then re-locked. This whole series of operations are done automatically by mechanical drivers that the train encounters as it passes through the facility.

The first facilities are still used. Until 1992, there were only two facilities of this type in Spain, at the French border: Irún-Hendaya and Portbou-Cerbere. Both are still used today by the Talgo trains that connect Madrid to Paris and Barcelona to Montpellier, Paris, Milan and Zurich. After the first high-speed line opened between Madrid and Seville, gauge changers were installed in Madrid (1992), Cordoba (1992) and the Sevillian town of Majarabique (1993). The purpose of these was to allow trains to travel trouble-free on the Barcelona–Madrid–Seville, Madrid–Cordoba–Malaga–Algeciras and Madrid–Majarabique–Cadiz/Huelva lines.

This type of gauge changer can only be used by Spanish Talgo trains. In 2001, the state railway company Renfe purchased new trains from the Alstom-CAF consortium, using CAF variable-gauge technology fitted with Brava bogies.

Although similar to the technology used by Talgo trains, this new technology has significant differences that mean that it cannot be used on the same platform. For this reason Adif (Spain's railway infrastructures administrator), jointly developed a gauge changer with Ineco that would allow both Talgo and CAF changers to be used within the same pit. This minimized the use of space, shunting, track, electrification and so on, thus considerably reducing railway infrastructure construction and maintenance costs. ✱

Generational renovation

The technical features of today's trains and the difficulties in the international railway market have led Adif to work in close cooperation with Ineco to develop a new generation of gauge changers for passenger trains. These enable:

- **Trains based on Talgo and CAF technology to use the facility; in both cases, they can be towed or self-propelled.**
- **Incorporation of electric voltage and signaling system transition capability.**
- **Connection to the communications, management and remote control systems for the lines on which they are installed.**
- **Incorporation of the necessary safety systems for the new mechanisms and changer movement.**
- **The advantage of this type of changer is that, apart from the pit or unit, it can be moved from one place to another depending on how the lines are advancing or operational needs. This means that the changer stops being a fixed part of the railway infrastructure and becomes a moveable item based on requirements.**

INECO'S ROLE

Ineco provides maintenance and maneuverability services for gauge changers on high-speed lines. This includes any work required for ensuring the functioning of the facilities, such as cleaning or checking wear and tear of components.
Part of Ineco's commitment to continuous improvement is its computer application MACAVI, which enables the maintenance of all changers to be managed online while optimizing the use of materials and human resources at the facilities.
All of this provides customers with access to full information, thus speeding up decision-making if problems arise.

New dual changer system in Antequera

1_TRAIN CENTERING COUNTER RAIL

This ensures that when the train comes into the facility it is properly centered with regard to the track's axis.

2_SUPPORT GUIDES

These support the weight of the carriages as they pass through the changer.

3_BOLT RELEASE GUIDES

To ensure unbolting of gauge-changer mechanisms before change maneuvers take place and subsequent bolting before the wheels come back into contact with the track.

4_CENTERING BOLTS

To ensure that the platform does not move as the train passes through the facility.

5_LATERAL DISPLACEMENT GUIDES

These guides force the wheels to move to their new position as the train moves.

Numerous advantages

The dual changer system conforms to the two approved technologies: Talgo RD and CAF Brava. This means that use of space, track and electrification is minimized, while increasing reliability and offering higher traffic capacity, thus reducing waiting and maneuvering times.

TESTING ZONE

The image A (far right) shows the prototype collapsible dual gauge changer which started operating in 2001 as part of an experiment (on the Olmedo to Medina del Campo section of test track).

R&D | **SPAIN** | Innovative systems

Virtual tunnel, real life

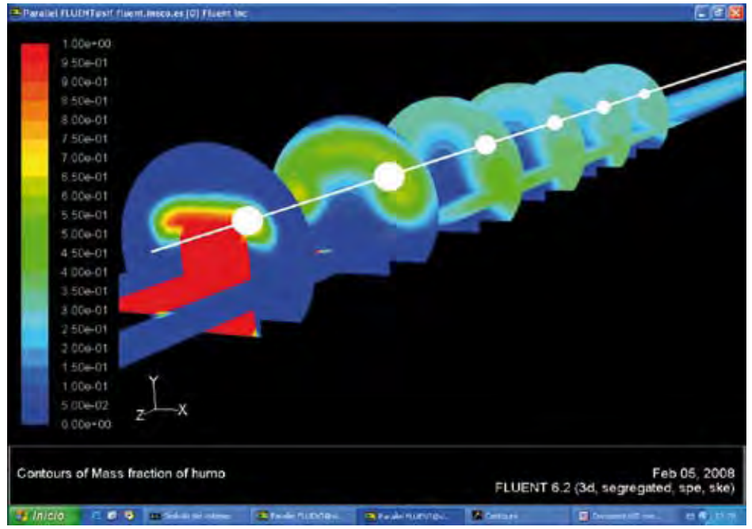
Increased safety with 3D simulators

Published in itransporte 21

R&D

Simulation

Ineco has developed an innovative system that takes into account different critical factors in the event of an accident, recreating real-life scenarios in the tunnel, and enabling safety conditions to be improved.



Passenger safety is an essential factor in designing and operating railway infrastructures. A fire on a train in a tunnel is the incident that presents the greatest challenges in terms of evacuation and getting passengers to safety.

Knowing the exact evacuation time required is essential for optimizing the design of the facilities and defining the actions that must be followed. Given that the amount of time depends on a variety of factors (infrastructure, type of train, characteristics of the fire, number of people, and so on), a comprehensive approach must be taken to tackling the problem in order to obtain optimal results.

As part of its R&D program, Ineco has developed a study methodology that combines all these factors by generating real-life scenarios and using specific simulators. Thanks to this system, the use of facilities can be optimized and those that improve safety can be defined, with the pertinent cost-benefit analysis.

Given that tunnel safety is directly related to the facilities with which it is equipped, these will ideally be decided upon in the design phase given that this stage represents the least technical and financial disruption in implementing them. In the case of tunnels that have already been built, the safety plan needs to consider the facilities so that each and every one of the actions to be carried out in the event of an incident is the most appropriate. With this method, the problem is tackled by integrating the dynamics of the fire, 3D scenario modeling and human behavior simulators, along with the infrastructures and protocols for actions in the event of an incident.

Maximum safety levels. When designing new tunnels, full details of the facilities required are carefully defined in order to achieve maximum safety levels: optimum distance between emergency exits, ventilation system performance and optimal course of action, as well as the state and condition of evacuation routes. This ensures maximum safety while achieving a compromise in terms of financial factors.

For example, for each specific tunnel, depending on its operating conditions, there will be a maximum distance between emergency exits, which will optimize evacuation time. However, while reducing this distance might not necessarily provide an advantage from a safety viewpoint, it may involve an increase in the overall cost of the project. ✱

HARMONIZING VALUES

In order to harmonize technical and administrative requirements, European regulations establish general minimum safety values for all tunnels in the European Union. Ineco's design goes further: it calculates the optimum safety values in each tunnel. When designing new tunnels, the most important activities, and those that involve the greatest planned investment, are as follows: building emergency exits (34%); ventilation, fire detection and fire extinguishing systems (18%); adapting the structure and drainage (14%), and lighting, control facilities and signaling.

SUSTAINABILITY | **SPAIN** | Environmental protection

The lynx freeway

The new A-32 freeway will incorporate 24 special passageways

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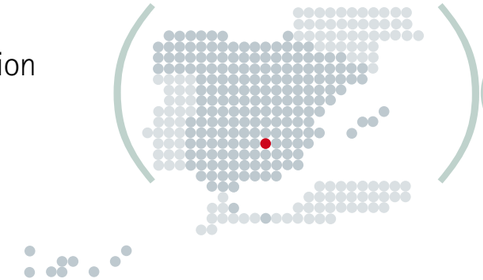

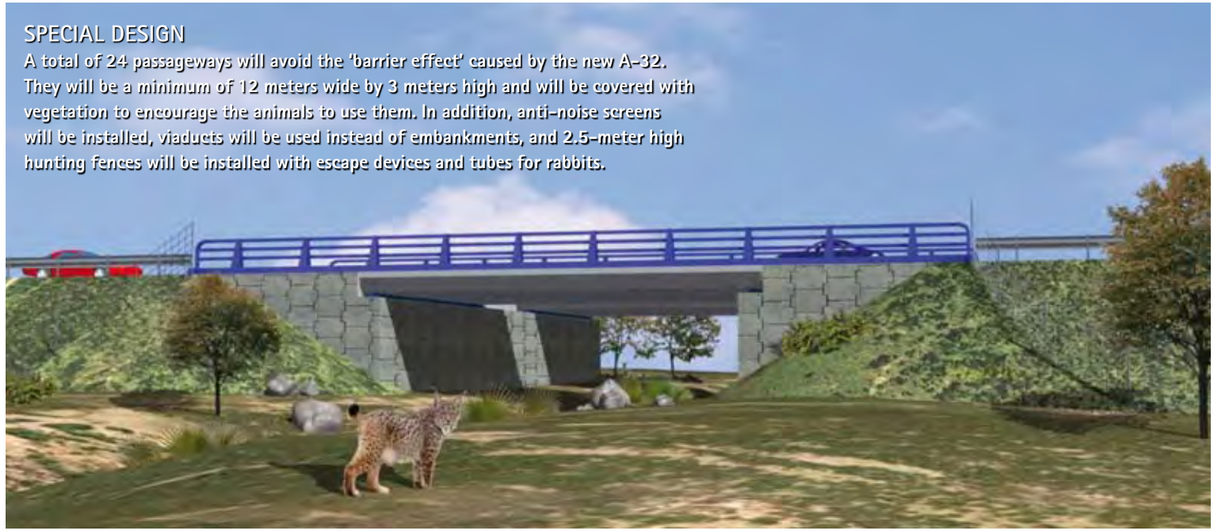

To build an infrastructure to connect Andalusia to Levante while minimizing the impact on the only wild population of Iberian lynx: this is the challenge resolved by the new Linares–Albacete freeway. The Spanish Ministry of Development will invest €8 million to protect the world's most threatened cat.

Combining the need for infrastructures with protecting the environment is a complex task that requires a lot of effort. If the survival of a unique species is at risk, as is the case with the Iberian lynx, then environmental measures are even more important.

As part of the new Linares–Albacete A-32, the Spanish Ministry of Development announced in 2009 an investment of €8 million to protect the Iberian lynx, whose territory crosses through 32 kilometers of the 225-kilometer freeway. The new road will connect Andalusia to the Levante. Ineco's work on the project involves managing and monitoring the works on the second stretch (Ibros–Úbeda) which, together with the first stretch (Linares–Ibros), records the highest density of traffic (10,500 vehicles a day). The current route was selected because it has the least environmental impact.

According to the Environmental Impact Statement (EIS) approved in 2006, the unused tracks will not go to waste as they will become part of a rural road. The EIS also establishes specific measures for protecting the imperial eagle. These include using only the road to access the site and a ban on locating landfills, earth stockpiles or ancillary facilities outside the site. ✱

Keys to survival

The Iberian lynx is the only cat in the world that is at critical risk of extinction. It is endemic to the Iberian Peninsula, where there are only around 200 specimens remaining. The conservation and recovery of this species is based partly on breeding programs in captivity with a view to reintroducing them into the natural environment, and partly on conserving their habitat.

Avoiding the 'barrier effect' caused by major infrastructures is essential to preventing lynx populations from becoming isolated and therefore in-bred which, in turn, leads to deterioration in genetic diversity and, ultimately, the extinction of the species. According to the assessment report on the lynx for the Natura 2000 network, the EIS for the new freeway shows that being hit by automobiles is an important cause of death among lynxes and, for this reason, there will be 24 passageways specially designed for them.

Looking at society

Ineco's social commitment

Ineco is a company that reports to the Spanish Ministry of Development. Its shareholders are public companies responsible for the complex management of Spain's transport systems.

Ineco's quality commitment extends not only to technical performance, but also to the whole society. The company aims to contribute to societal growth by developing its corporate policies: supporting solutions for clients and employees, collaborating with non-profit organizations (NPOs) and by promoting technical and scientific debate through initiatives such as Aula Carlos Roa, a forum comprised of a multidisciplinary group of transport and engineering experts.

In the NPO field, there are several outstanding collaboration agreements that merit mention, such as those signed with Engineers without Borders (ISF), Intermón Oxfam and the Spanish Red Cross. Ineco has also worked with other non-governmental organizations (NGOs), such as Aldeas Infantiles, the Niemann Pick Foundation and the Apsuria Foundation, which assist disabled and unprivileged groups. Furthermore, the company supports the Lealtad Foundation in its work to promote social action and build trust in Spanish society towards NGOs. ✱

Ineco's headquarters in Madrid (Spain).

Campaign for Haiti and other actions

INECO WITH HAITI_In February 2010, the company and its employees donated close to €78.000 to the Spanish Red Cross for Haiti's earthquake victims. In 2009, Ineco signed a collaboration agreement with this NGO.

EURO SOLIDARITY CAMPAIGN_Through the 'Euro Solidarity Campaign' that Ineco rolled out for the first time in 2009, employees can make a monetary contribution, deducted directly from their salaries, to an annual solidarity project. The funds donated are tallied up by the company. In 2010, the donations were allocated to Doctors Without Borders.

OPERACIÓN KILO-FOOD BANK_In collaboration with the Madrid Food Bank, in 2009 and 2010 the company organized food collection campaigns in its main buildings in Madrid, named 'Operation KILO', for its distribution to underprivileged groups through food banks for the homeless, food programs, etc.

AWARDS AND RECOGNITION

A GOOD PLACE TO WORK

For the third consecutive year, Ineco received a 2010 Spain Top Employers award from the CRF Institute. Top Employer promotes companies that genuinely excel, providing their employees with the best benefits and quality of life (see picture to the right).

EQUALITY FOR EVERYONE

The company has specific programs (Plan de Igualdad and Plan Integra) to promote gender equality among employees, to manage integration of diversity and the disabled, to maintain a healthy work-life balance and to prevent sexual harassment.

EUROPEAN BUSINESS AWARDS

Ineco has been chosen as one of Spain's 25 national representatives by the prestigious European Business Awards, which recognize and promote excellence, good practices and business innovation within the EU.

ACTIVE COLLABORATION

The company actively collaborates with the Spanish NGO Engineering Without Borders (ISF) in the development of various projects in Africa and Latin America. In the image above, drinking water in Mozambique supplied by Engineering Without Borders, with the support of Ineco.

COURTESY OF ISF

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