

# 47

JANUARY 2013

### INTERVIEW

**Pablo Vázquez,**  
president of Ineco:  
“Our engineering  
firm is global”

### SAFETY INSTALLATIONS IN TUNNELS

**With a seal of approval**

### ODESSA AIRPORT

**Odessa, on an  
international scale**

### MADRID-LEVANTE LINE

**Alicante, the AVE's next  
destination**

### THE OLIVAR HIGHWAY

**Crossing the Víboras river**

### BRAND SPAIN

**Biotechnology, more  
alive than ever**



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## Editorial



The recent cooperation agreement on transport, logistics and infrastructure signed by the Governments of Spain and Brazil is an opportunity for increased participation by Spanish engineering and construction firms in the expansion and modernisation of Brazilian ports, railways and roads. This is excellent news, allowing us to continue contributing to the economic and social development of this great country –culturally, geographically and economically– in which Ineco has already been working for 22 years.

**Within the framework of this agreement**, our company will collaborate with the Brazilian state-owned company EPL, responsible for planning and logistics of its large infrastructure. The agreement we have reached for technological cooperation, technology transfer and preparation of joint studies and projects will lay the grounds for a promising partnership.

**In addition to this collaboration are** the economic cooperation agreements signed between Spain and India a few months ago, the agreement signed by Ineco with the Andean Development Corporation (Corporación Andina de Fomento, CAF) to support the sustainable development of Latin American nations, or the agreement reached with Banobras in Mexico for developing its roads.

**In this edition we discuss some of our more** recent activities, such as that resulting from our collaboration on the Atlantic side of the high-speed railway line between Spain and France. We also consider other work beyond our borders, such as in Odessa, Kosovo and Mexico. We hope these projects and news will please and interest our friends and readers.

**Javier de Cos**

Managing Director  
Business Development





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COVER IMAGE: Pajares high speed tunnel.  
By Pablo Neustadt, 2009.



Spain | Andalusia



Inauguration of a stretch of highway A-32

The minister of Public Works, Ana Pastor, inaugurated last 5 December the 15 kilometres stretch between the towns of Ibroos and Ubeda, in the province of Jaén. It is part of highway A-32, which has a length of 225 kilometres, and is one of the stretches with the highest traffic density: about 10,500 vehicles per day, particularly during the olive harvest season (see *itransporte* 21).

Ineco has provided technical assistance for supervising and monitoring the works which, in addition to the construction of the actual road, which has two carriageways with two lanes in each direction, included a viaduct 168 metres in length, two links, the execution of over 70 drainage works and the replacement of 52 affected services, particularly for electrical supply and olive grove irrigation systems.«

The image shows Ineco’s team from left to right: Francisco Gimeno, José María Carrasco, José Isidro Díaz and Rafael Aguilar.

Ecuador



The president of Ecuador, Rafael Correa (centre) with the Ineco’s team in charge of the Plan: from left to right, Óscar Díaz-Pinés, Ángel Galán and Javier Gómez.

STRATEGIC MOBILITY PLAN  
Ineco presents the SMP to the president of Ecuador

The final document of the Strategic Mobility Plan (SMP) for the country, which has been under development since 2011, was presented to the president of Ecuador, Rafael Correa. The plan includes proposals regarding ports, airports, railways, roads and public transport, as well as intermodal connections. It also includes a financing study and the Plan budget. The object

is to plan an integral transport system to interconnect the entire territory and determine how to use the natural linkage routes, such as Amazonian river routes or maritime routes in the Pacific. President Correa informed the public of the document prepared by Ineco in his weekly live programme broadcast on 15 December.«

**Road training for transport technical staff**  
Ineco conducted two technical training workshops for employees of the country’s Ministry of Transport and Public Works. The transfer of technology and know-how is included in the contract for the road concession between Santo Domingo and Esmeraldas that is being carried out by the company (see *itransporte* 46). The training was divided into two blocks, on one economic-financial models and another on design, conservation and operation of high-capacity roads.

World summit on air navigation in Madrid

Ineco will be present as an exhibitor (stand 845), together with Aena and Senasa, in the World Congress of CANSO, the Civil Air Navigation Services Organisation, to be held for the first time in the convention centre in the Spanish capital from 12 to 14 February. The ATCA (Air Traffic Control Association) is

organising this Congress jointly with CANSO, with whom Ineco formed an alliance one year ago after obtaining certifications as an AFIS and ATC services provider. Over 70 public and private entities in charge of controlling 85% of world air traffic are expected at the event. Large suppliers of the aeronautical industry such as Boeing or Airbus will also be present.



Brazil

GOVERNMENT COLLABORATION COMMITMENT  
Transport cooperation agreements

Ineco has signed a technical cooperation agreement with the Brazilian firm EPL (Planning and Logistics Company) within the framework of a joint collaboration commitment agreed between the two countries’ ministries of Public Works.

Ineco and EPL will develop a general strategy for the implementation of high speed rail that will start with the line

Rio de Janeiro-São Paulo-Campinas (510 kilometres), which the Brazilian government plans to grant by public tender in late 2013.

The agreement includes the exchange of information, staff training and preparation of joint projects and studies, as well as strategies for promoting the infrastructures and different transportation modes.«



Panama

Ana Pastor held a meeting with president Martinelli



Accompanied by the president of Ineco, Pablo Vázquez, and the Spanish ambassador, Jesús Silva, the minister of Public Works, Ana Pastor, held a meeting with the president of Panama, Ricardo Martinelli. In this meeting the minister offered the collaboration and experience of Spanish companies for the infrastructure and transport projects currently underway in the country.

Ana Pastor also visited the Panama Canal enlargement works and line 1 of the underground train of the capital, in which large Spanish companies are participating.«

El Salvador

The airport plans its business strategy with a view to raising revenue

Ineco has been preparing since November the business spaces policy for the international airport of the capital of El Salvador, which handles 1.8 million passengers yearly. This project includes a proposal for redesigning the business



areas and establishments, products, granting operating licenses, etc.

The main goal is to maximise business revenue in both the passenger and cargo areas and in areas adjacent to the airport, which is managed by the state-run agency CEPA (Autonomous Port Executive Commission of El Salvador).«



## News

### Spain | France



### Inauguration of the AVE Barcelona-Figueras

The entry into service of these 132 kilometres completes the direct high speed rail connection for passenger transportation between Spain and France. The execution of this link, in which Ineco has participated, reduces the travel time from Barcelona to Girona to 37 minutes, and from Madrid to Girona, to 3 hours and 32 minutes. Direct routes to Paris will be available as of this spring. Ineco has collaborated with Adif since 2001 in the execution of this stretch.»

### Satellite navigation

Ineco will collaborate in the implementation in the next three years of the satellite navigation system for North-African countries as part of the EUROMED GNSS II project. With this initiative the European Commission intends to increase the use of the system in Morocco, Algeria, Tunisia, Libya and Egypt, as well as in Jordan, Israel, Palestine, Syria and Lebanon.



### The Tenerife Tram enables card payment

The new service allows purchasing tickets in the ticket vending machines installed in all stations using debit or credit cards. Travellers will thereby gain in "comfort and speed", as the company Metropolitano de Tenerife (MTSA) explains. Ineco, together with another two companies, holds a share in the stock of this company via the company Tenemetro, which owns 14%. The rest is owned by the Tenerife Council (80%) and Caja Canarias (6%).

### Kuwait



PHOTO: PRESS OFFICE OF THE MADRID-BARAJAS AIRPORT

### MEETINGS WITH THE MINISTRY OF PUBLIC WORKS, INECO AND ICEX Visit by the Kuwaiti Ministry of Public Works and Civil Aviation

The minister of Public Works, Ana Pastor, received in December a delegation from the Kuwaiti Ministry of Public Works, headed by under-secretary Abdulaziz A. Alkhulaib (second from the left in the photo below). This delegation was accompanied by another from the Directorate General for Civil Aviation (DGCA) of Kuwait, led by the assistant general director for Planning and Projects, Khaled Al-Shayji, and by Adel Al-Qaoud, president of the committee in charge of the construction of the new Kuwait International Airport terminal, in which Ineco is participating.

Both delegations visited the company headquarters and the ICEX (Spanish Institute of Foreign Trade).

The delegation of the DGCA visited the airports of Madrid and Barcelona, accompanied by representatives of the airports, as well as of Ineco (see photo). In addition, the Public Works delegation held a meeting with SEOPAN, the Spanish construction companies association.»

### Ineco's works in Kuwait

Ineco is in charge of the project management of Kuwait International Airport (KIA) expansion plan as well as the preparation of the Master Plan, together with the consultancy firm Kuwait United Development (KUD). It is also providing consultancy work and technical assistance in the construction of the industrial area of Shadadiya.

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at stand 845



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12-14 February 2013 Madrid, Spain [www.worldatmcongress.org](http://www.worldatmcongress.org)

Register at [www.worldatmcongress.org/Register](http://www.worldatmcongress.org/Register)



# With a seal of approval

## Ineco’s extensive experience in tunnel safety

By **Alberto Rodríguez**, industrial engineer (Area of Material and Technology)

**Ineco has 14 years’ experience in working to improve safety in tunnels. The company carries out all kinds of projects and studies related to safety installations in both road and rail tunnels.**

**A**ccidents in tunnels are particularly critical from the safety standpoint, irrespective of the circumstances of the incident, because they are in an enclosed area. An example of this is the incident that occurred on 27 October, in which an engineer and a technician died in a fire that occurred in one of the bypass galleries connecting the two tunnels of the Madrid M-30.

The fire ignited in the room where the battery backup system for the tunnel lighting is kept. Excess energy during the charging process or a simple defect in the casing could have led to the escape of hydrogen, produced in the chemical reaction occurring when the temperature rose. This gas, highly flammable, and the right proportion of oxygen and a spark could have caused the tragic accident.

A gas detection system (hydrogen in this case) and proper ventilation of the enclosure may be sufficient to minimise the risk of such accidents. At any rate, a notice on the door to the battery room should alert staff to the possible presence of flammable gas.

### Deficiency reports

In 2009, the European Tunnel Assessment Programme (EuroTAP), after extensive inspection work in 26 tunnels in Europe, established that 40% of these



**FIRE DRILL**  
A firefighting crew handles a fire drill inside a tunnel.

The most modern and reliable protection systems to date were installed in the Guadarrama tunnel. It is a shining example in terms of tunnel security.

constructions were deficient in oxygen supply. The report, drawn up with the collaboration of RACE, complained that a high percentage of the facilities were not equipped with sufficient breathing apparatuses or the oxygen bottles needed in case of fire. The same study reveals a surprising fact: drivers do not know how to act in an emergency. The human factor is decisive and, in this sense, providing travellers with information before they use a tunnel, training of on-board personnel in the case of railway tunnels, or the existence of public address systems are all essential.

### Requirements of European law

In recent years, at the European level, sensitivity to safety in both road and rail tunnels has burgeoned. Society’s widespread awareness of this issue has meant the matter is being reviewed internationally. Regarding railway tunnels in Spain, Adif enforces the safety requirements requested by the Technical Specification

*In 2009, EuroTAP, after extensive inspection work in 26 tunnels in Europe, established that 40% of these constructions were deficient in oxygen supply*

for Interoperability (TSI), as well as those included in the Technical Safety Guide, generally even more demanding than the TSI. In addition, Royal Decree 393/2007 provides that railway tunnels over 1,000 metres in length must have a Safety Plan, a document that Ineco draws up for the»



Due to the many types of incidents that may occur, every effort to minimise human error will improve safety during a possible evacuation

tunnels built on the new high speed lines. With regard to road tunnels, both Directive 2004/54/EC of the European Parliament, and Royal Decree 635/2006, establish the necessary safety measures to protect tunnels on the road network.

Safety regulations

Each new tunnel built is unique. Adapting safety regulations for tunnels requires a study process to identify which facilities are needed to ensure safety. The first step is to conduct a risk analysis to determine the possible factors that could cause safety threats, considering the characteristics of the tunnel being analysed (construction and operation). Among the risks studied are collisions, derailments, fires, explosions, toxic gas emissions and spontaneous evacuation due to vehicle failure. Having identified the risks, prevention and mitigation strategies, as well as rescue and evacuation measures, are designed.

Among the risks analysed are collisions, fires, explosions, derailments, toxic gas emissions and breakdowns

Following the risk assessment, the security facilities needed to mitigate them as far as possible are identified. Each safety facility has its function, although at first sight it may appear that they are independent systems, they must work in a coordinated manner to improve overall tunnel safety.



Pajares tunnel exit in Buiza, Leon.



Emergency drill.



Pressurization system tests in the Guadarrama tunnel.



Signal in the Sagrera tunnel, Barcelona.



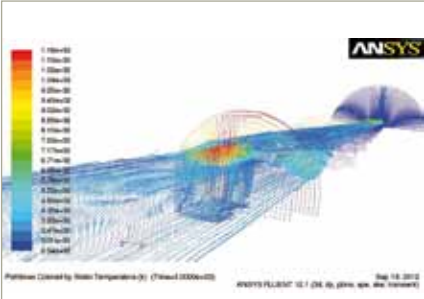
Atocha-Chamartín tunnel, Madrid.



Inspections in the installation phase of the Guadarrama transformer centres.

Main safety facilities

→VENTILATION SYSTEM  
This is used in fire emergency situations or if ventilation is required to maintain healthy conditions. Simulation tools based on CFD (Computational Fluid Dynamics) are used for sizing and studying the behaviour of air currents and smoke inside a tunnel.



→FIRE DETECTION  
This is the system responsible for detecting rapid temperature increases. It uses a sensor wire along the tunnel length and also monitors the ventilation system. The system is also installed in the equipment rooms.

→LIGHTING SYSTEM  
In an emergency or evacuation, this system facilitates an exit to safe areas: galleries leading to a tunnel where there is no risk, or to the outside.

→VIDEO SURVEILLANCE SYSTEM  
These are CCTV systems to observe what is happening in the tunnel.

→EMERGENCY RADIO COMMUNICATIONS SYSTEMS  
These are highly available communications networks that facilitate coordination between emergency personnel, firefighters and civil defence staff who intervene in an incident.

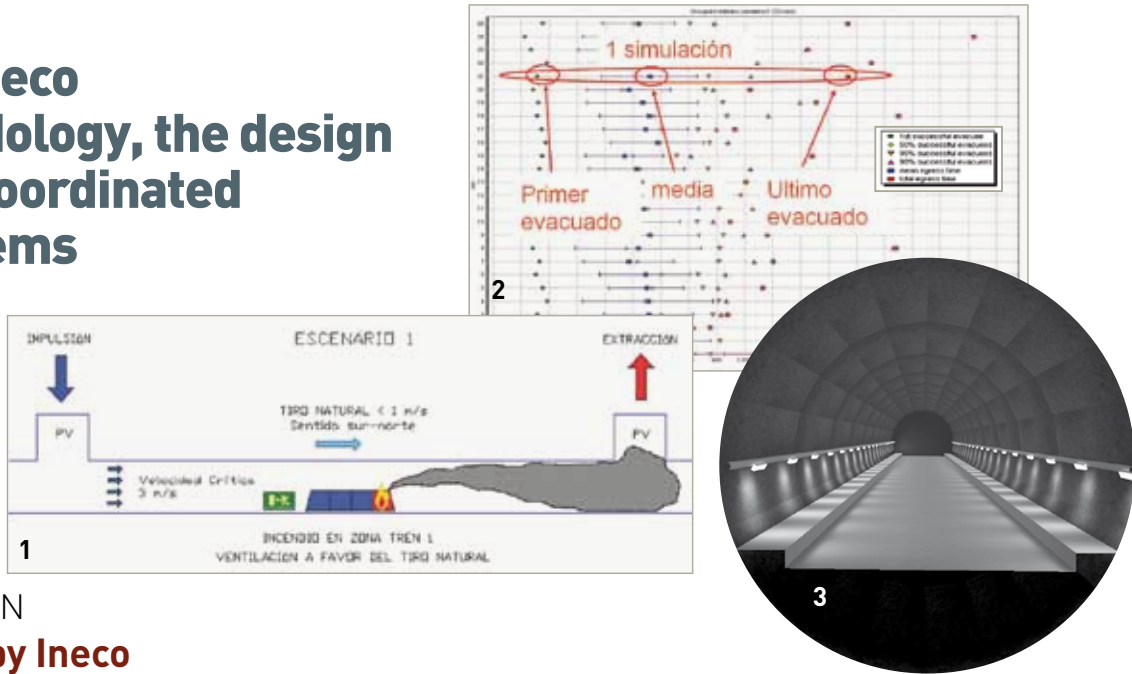
→FIRE PREVENTION SYSTEM  
These are facilities for mitigating the effects of a fire inside a tunnel. The hydrants, fire cabinets and equipment room fire extinguishing systems are part of this protection system.

→AIR QUALITY MEASUREMENT SYSTEM  
This system comprises gas sensors strategically placed in the tunnel to monitor air conditions in real-time. It detects noxious gases from internal combustion engines, particulate matter and CO (carbon monoxide). These sensors are also used to activate the health ventilation and air renewal modes inside the tunnel.

→POWER SUPPLY  
All safety facilities require a power supply to operate. Because these are safety systems, they need backup systems to ensure operation in case of power failure or to increase availability in emergencies.



# To improve safety, Ineco optimises its methodology, the design of facilities and the coordinated operation of all systems



## HIGH SPEED TUNNELS IN SPAIN Types of work carried out by Ineco

### Design of tunnel facilities

Design of the safety facilities in railway and road tunnels.

### Ventilation studies (photo 1)

System optimisation through simulations, saving on installation costs and energy consumption. Studies of load loss in ventilation shafts and design improvements, establishment of proper fan operation, designing of ventilation strategies taking environmental factors and external conditions into account. Calculation of time available for a safe evacuation.

### Evacuation studies (photo 2)

Modelling of trains and tunnels, with computer simulations of the time required for all passengers leave the train and reach a safe area. Evacuations are simulated taking into account environmental conditions resulting from the CFD analyses: temperature, visibility and air quality. The ventilation system must guarantee this minimum time under ambient conditions acceptable to humans.

### Lighting studies (photo 3)

To determine the best lighting system from the standpoints of safety and energy efficiency.

### Control centre design

All safety facilities are monitored from safety and civil defence control centres. These computer applications, which are designed to synchronously control all facilities, implement algorithms and important automated safety systems.

### Distributed control centre design

All tunnel systems have multiple control

signals distributed among equipment rooms and buildings. This system is responsible for collecting and centralising all the information needed.

### Technical assistance for installation and commissioning

Technical assistance during field installation, partial testing and commissioning after each installation and of the whole.«

## Some of Ineco’s most important jobs

### ■ Pajares (Asturias)

Double tunnel of 25 km

### ■ Guadarrama (Madrid)

Double tunnel of 29 km

### ■ San Pedro (Segovia)

Double tunnel of 8.5 km

### ■ Atocha-Chamartín

(Madrid capital)

Monotube double track of 7 km

### ■ Sants-Sagrera

(Barcelona capital)

Monotube double track of 5.6 km

### ■ Girona (Girona)

Monotube double track of 6.6 km

### ■ Abdalajís (Málaga)

Double tunnel of 7 km

### ■ La Cabrera (Valencia)

Double tunnel of 7.2 km

### ■ Regajal (Madrid-Toledo)

Double tunnel of 2.4 km

### ■ Cabrejas (Cuenca)

Monotube double track of 2 km

### ■ Hoya de la Roda (Cuenca)

Monotube double track of 1.9 km

### ■ Novelle (Pontevedra)

Monotube double track of 1.2 km

### ■ Redondela (Pontevedra)

Monotube double track of 2.4 km

### ■ San Amaro (Pontevedra)

Monotube double track of 1.9 km

### ■ Quinteiro (Pontevedra)

Monotube double track of 1.9 km

### ■ Valicobas (Pontevedra)

Monotube double track of 1.3 km

### ■ Bustelo (A Coruña)

Monotube double track of 1.3 km

### ■ Barrancadas (Alicante)

Monotube double track of 2.8 km

### ■ Sierra de las Águilas (Alicante)

Monotube double track of 1.2 km

### ■ Tunnel entrance to Alicante

Monotube double track of 1 km

### ■ Peña Rayada (Valladolid)

Monotube double track of 2 km

### ■ El Almendro (Burgos)

Monotube double track of 840 m

### ■ Calbezadas (Burgos)

Monotube double track of 904 m



Commissioning of aeration facilities for the Guadarrama tunnel.

## Type of facilities planned and designed

- Lighting of adjacent rooms (emergency exits and equipment rooms)
- Tunnel ventilation analysis
- Photo-luminescent emergency beacons
- CCTV
- Dry riser
- Intruder detection
- Earthing equipment for the overhead line
- Extinguishers in galleries
- Integration of systems in CPS
- Handrails
- Evacuation doors
- Safety communications network
- Room for outside aid
- Emergency signage
- Systems
  - \_\_for pumping
  - \_\_for gas detection
  - \_\_for detection and extinction
  - \_\_for fires at emergency exits and equipment rooms
  - \_\_for radio-communications
  - \_\_for ventilation
  - \_\_for protection of the physical perimeter
- Electric power supply
- Supervision and control of Civil Defence facilities
- Power outlets
- Ventilation outlets in emergency and equipment rooms



Future appearance of the tunnel that OHL is building under the Reforma roundabout in Mexico City.

## INTERNATIONAL PROJECTS

Ineco has worked on various projects related to safety and electromechanical facilities in tunnels outside Spain. Recently, the firm has been working on the Hs2 high speed project between London and Birmingham (High Speed

2 London) as well as supervising the electromechanical installations; it has also worked on the signalling and safety facilities design in the Reforma tunnel being built by the Spanish construction company OHL in Mexico City.«

### Urban tunnel Reforma Roundabout in Mexico City

At 700 metres long, the future urban tunnel under the Reforma Roundabout being built by Spanish company OHL will have more than three lanes in each direction and two decks. The purpose of this tunnel is to preserve the Chapultepec Park area. The tunnel is part of the new Northern urban freeway, 9 kilometres in length, the sixth built by the OHL Group in

Mexico. This action by OHL is important for Mexico City because it renews a 6-lane elevated highway along which 300,000 vehicles travel daily.«

### Ineco has carried out the following studies for this tunnel:

- Ventilation systems
- Fire prevention system
- Lighting system
- Variable signalling system



# Odessa, on an international scale

## Design of the new terminal building

With the collaboration of **Roberto Serrano** (Head of Airport Construction) and **Rafael Rúa** (Head of Airport Buildings), aeronautical engineers

**Ineco has designed and planned the new terminal which is being built in this important industrial, commercial and tourist centre known as “the pearl of the Black Sea”. An undulating roof and expansive, light-filled spaces are the hallmarks of the building, which will triple its current capacity.**

Odessa has an international airport located 7.5 kilometres from the city centre. In 2011 it received 824,300 passengers and more than 7,355 daily

flights, representing a growth of over 7% over the previous year, according to data from Eurocontrol. That same year, the city council and the airport operator formed the company Odessa Airport Development, which drives the expansion of the facilities, which currently occupy 570 hectares. In July 2011, Ineco was awarded the contract to design a new building which was to be bigger, brighter and more functional, as well as being equipped with the latest technologies. The design presented is also based on the general idea of modernity that is to be projected to visitors.»

## The aeronautical market in Ukraine

**Air traffic in Ukraine contracted** sharply during the 1990s, after the breakup of the Soviet Union, leading to the closure of many regional airports. However, from 2002 the aeronautical market experienced a sharp rise in the country, reaching an average of 20% annually. The hosting of the European Football Championship in 2012 prompted the reform and expansion of the main Ukrainian airports and other transport infrastructure. Ukraine has 30 civil airports, of which 24 are international, mostly built between 1960 and 1980. The largest is that of the capital, Kiev, which accounts for 60% of total passenger traffic.

**The airport in Odessa** was opened in 1961. Municipally owned, it is third in the national ranking, and about 70% of its traffic is international. The improvements have been divided into two phases and include the construction of a new terminal building and remodelling of

the airfield. The country, which gained independence from the Soviet Union in 1991, is also modernising its airport and aviation legislation to adapt it to international standards.

**In this context**, the Spanish Ministry of Public Works, in partnership with the Swedish provider of air navigation systems Luftfartsverket (LFV) and the Ukrainian State Aviation Agency, has been developing a European twinning project since 2011. The aim is to harmonise the regulations of the country in accordance with the procedures and recommendations of the ICAO regarding airports, airfields, traffic management and air navigation. It is expected that the project, funded to the tune of 1.7 million euros by the European Union, will be concluded in late June 2013.»





For the choice of materials, the severity of the climate and the proximity to the sea have been taken into account, while at the same time seeking a modern and unique image, along with expansive and functional spaces

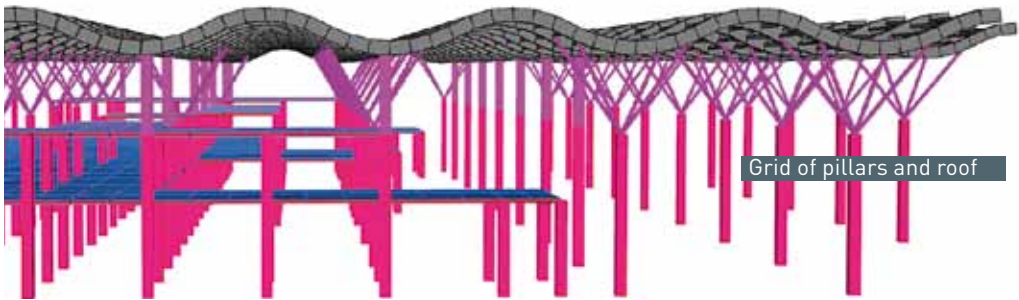
This is what the new terminal building will be like

The building is located on a plot of land located to the north of the existing terminal, parallel to the current access route to the airport and to the runway. It has a rectangular floor and covers an area of 11,000 m², under an undulating roof that extends beyond the perimeter of the façades to cover the access roads. The building rests on two pillar grids: one measuring 18x18 metres to support the roof, and the other measuring 9x9

metres, which support the reinforced concrete slabs of the different floors, with a square cross-section and variable sizes depending on their position. The pillars supporting the roof, made up of wave-shaped steel beams, terminate in steel lintels with four supports that open out in a propeller shape. The combination offers an unusual appearance which is the most emblematic element of the building. The building has two types of façades. Those

on the east and west, which correspond to the land and air sides, are glazed and each measures 144 metres in length, allowing visibility from both outside and inside. Also, the building has two side volumes, lower in height, which are on the north and south façades. Each of these measures 77 metres and they are opaque, with the opening of gaps responding to strictly functional needs. This volumetric design meets functional criteria and also, at the same time, the idea of providing large, open and glazed

spaces in the public use areas, while the private areas are designed to be smaller opaque spaces. In line with this approach, the entrance hall from the land side is planned as a large space with the full height of the building. The rest of the floors are “tilt” into it, providing an overview of the volume and the roof from the inside. This same concept governs the boarding area, also conceived as a large space with visual continuity.«



Distribution of the spaces

■ The building has a total height of 19 metres. It is divided into four floors and a basement for facilities on a floor area of 26,500 m². The morphology and distribution of spaces allow the adaptation of the flow of passengers and luggage to the safety requirements for an airport of this category.

→ENTRY HALL  
The first floor is at street level, and occupies the entire floor area of the building, which houses the check-in and arrivals hall, the baggage handling and collection area and the VIP area.

→STAFF FACILITIES  
The second floor is raised to a height of +3.45 m, occupying an area of 4,200 m². It mainly houses facilities for the airport staff.

→BOARDING AREA  
On the third floor, at a height of +6.90 m, is the boarding area, national and international, with a total area of 8,000 m².

→TECHNICAL FLOOR  
At a height of +11.25 m is the planned technical floor, with a surface area of 2,500 m², in which the main facilities are located.



Look of the new arrivals hall.



The undulating roof of the building extends beyond the perimeter of the façades.

Odessa, a city on the rise

With more than one million inhabitants, it is the fifth largest city in Ukraine, which has a population of 45.5 million in all. Located in the southwest, on the shores of the Black Sea, it is the centre of the country's largest oblast (or region) and is the largest of the seven ports distributed along its 300 kilometres of coastline. Along with the nearby cities of Yuzhny and Ilyichevsk, it accounts for three quarters of Ukrainian port capacity, and there is an ongoing expansion plan to build a new

cargo terminal. With regard to its business activity, livestock and industrial agriculture (especially grains) are the basic pillars of the entire region, along with the petroleum, chemical and metallurgical industries. In recent years, tourism has also begun to develop strongly: each year the region receives more than one million visitors, of which half are foreigners.«

Start of works



An attendee at the act of commencement of works on 8th June 2012 observes the drawings for the new building prepared by Ineco.

Cornerstone



Symbolic act of laying the cornerstone. To the left, Andrey Shkatiuk, from Odessa International Airport.

Latest equipment

In addition to building facilities, the new airport will be equipped with the latest airport technologies and systems, monitored and centralised from two redundant checkpoints.

■ It is worth mentioning the security elements used both for processing people and luggage in security checks (body scanners, metal detectors). The baggage handling system will be capable of handling the flow coming from the 21 check-in counters with the aid of three EDS machines in a row for normal luggage and two Rx machines for special

sized luggage. For boarding of passengers, four walkways were installed to connect with the attached platform, three of them for type C aircraft and one for type D.

■ The AODB (Airport Operational Data Base) will integrate all the systems required for normal operation of the airport, such as: public address, public information systems, CUTE etc.



# Alicante, the AVE's next destination

## High speed stretch from the Spanish capital

In collaboration with the Areas of Railway Projects, Works and Maintenance and Railway Installations and Systems

**This spring, the line linking Madrid with the east coast will inaugurate 164 kilometres of new track, linking Albacete and Alicante. Ineco, which has worked on high speed rail in Spain since its inception, has been involved in all the stages.**

Since December 2010 the high speed line between Madrid and Albacete in the south, and the regional capital of Valencia in the east, has been operational. Within a few months, the Alicante stretch will enter into service. In total, 164 new kilometres in addition to the 438 already in operation. This high speed line will connect to the future Mediterranean Corridor, that will run along the entire east coast of Spain from Barcelona to the Spanish port of Algeciras, the most important in the country, and which will serve both passenger and freight traffic.

The line is designed for speeds of between 220 and 350 km/h, with double internation-

al gauge track (1,435 mm), equipped with the most advanced traffic control systems (ERTMS level 2), signalling and electrification. In some stretches, the Iberian gauge track has been adapted for high speed by using dual gauge sleepers, while others are newly built and run parallel or very close to the conventional track.

Ineco's experience in high speed goes back to its first implementation in Spain, with the first Madrid-Seville line (see *itransporte 10*) and extends to all phases of work: design, implementation and main-

*The line is designed for speeds of between 220 and 350 km/h and has the most advanced traffic control, signalling and electrification systems*

tenance. Subsequently, it has continued to evolve over two decades on all lines of a network that now totals more than 2,800 kilometres.«

## Albacete-Almansa stretch, like hand-made lace

A set of complex but successful actions by the Ineco management teams for facilities and construction has been instrumental in the arrival of the AVE in Alicante. While recovering and adapting for high speed the old Alpera and Chinchilla bypasses –disused since 2006– the sidings were simultaneously built and work on changing the gauge was carried out without affecting the passage of trains. To do so a detailed plan of partial commissioning –a total of

five– plus other interventions along the 74 kilometres built were executed: 24 link points of double electrified track, three stations with 35 sidings, two electrical substations and the safety facilities needed for the high speed line. A real display of engineering expertise, since all these actions were carried out without interrupting rail traffic at any time.«

### Ineco's work

#### →DRAFTING OF CONSTRUCTION PROJECTS

Among the most noteworthy: change from Iberian gauge to UIC and installation of track, electrification, fixed installations, centralized traffic control (CTC); train safety and protection systems, security installations on the conventional gauge line and temporary access to the new high speed station in Villena.

Coordination and supervision of projects.

#### →COORDINATION AND SUPERVISION OF CONSTRUCTION

— Technical assistance on construction supervision (track, installations, assembly base...)

— Construction management

— Environmental management of railbed and superstructure work

— Audits, supervision and coordination of the works

— Supervision of the quality of track materials

— Traffic control and traction services

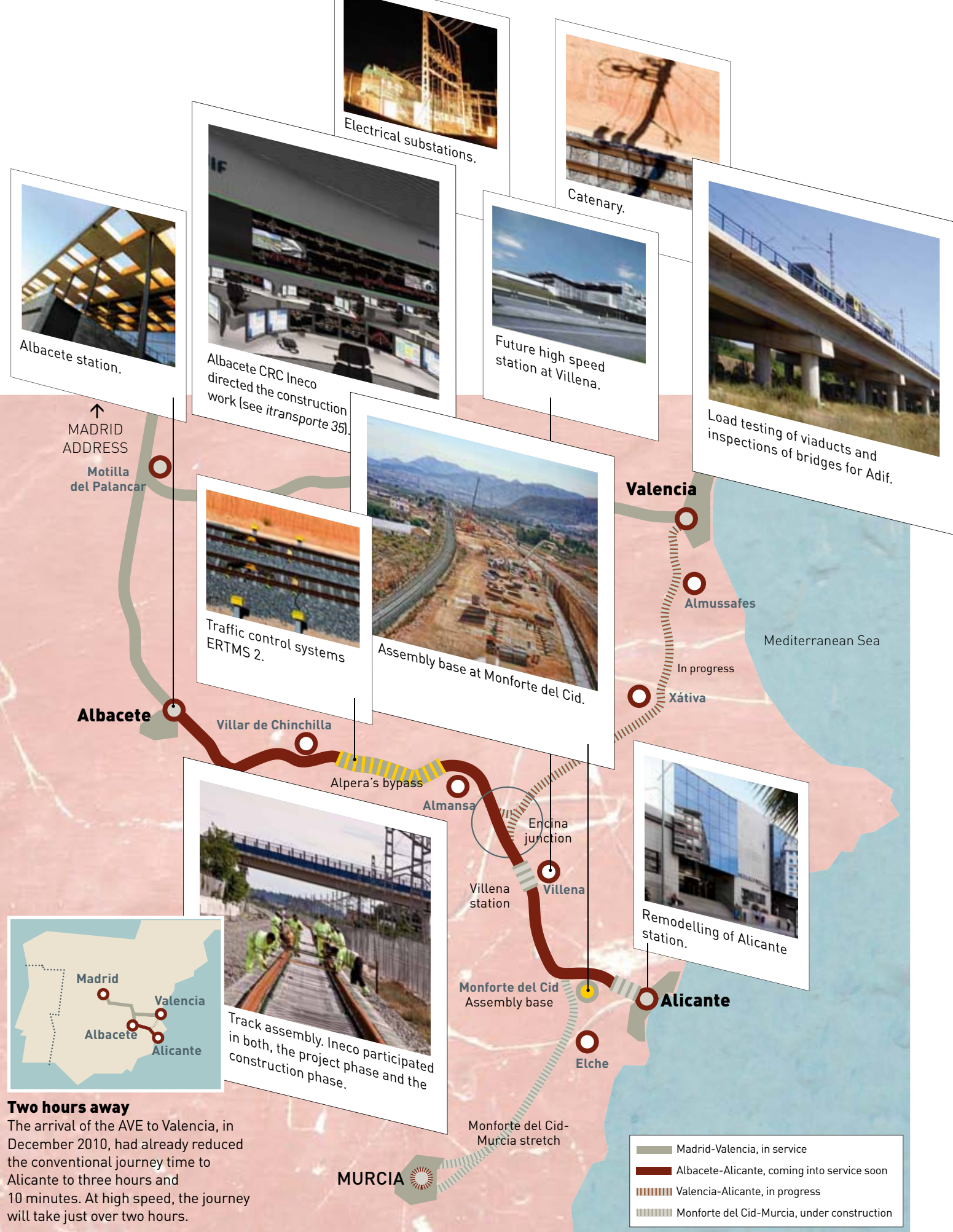
— Load tests and inspections of bridges

#### →OTHER TASKS

Studies of line operations, environmental, geological and geotechnical studies.

Architecture for the temporary station at Benalúa (Alicante).

Compulsory purchase processes.





# Six feet under

## A decade of protecting our heritage in high speed rail infrastructure

By **Emilia de Aragón**, archaeologist (Area of Environment and Ground Engineering)

**One of Ineco’s important activities is to preserve and protect cultural heritage in high speed rail works. Its extensive experience doing this work in Spain is now applied worldwide.**

In the construction of this kind of infrastructure, the need arises to adopt measures to eliminate or minimise their effect on cultural heritage, in compliance with applicable laws. This is a challenge that has been faced in the last decade in the construction of all Spanish high speed rail lines. Fostered by Adif, Ineco’s specialists control and monitor the actions for preserving cultural heritage. Many affected assets are defined in the construction project, and so corrective measures are applied before the works

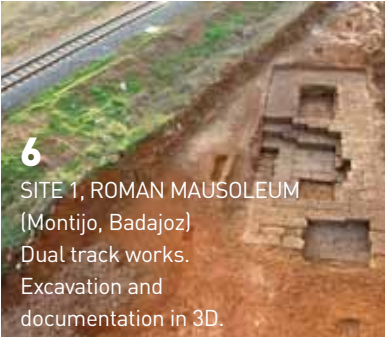
begin. Other elements are in the subsoil and are discovered only after earthworks begin. To protect this heritage, when the construction projects are prepared the cultural elements are assessed and the preventive, corrective and compensatory measures needed for their protection and documentation are proposed. In the work phase, the archaeological tasks required are scheduled and the work prescribed by the corresponding organisms is controlled and monitored. In addition, the archaeological, palaeontological or ethnological actions are coordinated with the works.

**Respect for the heritage**  
This task performed by Ineco is a clear example of respect for the heritage that has been passed down to us and for which we are responsible. The com-

pany implements all the mechanisms available in view of current research and technology to make the construction of large infrastructures compatible with the protection, study and recovery of the historical-cultural assets in the surround-

*Ineco has coordinated the excavation and recovery of Lo Hueco, the largest palaeontological site found in Europe*

ing environment. In this way, regardless of the country where the work is done, a method and experience are brought to bear that make any intervention related to that country possible without creating a delay or freeze in the construction of the planned infrastructure.»



### PROJECTS EXECUTED 10 years of work and research

- Managing and coordinating the recovery of important parts of Spanish history in all high speed lines.
- Coordinating the archaeological excavation of sites: **Lo Hueco**, Fuentes, Cuenca; **Neolithic pit**, La Sagrera, Barcelona; **Roman mausoleum**, Montijo, Badajoz; **Fifth sluice of the Royal Canal of the Manzanares**, Madrid; **Senovilla**, Olmedo, Valladolid; **Castro de Bendoiro**, Orense; **Mayorga**, Antequera, Málaga; **Villa de Cadima**, Almería, etc.
- Documenting relevant pieces of ethnological heritage influential in the history of the territories crossed. Such is the case of the research performed on the gypsum mines and their economic and social influence in the area of Villena, Alicante, or of the research carried out on irrigation systems in the Valencian gardens and their plots dating from Roman times.
- Controlling the transport of cultural items such as the Water Tower of Can Marferrer in Montornés del Vallés, Barcelona, or the Roman kiln in the excavation site of Alfar de Villalta in Bobadilla, transported to the museum of the city of Antequera.
- Managing the appraisal of assets such as the defensive tower of the Almohad farm in L'Enova, Valencia, or the Iberian-Roman site of Can Suari in Llinars del Vallés, Barcelona.
- Coordination of several publications, among them the notes of the archaeological excavations performed for the Madrid-Levante line, such as La Villa de Cornelius, or those for Las Aguas del Rey and Los Canónigos.
- Design and appraisal of the most important sites studied in the Madrid-Levante high speed line, exhibited in the Museum of Science of Cuenca.»

### Some figures

- Ineco has directed the excavation and scientific documentation of 272 archaeological sites: **Palaeolithic: 14 | Neolithic/Chalcolithic: 27 | Bronze: 39 | Iron: 49 | Roman: 58 | Medieval: 36 | Modern: 22 | Contemporary: 27**
- Managing 38 palaeontological interventions, 191 documentations of ethnological items, studies of 24 historical roads and directing 4 studies on historical landscapes.



# Tunnelling to protect

## Construction management of the longest tunnel in Andalusia

With the collaboration of **Diego Martínez** (Department of Works, Track and Operations) and **Noelia Alonso** (Area of Environment and Ground Engineering), civil engineers

**At 7.5 kilometres, the Sorbas tunnel is the sixth longest high speed tunnel in Spain and the longest in Andalusia, beating the Abdalajís tunnel on the Córdoba-Málaga high speed line, on which Ineco has also worked.**

The tunnel is located in the province of Almería, on the Sorbas-Barranco de los Gafarillos stretch, and belongs to the 184 kilometre high speed line that will link the cities of Murcia and Almeria. Since 2009, Ineco has handled the construction management of this tunnel for ADIF, which has involved the drilling of two tubes with an approximate length of 7.5 kilometres, and 19 interconnecting galleries placed every 400 metres. To do this, we used the same TBM, nicknamed La Alcazaba, that broke the world record for tunnelling progress seven times when drilling the La Cabrera tunnel. Furthermore, Ineco’s geotechnical and tunnel specialists have provided technical support to construction management; this is

complex work because the tunnel goes through complicated geological terrain with several fault zones. The alternation of materials to be excavated defined a specific construction system in which the TBM was combined with conventional methods. Once the drilling of the two tubes was complete, construction of four cut-and-cover tunnels (two for each tube) began outside, completing the total underground length as well as finishing the remaining 0.3 kilometres of railbed that will allow it to be connected at both ends.

*The tunnel passes through a complicated geological terrain with various fault areas*

The Murcia-Almeria high speed line is co-financed by the European Regional Development Fund (ERDF) through the ERDF Operational Cohesion Programme 2007-2013 and the Operational Programme of Murcia 2007-2013. The European Investment Bank (EIB) is also a stakeholder.«

### The Sorbas tunnel in figures

- Tube One is 7,528 m in length and Tube Two, 7,520 m
- 4 cut-and-cover entry and exit tunnels, each 96 m in length
- Two parallel tubes equipped with electrified single track and 2 platforms
- 52 m² of clear section in each tube
- Spacing between the tubes is 26 m, on average
- Maximum longitudinal gradient of 12.5‰
- 3 km of central straight section
- 2 large radii entry and exit curves
- 19 interconnecting galleries, one every 400 m
- TBM double shield tunnel boring machine for rock with a total thrust force of 8,500 metric tonnes, a cutting head diameter of 10 m and a weight of 1,500 metric tonnes



Building the interconnecting galleries.



Construction of cut-and-cover tunnels.



View of the twin tube tunnel collaring.



Head of the TBM.



Building the floor.

## A long and meticulous construction process

The installation of the infrastructure that accompanies a double shield rock TBM meant that preliminary work of clearing and grading the terrain had to be completed first; this was done at La Herrería in mid-2009. On 9 July, 2010 La Alcazaba began work; its head cut decisively into the first metres through Almeria’s Sierra de Cabrera, followed by its lengthy back-up train, over 200 metres in length. 7.5 kilometres from this point, at the southern mouth of the future tunnel, just before crossing the Gafarillos ravine, the conventional attack on the solid rock mass had begun by blasting.

After more than eight months from the start of drilling, these works concluded, improving on the initial performance forecasts. The TBM cut the 6,606 metres planned for this first tube, lining the route with rings of reinforced precast concrete segments. In the same tube, but from the south entrance, the conventional bench

excavation work completed 826 metres, later finished by waterproofing and lining processes. In the second tube (7,520 metres), the TBM tunnelling work began after dismantling, removal, repair and assembly, to start drilling in north-south direction. Previously, the conventional works from the south entrance were completed; they were of similar length to the first tube.

*The TBM cut the 6,606 metres planned for this first tube, lining the route with rings of reinforced precast concrete segments*

Finally, the civil works phase inside both tubes centres on preparing them by constructing flooring, walkways and pavements as a prelude to the installation of the slab track, the lining of the interconnecting galleries and the assembly of other railway facilities.«

## Goal: to save the spur-thighed tortoise

Environmental excellence is a primary goal for Adif and Ineco when building high speed infrastructure. In this case, one of the priorities is also to ensure sustainability in these fragile semi-arid lands, with unique natural and scenic resources in Europe that are rare and valuable, and widely recognised regionally, nationally and internationally. The new infrastructure allows the environmental impact of the railway line

passing through the Site of [European] Community Interest (SCI), Sierra de Cabrera-Bedar to be minimised. For this reason, the environment will be minimally affected, thus helping to preserve the local flora and fauna, among which the spur-thighed tortoise stands out as an endangered species for which special protection measures have been established.«



## Q&A | PABLO VÁZQUEZ, president of Ineco

“Our engineering firm is global, as shown by our many grand projects”

**A**t a time when the crisis is having a profound impact on the Spanish economy, Ineco is approaching this situation with a strategy determined to strengthen its international presence as much as possible. To talk about it we interviewed Pablo Vázquez, president of Ineco and the driving force behind this new approach.

A Law graduate with a PhD in Economics and full professor in the Complutense University of Madrid, Pablo Vázquez Vega joined Ineco almost one year ago, after working on the senior management team of the Foundation for Applied Economics Studies (FEDEA). He was an advisor to the prime minister from 1996 to 2002 and is an expert in economics, public policy and the labour market, having published numerous papers and works on the matter. In addition to being president of Ineco, Prof. Vázquez Vega presides the Spanish consortium for the high speed railway between Makkah and Madinah.

**Now more than ever before exports are essential to the country's economy. What is Ineco's international approach?**

My main mission is to promote our international outlook and consolidate Ineco as a leader in transport engineering and consultancy, as well as to foster the company's growth and sustainability. Spain has made a great investment effort in infrastructure in the last 25 years, a task in which Spanish engineering firms have played a crucial role. We are a mature market, with internationally recognised projects. Indeed, it is now time for all of us to start looking abroad. What I see is a potential market

where we have much to offer; transport infrastructures are, have been and will be a decisive factor in a country's growth. We have a great opportunity to showcase the talent we've acquired over these years.

**How do you intend to face this challenge?**

To me, more than a challenge, this is our natural responsibility as a company. Engineering firms need to be wherever added value is required. In our case, we know that our strength resides in our experience, know-how and solvency. These three pillars are complemented by a more flexible organisation that enables a more agile response and increased cooperation with other public or private companies, always with customer-oriented approach.

*We will focus our efforts on opening new markets alongside other companies in the sector*

**Do you think there will be good opportunities in the sector?**

The world is heading towards a prodigious decade for infrastructure. In the next eight years, for example, over 50 undergrounds will be built worldwide, due to the growth of developing nations and the continued population growth. This is definitely a good time for us, as we have outstanding references and human capital experienced in the latest innovative techniques.

**What would you consider your main baggage to be?**

This year Ineco will celebrate 45 years of history. These have been 45 years of

providing high-value solutions, with heavy specialisation and the creation of highly qualified teams. We have the prestige and recognition in both the national and international market, and references worldwide. The contract for building the high speed railway between Makkah and Madinah, the expansion of the Kuwait International Airport, the airports plan in Nepal or the roads contract in Mexico, among other great projects, all reflect this.

**What are your priority markets?**

We have been working for some time in markets where we are already known, such as Mexico, Brazil, Colombia, Puerto Rico, Panama and Ecuador, in the American continent; or Qatar, Kuwait and Saudi Arabia in the Middle East. Our engineering firm is global, as shown by our many grand projects. We are also an active member in many projects as part of European consortiums, with a leading role in some, and we have increasingly more projects in Africa and Asia. Nevertheless, I insist that Ineco should be present wherever a transport infrastructure is needed.

**So will you increase your international presence?**

As I mentioned before, we already have substantial experience in the foreign market. Evidence of this are the almost 200 international contracts on which we are currently working, in over 40 countries. The Ineco brand is already highly prestigious. Nonetheless, I believe it is time to take a qualitative and quantitative leap in our internationalisation strategy, and we know we have the capacity to do so. This is why, in addition to consolidating our pres-



Pablo Vázquez, president of Ineco, at the headquarters of the company in Madrid.

ence where we are already working now, such as Latin America or the Middle East, we will also focus our efforts on opening new markets.

**Where do you see Ineco in the medium term?**

In the world there are already 20 countries with high speed railways and the forecast is that 25,000 kilometres of new lines will be built within a few years. Air traffic

will double by 2030 in Europe alone, and cities and their governments will seek new and more efficient transport solutions. This is a reality and a tremendous opportunity for Ineco, which we must not waste.

**What can be learned from large projects such as Makkah-Madinah?**

This is an exemplary project in many aspects, reflecting the will of the Span-

ish government to promote the creation of mixed public-private consortiums, which is providing outstanding results in the Middle East, Europe and America. In the case of Saudi Arabia, it is the largest export contract signed by Spanish companies abroad. In addition, there are important technological challenges related to the severe climate conditions, regarding which the Spanish members of the consortium must show the world our experience and knowledge.

*We have outstanding references and a human capital experienced in the latest innovative techniques*

**What is your role as president of the consortium?**

My role is mainly to represent the leadership of Grupo Fomento, and to bring together the interests and synergy of the public and private parties. The purpose of this is to satisfy our customer and to showcase the technology and know-how of the Spanish consortium.

**Will there be more collaborations with the private sector in the future?**

We need to adapt to the new market situation, and this is certain to imply increased collaboration with different companies. Ineco has always been open to working with private companies. Without a doubt, collaboration with other entities that complement and reinforce our capabilities will provide essential leverage for facing the international challenge.◀



## Sound images

### Less noise on the Valencian railway

With the collaboration of **Gema Caballero**, civil engineer and **Mónica Magro**, geographer (Area of Environment and Ground Engineering)

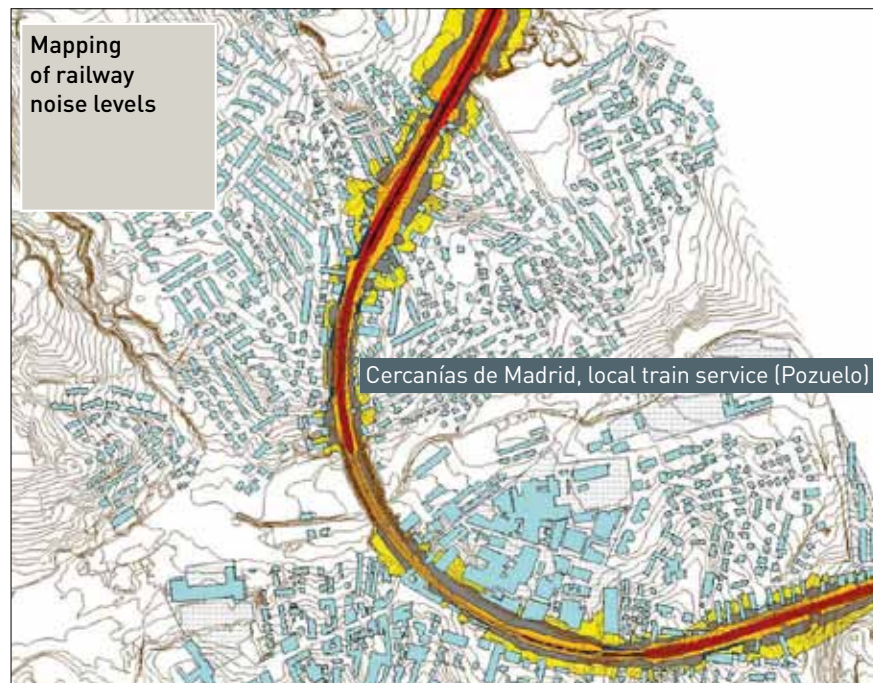
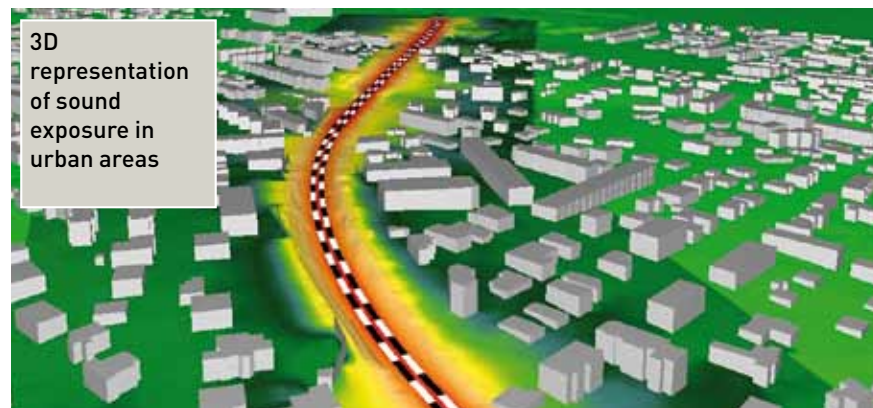
**The development of strategic noise maps allows us to analyze and design the necessary preventive measures to avoid noise pollution.**

Ineco has recently prepared strategic noise maps for the main railway lines of the Valencian Community, commissioned by the Department of Infrastructure, Planning and the Environment of the Generalitat Valenciana. Thus, in accordance with EU legislation, the Valencian government is taking on the performance of the acoustic mapping of the infrastructure under its jurisdiction: the narrow gauge lines and tram lines that run through the Valencian Community.

Law 37/2003, of 17th November, known as the "Noise Law", reflects the EU man-

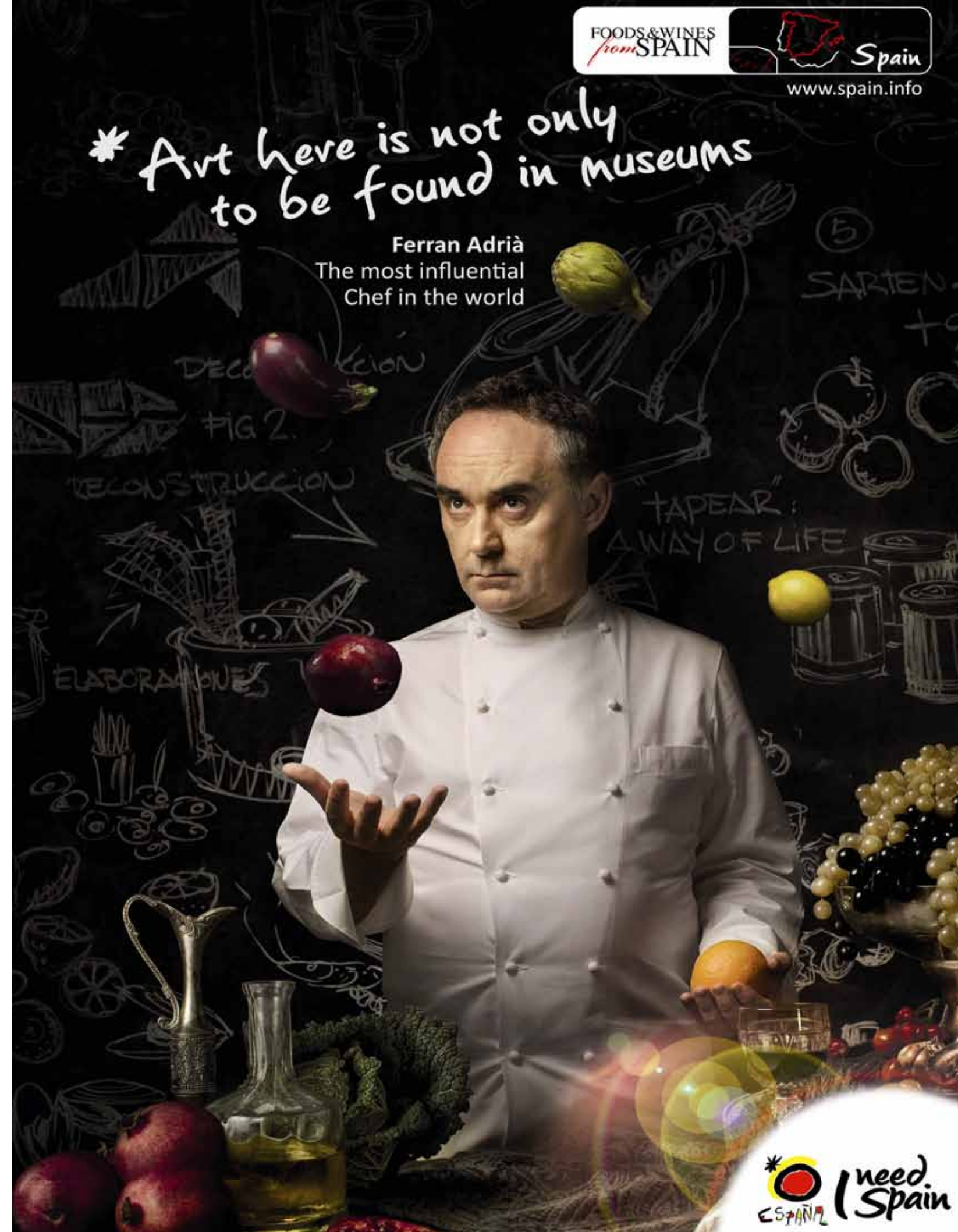
*Ineco has been working since the 1990s on the integrated noise management in the field of railway transport, as well as airports and roads*

date of 2002, under which public authorities have an obligation to develop noise maps for all transport infrastructure that exceeds certain traffic levels. The next step, according to the regulations, are the action plans which determine the necessary preventive and mitigation action in each case.«



### Ineco's extensive experience

■ Ineco has extensive experience in this area after carrying out the action plans for the first phase of the Strategic Maps for the Madrid-Castilla La Mancha and Asturias-Basque Country lines (ADIF), and the Acoustic Protection project for the Atlantic Axis of the High Speed railway in Galicia (Ministry of Public Works).





AERONAUTICAL | **KOSOVO** | Project management

# In the heart of the Balkans

## Expansion of Pristina airport

With the collaboration of **Fernando Remón**, industrial engineer  
(Head of unit in Kosovo-Department of Airport Infrastructure)

**Pristina airport needs to grow to accommodate its increasingly intense air traffic. It is expected that the terminal and control tower will be opened in late 2013. This will allow a quadrupling of the number of passengers to 4.5 million a year.**

**K**osovo has a population of 1.7 million people, of which about 200,000 live in Pristina, the capital. Its airport is located about 16 kilometres southwest of the city and is the only international airport in the area. It is divided into two terminal areas, one civilian and the other military, the latter for the use of KFOR, NATO's joint force in Kosovo.

**Traffic growth upwards**

Located in the heart of the Balkan Peninsula, around thirty airlines operate there (including regular, low cost and charter companies), offering connections with Slovenia, Croatia, Switzerland, Germany, Austria, Italy, Belgium, Denmark, the United Kingdom and Turkey. Routes are also being opened to the Middle East, a rapidly expanding aviation market. In fact, civil traffic growth in Pristina has been continuous: it has grown from 397,000 passengers in 2000 to 1.4 million in 2011, according to data from the Civil Aviation Authority of Kosovo (CAAK). With the expansion of its facilities, capacity will increase to 4.5 million passengers per year. In 2010 its management was privatised, and a concession for 20 years was granted to a company owned primarily by the Turkish construction company Limak (90%) and the operator Lyon

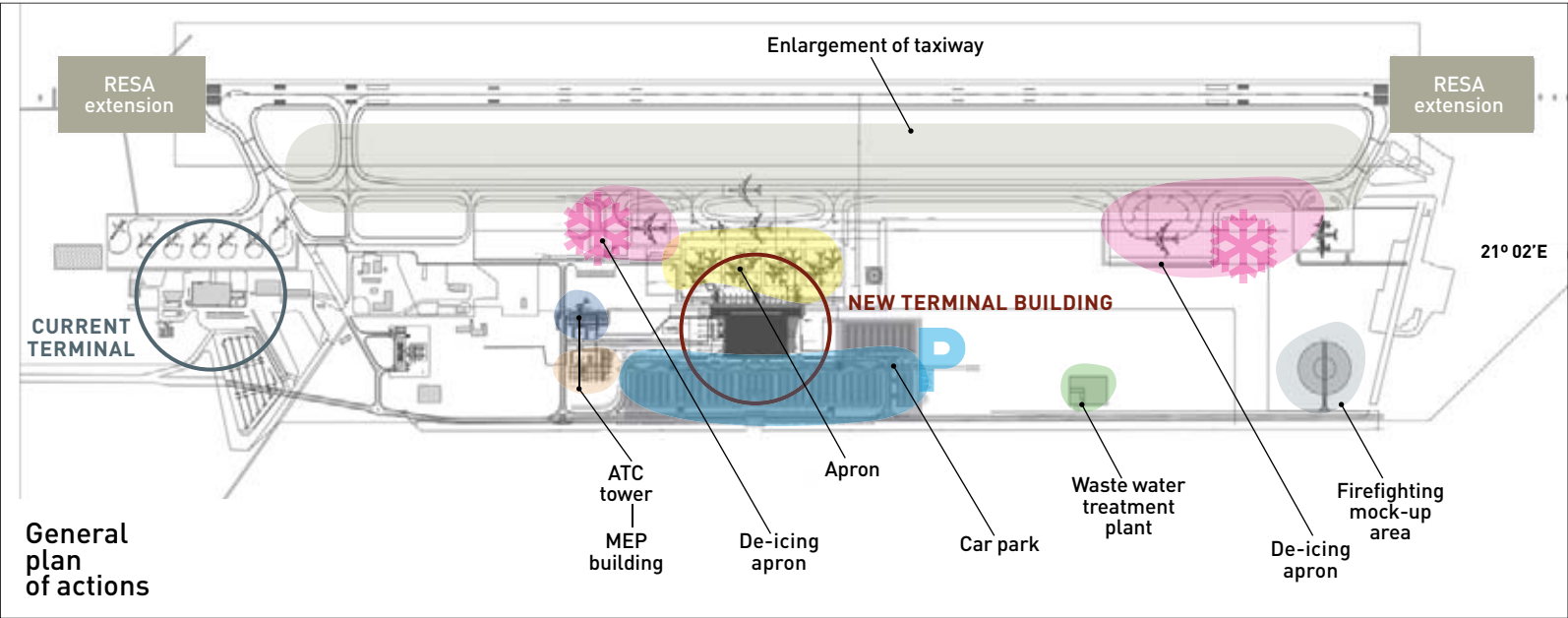
Airports (10%). The concession includes all airport activities except air traffic control and safety. The managing body and the Kosovo government have formed a public-private partnership to carry out the expansion. Ineco won the tender to act as an independent engineer, developing the project revision and controlling the execution of works, as well as coordinating the consortium members. Work began in April 2011 and will last until January 2014.«



**The current airport**  
The airport site currently occupies a total area of 194.2 hectares. It has a single runway, which is 2,501 m long by 45 m wide. The civilian terminal area consists of two buildings, one for departures measuring 4,700 m² and another for arrivals, measuring 1,700 m², which were remodelled together with the aircraft parking apron in 2002 and again in 2009. With regard to the control tower, the current one is a mobile model which was provided by the KFOR.



The terminal from the airside.



General plan of actions



Land-side from the car park.

**EXPANSION PROJECT**

In late 2013, the capacity of Pristina airport will increase to 4.5 million passengers per year.

**Actions already underway**

- **TERMINAL BUILDING**  
43,000 m²
- **ATC TOWER AND ANNEX BUILDING**  
Situated on the west side of the runway, it has a height of 36.6 m
- **FACILITIES AND CAR PARK BUILDING**  
50,000 m² and 1,750 parking spaces, with access roads
- **AIRFIELD**
  - Apron 70,000 m²
  - Two de-icing aprons
  - Enlarging of taxiways
  - **RUNWAY:** construction of two RESA areas (Runway End Safety Areas)
- **OTHER ACTIONS**
  - Firefighting mock-up area.
  - New waste water treatment plant

■ **Total budget of the works:**  
100,000,000 euros





# Ideas on the move

An innovative idea not only provides practical solutions, it also reduces costs. Ineco’s professionals are developing novel proposals in its various areas in order to reach both goals. These are some of the projects.

## DETEC

Development of new online control techniques for track behaviour

**CREATORS**  
Mario Ferreiro and David Pérez, civil engineers  
(Department of Construction, Tracks and Operation)

This is a remote real-time track measurement and monitoring system used to measure and evaluate the behaviour of track elements subjected to real loads.

Among its advantages are increased safety, as it does not require placing staff on the track (which at the same time reduces travel costs), homogenisation of data control and processing, optimisation of management, prevention and detection of incidents and real-time track control.«



DETEC (Development of new online control techniques for track behaviour)

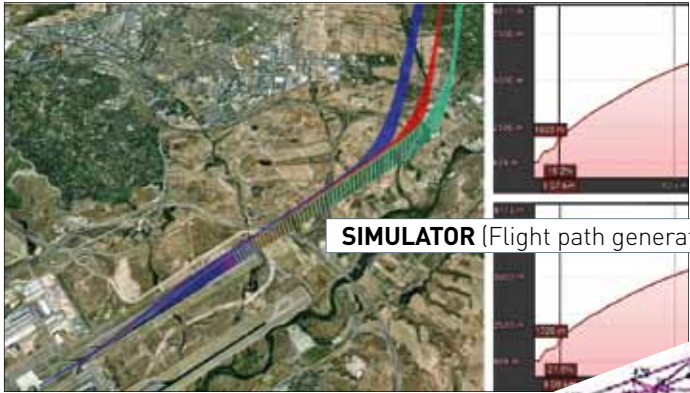
## SIMULATOR

Flight path generation

**CREATORS**  
Jaime García, telecommunications engineer and Juan Carlos G. Ballesteros, aeronautical engineer, Head of Software Systems Engineering (Area of Aeronautics)

This project involved the creation of a method for generating trajectories in ATM (air traffic management) simulation platforms to reflect as accurately as possible the behaviour of aircraft in order to allow flight procedures to be validated.

The project has provided tools such as the Procedure Validation Tool (PVT), the Average Trajectories Generation Tool (ATGT) and the Simulated Trajectories Generation Tool (STGT).«



SIMULATOR (Flight path generation)

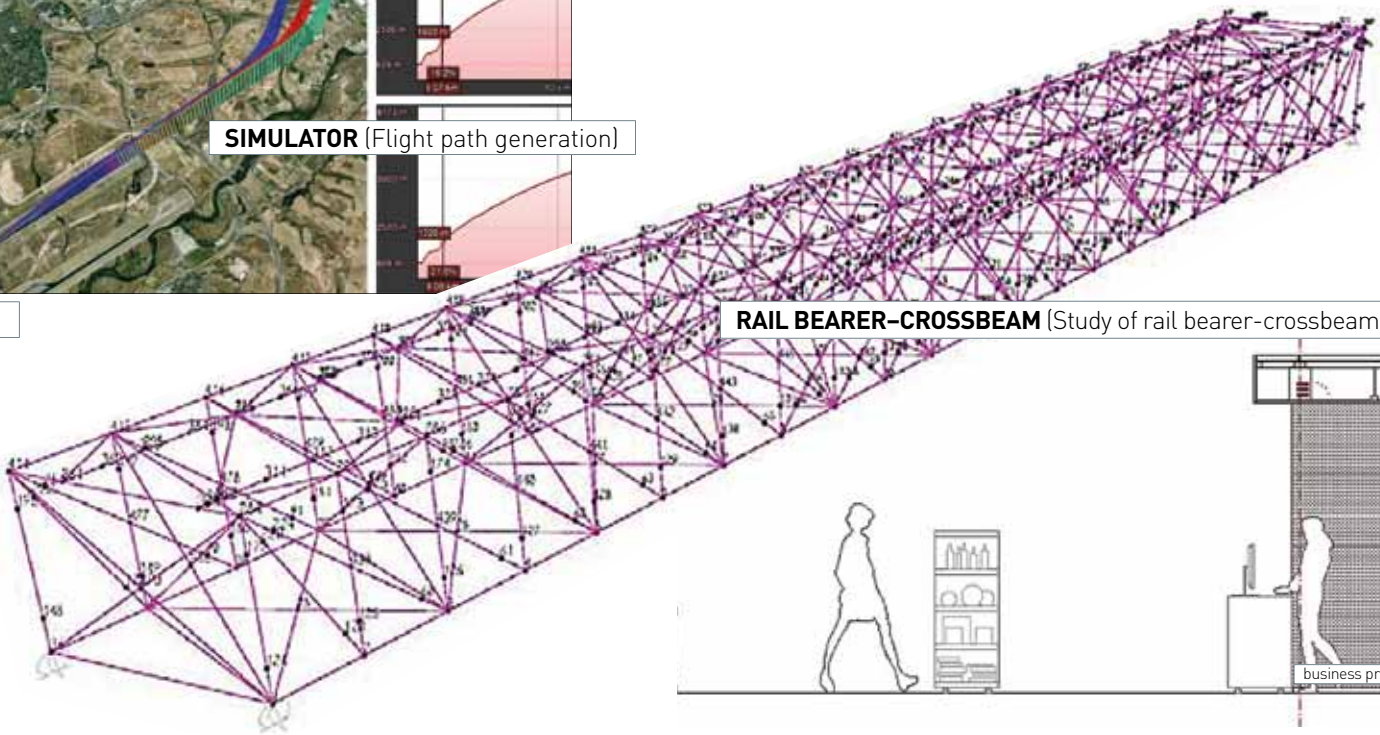
## RAIL BEARER-CROSSBEAM

Study of rail bearer-crossbeam unions

**CREATORS**  
Elena Jerez (Head of Structural Design Area), Marta Mascaraque and Alfonso Vegas (Department of Architecture, Structures and Instrumentation), civil engineers

Bridge rail bearers are the elements that support the track sleepers. Damages on these elements, wich are essential to the safety of the entire bridge, are being detected with increasing frequency.

This project develops a methodology for analysing the distribution of stresses in the unions between rail bearer and crossbeams and fatigue effects on them. It will contribute to an improved control of the bearing capacity of bridges in service and to improved design of new elements and repairs.«



RAIL BEARER-CROSSBEAM (Study of rail bearer-crossbeam unions)

## MAT

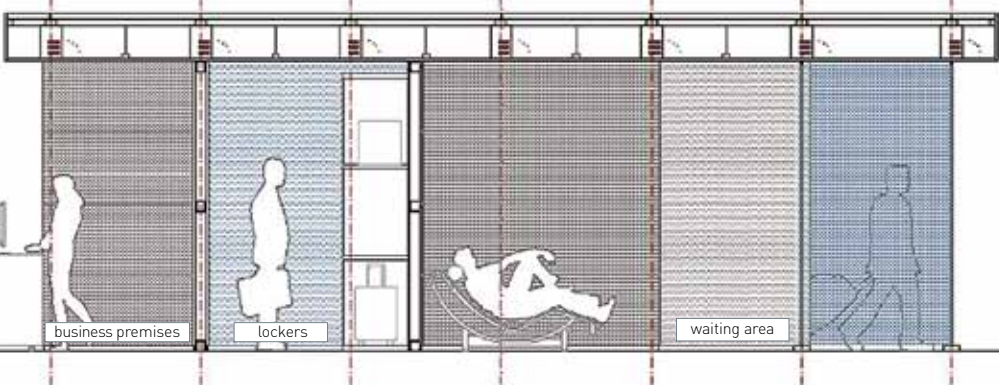
Module for architecture in transports

**CREATORS**  
Pablo Fernández-Victorio, Mar Armenteros, Paloma Nuche and Javier González de Riancho, architects (Department of Architecture, Structures and Instrumentation)

This is a prefabricated architectural element used as a hub between two different transport means. Its main function is to facilitate intermodality. It is built using prefabricated modules that are easy to transport and assemble, and its design and finish can be adapted to the surroundings and climate as well as to the mode of transport.

It can be installed in bus, tram or taxi stops, train stations, airports, etc. According to each case, they can provide different services to users: parking for bicycles and motorcycles, ticket sale points or tourist information, as well as lockers and other services for employees (drivers, etc.).«

*Ineco supports innovation in different areas, looking for utility and cost savings*



MAT (Module for architecture in transports)



INNOVATION | SPAIN | Bridges

# With our feet on the ground

## Bridge scour risk studies

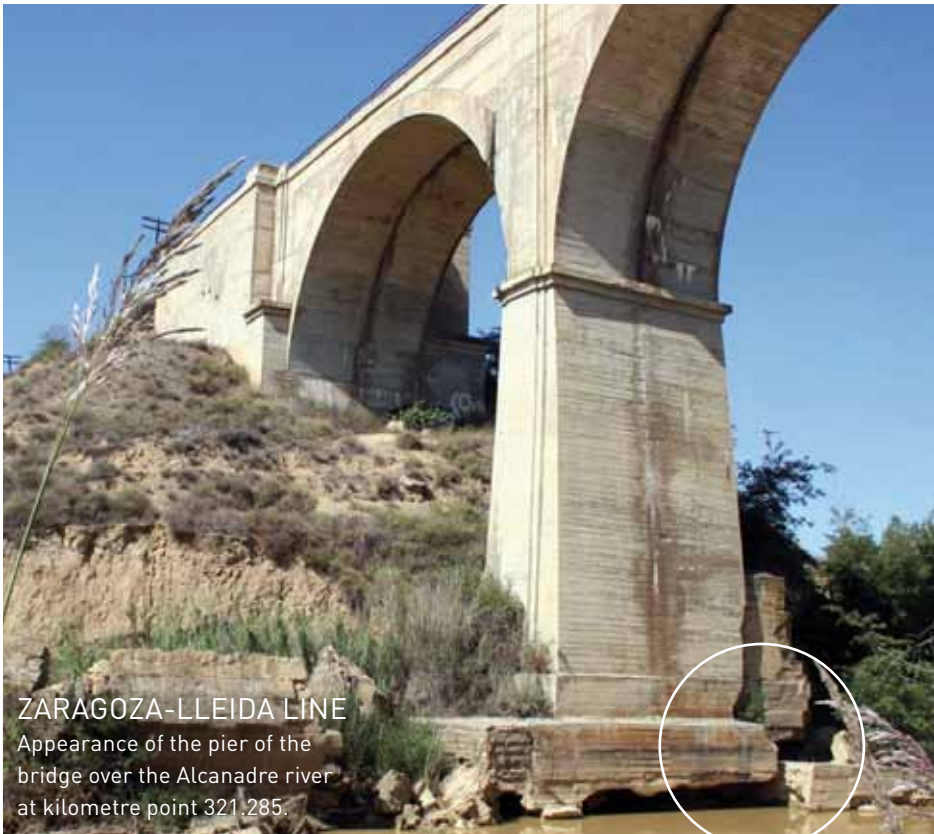
By **Leendert de Haan** (Head of Bridges) and **María Gloria R. Díez** (Department of Architecture, Structures and Instrumentation), civil engineers

The water erodes the piers that support the bridges and causes the erosion of the bed material, causing it to be undermined and potentially even to collapse. Ineco has developed an R&D&i project to study and prevent this phenomenon.

It is not simple to evaluate the interaction of the multiple factors involved in erosion and how these affect cross bridges that cross rivers and other water courses. Nevertheless, having an appropriate model provides essential information for knowing how they affect structures and, ultimately, for how to prevent a potential collapse. The action of the water wears out the piles and the abutments on which the bridge deck rests, but it can also carry away the ground on which they rest, which is known as scour.

**Ineco's extensive experience**

Ineco has been studying these phenomenon for over a decade; they are affected by many variables, in addition to the flow or amount of water reaching the bridge, which determines the water depth and speed. Among others, some relevant factors are the type and slope of the riverbed, the pier characteristics (their shape –for example, a rounded front has better hydrodynamics than a square one, for example– their orientation with respect to the water flow, which determines the extent to which they obstruct the current, their thickness, width and the distance between piers). To date, several authors have attempted to quantify the erosion phenomenon ac-



cording to these parameters using different formulae. In Ineco, a proprietary method is used that combines laboratory calculations and field data to measure two types of erosion: 'present erosion', that recorded at the time of physical inspection of the bridge, and 'potential erosion', that which would occur in case of a flood. Each

*In 2010, Ineco developed a project to study the effects of erosion using a two-dimensional flow model*

bridge receives a score on a scale from 0 to 20 where a higher score represents lower risk of erosion. This method was described for the first time in a water courses manual in 2003, and was perfected in the 2005, 2007 and 2012 editions. In 2008, another manual was written on Bridge Scour Protection. In 2010, Ineco went one step further: in collaboration with the firms TECMA and SICA, it developed an innovation project to study the effects of erosion using a two-dimensional flow model, instead of the one-dimensional model used until then. This involved obtaining data from 360 piers

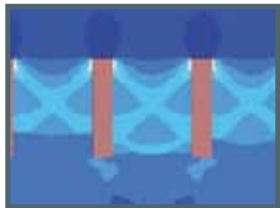
### Recent cases

■ In late September 2012, heavy rain in Murcia, in southeast Spain, caused the collapse of some drainage works and a bridge on the Lorca-Águilas railway line, as well as the collapse of two more bridges over the highways A7 and AP7 (see photo). All of these crossed ramblas or brooks - dry riverbeds with temporary water flow in which the heavy rains caused flooding, which carried away soil, undermining the foundations.

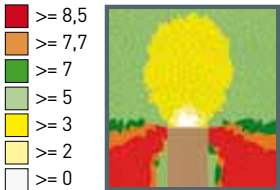


of the over 500 bridges studied until then, with different front shapes, sizes and riverbed slopes, and different flow rates. These data were processed with computer software (InfoWorks RS) that could represent the speed and depth of the water flow at certain points on the piers. The simulations thereby obtained allow for observing the behaviour of the water in 2D and using these data to improve the accuracy of the estimated scour.«

### Drafts and speeds in 2D



The boxes represent the bridge piers, in this case with a square front. The dark blue areas represent the points where the water, which flows downward, reaches its greatest depth, just in front of the pier.



The arrows indicate the direction of flow, and the colours represent the speed of the water in metres per second. The flow can be seen to decrease at the front, upstream from the pier, which interrupts it (yellow area) making it diverge on both sides, where it reaches its maximum speed (red area).



The other square pier front, downstream, and to the right another pier with a round front, which offers less resistance.

### Almost three decades of experience with bridges

■ Ineco has nearly 30 years of experience collaborating with Adif in the maintenance and reinforcement of bridges and viaducts and in all related activities (see *itransporte 07*). As regards to preventing scour at bridges, it is possible to act in both the project stage as the subsequent maintenance stage. In the first case the basic measures involve avoiding the placement of piers within the water course and, if this is not possible, applying direct or deep foundations to a depth beneath the

theoretical maximum scour depth and with the appropriate protections. ■ Once the bridge has been built, inspections are essential to detect any deterioration. Regulations establish 'main' inspections every 15 years or each time there is a flash super flood. Nevertheless, unexpected external circumstances can occur that may affect erosion, such as the extraction of aggregates reducing the river bed level or diversion of water courses due to construction work.



# A hundred-year old bridge rejuvenated

Ineco has drawn up the project and coordinated the works

By **Elena Jerez** (Head of Structural Design Area) and **Asier Sobrado** (Department of Railway Maintenance and Equipment), civil engineers

When it was inaugurated in the late 19th century, it was the highest railway bridge in Spain. Ineco has carried out the preliminary studies, load tests, construction project and technical assistance for the renovation works for Adif.

The El Salado bridge, in Jaén (Andalusia), is located at kilometre mark 67/445 of the conventional gauge line Linares-Almería. It crosses the river after which it is named –dry most of the year– at a height over 100 metres, which in its day set a record for Spanish railway bridges.

In May 1899, when it was commissioned, the first automobiles were just beginning to circulate and railways were in a period of strong growth. Its construction was very complex. It was designed by the civil engineer José Olano, and originally had a length of 315 metres and an iron structure resting on two large stone pillars. It was remodelled in the 70's, when the iron structure was replaced with a new structure that allowed its load capacity to be increased from 14 to 22.5 tons per axle.

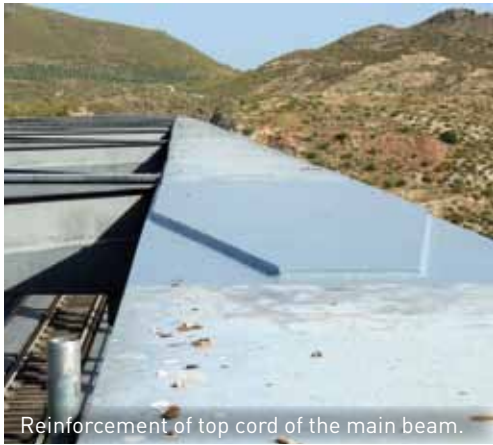
The current bridge comprises three isostatic spans. The main beams of each span are Warren type lattice structures with intermediate struts and a theoretical span of 103.9 metres. They have a maximum edge of 9.5 metres and a horizontal separation of 8.1 metres. The new deck is in a lower position with respect to the main beams and supports the old deck in which the ends of the crossbeams have been cut.«



General view of the bridge.



Inside views and scaffolding.



Reinforcement of top cord of the main beam.



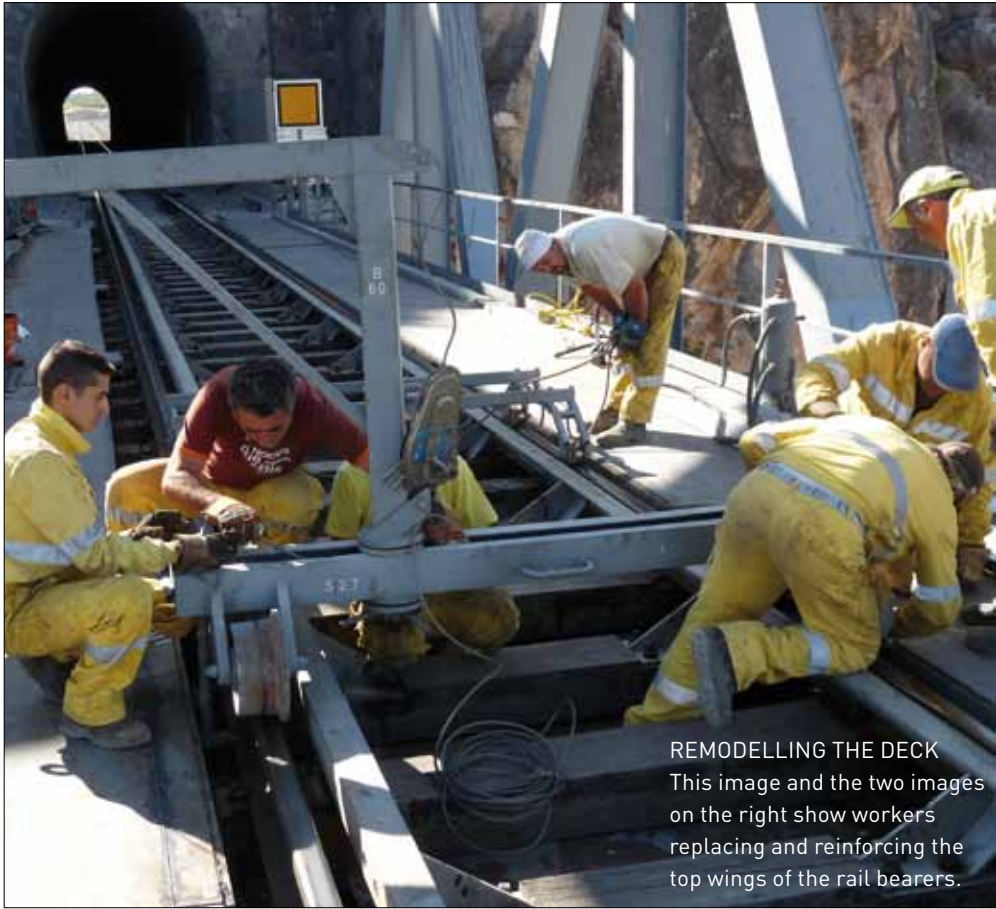
Filling gaps inside joints.



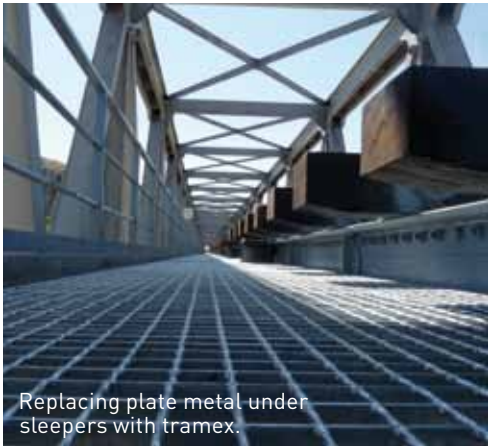
A worker reinforcing a strut.



Replacing service walkway.



REMODELLING THE DECK  
This image and the two images on the right show workers replacing and reinforcing the top wings of the rail bearers.



Replacing plate metal under sleepers with tramex.

## Modernisation actions

In 2011 inspections revealed a need to renovate the structure. Ineco carried out this work at Adif's request, as it has done since 1984, and drew up the modernisation project as well as providing technical assistance for the works. The main actions are:

■ Localised reinforcement of some of the joint of the main beams: plates have been placed on the top and bottom cords of beams, and some of the struts have been reinforced.

■ Remodelling part of the deck: the top wings of the rail bearers on which the sleepers rest have been replaced.

■ Replacement of service walkways: their position prevented performing the track levelling and maintenance works. The new walkways are located at a lower height, freeing the sleepers.

■ Conservation works: repairs, closing gaps, cleaning and greasing supports and surface protection.



# Vitoria-Dax, through the Atlantic Pyrenees

Ineco and Egis Rail are developing the “international section” of the connection

With the collaboration of **Carlos Cubillo** (Head of the Network Development Department) and **Javier Sesma** (Network Development Department), civil engineers

The international rail connection between Vitoria and Dax is a key project that will allow mixed traffic of passengers and goods between Spain and France along the Atlantic coast.

The high speed line linking Spain with France along the Atlantic coast is considered one of the strategic priorities of the European transport network that will link Madrid, Valladolid, Bordeaux and Paris by 2020. In this context, the complementary study of the rail connection between the cities of Vitoria and Dax is an international link that will take place mainly through the national networks (“Basque Y” in Spain, Grand Projet du Sud Ouest (GPSO) in France). The study covers the determination of a fundamental link: the “international section”, the civil engineering of which can only be achieved by taking into account the regional and technical constraints on both sides of the border. The public debate phase on the French side, the continuation of the studies lying outside the scope of Astigarraga/

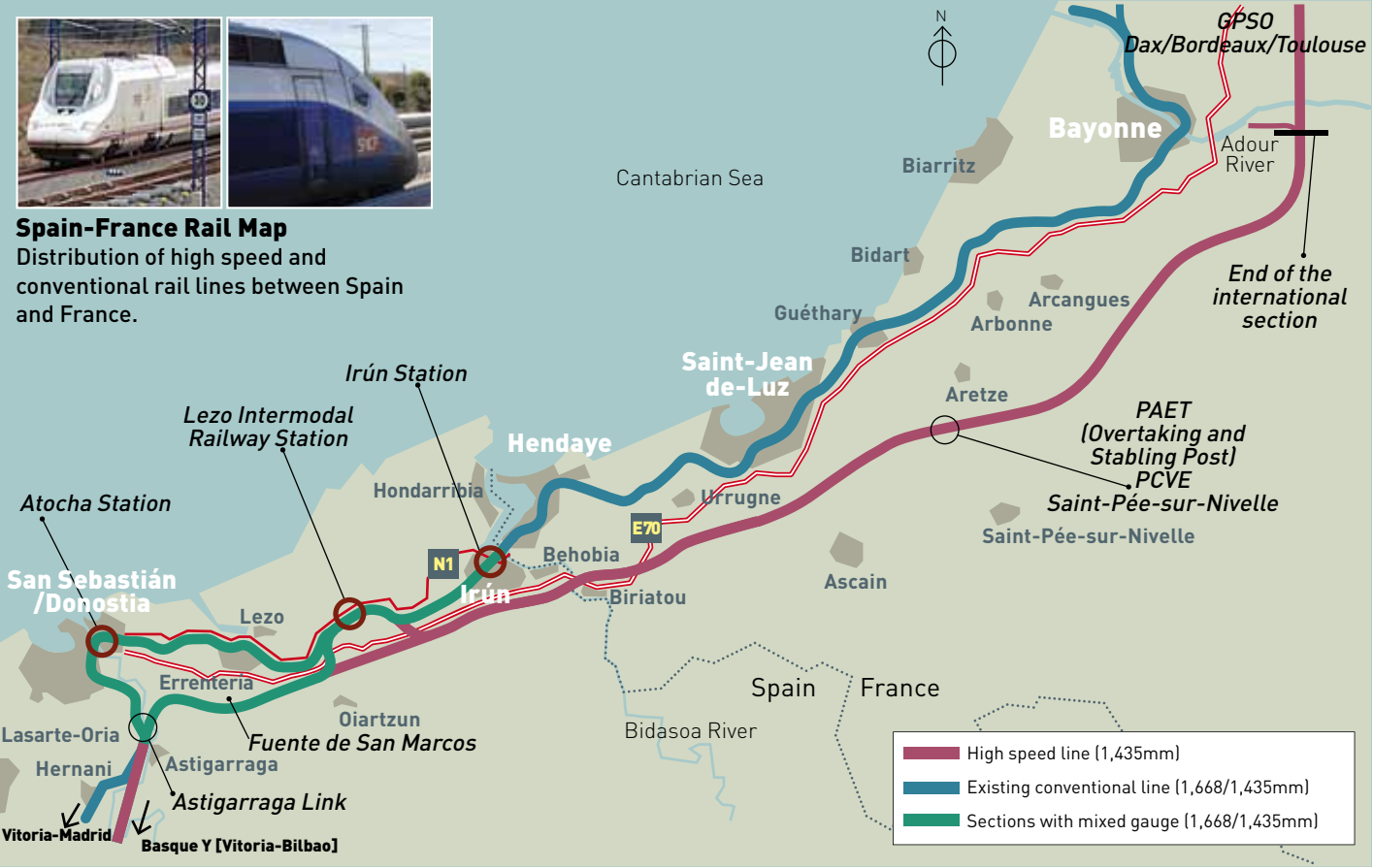
San Sebastián, and the strategic inclusion of the conventional network between Astigarraga, San Sebastián and Irun as part of the action have made it necessary to harmonise the whole. This need has been met by this study by the head drafter from GPSO (Egis Rail) and Ineco, which drafted the study report and other projects for the “Basque Y” as well the preliminary studies of the international link itself. The study plans a direct route between Astigarraga/San Sebastián and Bayonne, and its connections to the conventional network.

## The joint development of the project

Twenty experts in infrastructure and operations from Ineco have participated in the development of this document. It analyses the necessary rail infrastructure, travel times, capacity, interoperability and international transport plan. To carry it out, the planned change has been evaluated in the modal distribution of road freight to rail by means of ferroustage or rail

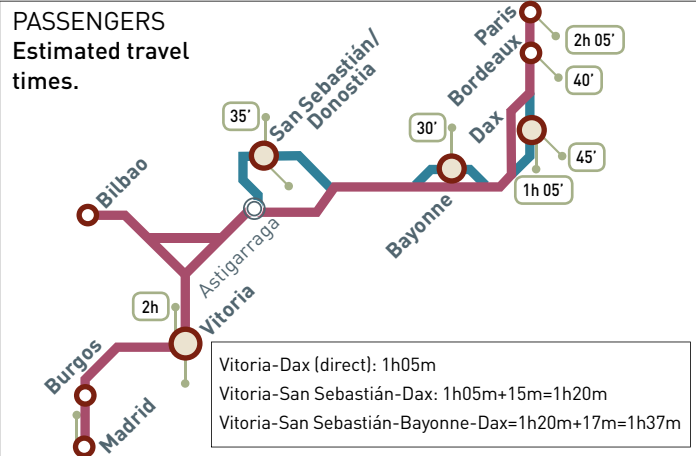
In this regard, it addresses all its engineering, environmental and operational aspects, and examines the various alternatives. These include optimisations and the planning of line facilities for efficient operations involving both passengers and goods. It also includes analysis of the territorial integration of the route in complex areas such as Astigarraga, Oiartzun, Behobia, Biriadou and the natural border crossing viaduct on the Bidasoa river, which more than any other element represents the character of the project.«

highway; the Madrid-Vitoria-Dax-Paris passenger rail axis; the axis of the Great South West Project (GPSO) which organises the high speed network in southwest France; and local and cross-border trips between local towns. The paper also analyses the frequencies of passenger and freight transport, taking the safety requirements into account, including those of dangerous goods.«



Key data on the infrastructure			
→INFRASTRUCTURE [length in km]	TOTAL	TUNNEL	VIADUCT
Full international section [Astigarraga / Adour]	54.5	19.6	9.4
Spain section [Astigarraga / Bidasoa River]	20.5	11.9	4.9
France section [Bidasoa River / Adour River]	34.0	7.7	4.5
→INVESTMENT BY SECTIONS [in millions of euros]	SPAIN	FRANCE	
Low estimate	2,267	1,016	1,251
High estimate	3,223	1,016	2,206

- SAFETY AND COMMUNICATIONS
  - \_ GSM-R throughout the inter-section
  - \_ ERTMS Level 2 on new lines
- ELECTRIFICATION
  - \_ Sub-stations
    - Spanish section Hernani substation
    - French section Arcangues substation
  - \_ Catenary
    - Catenary 2x25 kV suitable for speeds up to 250 km/h



## Travel times

- The estimates of travel times and operating analyses have been carried out with Ineco tools. Thus, we can determine the time, velocity curves and energy and train schedule consumption (programming of operational routes). The study provides for a link between Madrid and Paris by rail in less than 6 hours and a connection to the most important parts of the Basque Country and Aquitaine in under 1hr30mins.
- Madrid - Paris (direct between Vitoria and Dax, stops in Valladolid and Burgos): 5h50m.
- Madrid - Paris (stops in Valladolid, Burgos, Vitoria, San Sebastián, Bayonne, Dax, Mont de Marsan, Bordeaux): 6h27m.



# The study by Ineco and Egis Rail is the basis for the intergovernmental agreements that are needed to promote the construction of the international section between Spain and France

## EUROPEAN NETWORKS

### Connection with France, major issue

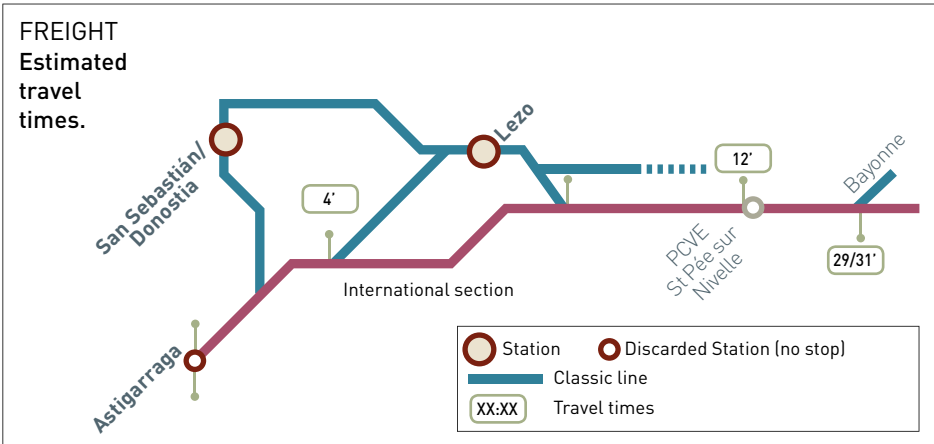
The presidents of the governments of France and Spain emphasised the importance of this project when, following the Spanish-French summit held in Paris on 10th October 2012, they highlighted the “progress with the construction the ‘Basque Y’ (Vitoria-Bilbao-San Sebastián) and studies of the new Bordeaux-Spain line route, as well as the performance as part of the Dax-Vitoria GEIE of the coordination of the

*The Vitoria-Dax connection is a crucial step in improving transport and economic development*

routes at the border”. It is expected that in 2013 the process of public information regarding the Lezo/Oiartzun-border route in Spain will begin, continuing with the final stages of consultation for the GPSO in France.

While the Vitoria-Dax connection is a crucial step for the improvement of transport links, and therefore economic development, between the Iberian Peninsula and the rest of Europe, the French authorities also see a source of wealth in this project for the region of Aquitaine, in its access to the Spanish market, as well as to the north (through Bordeaux) and the southeast of France, with the future high speed line linking Dax and Tarbes to Toulouse, Narbonne and Montpellier.

**Considered as the number one** agricultural region in France, Aquitaine shares a long tradition of high-quality tourism with the Spanish regions of Navarra, Aragón, the Basque Country, Cantabria and La Rioja. They all have a wealth of cultural and architectural heritage, on the Atlantic coast and in their national and natural parks, prehistoric caves and a broad offering of tourism based on cuisine, spas and outdoor activities.«



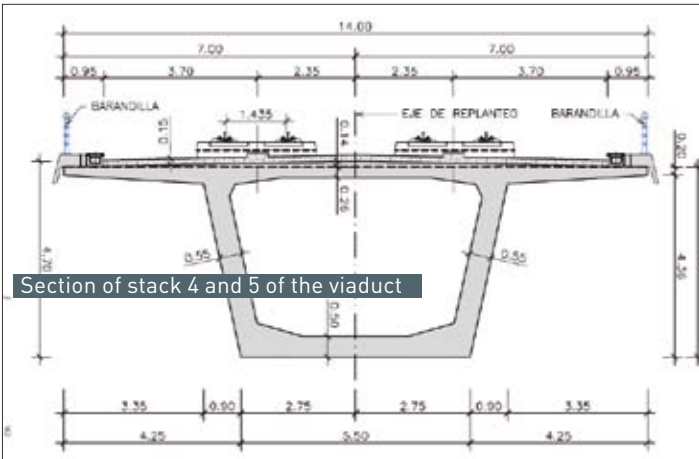
## ENVIRONMENT

### Complex geology

The international gauge section between Vitoria and Dax goes through one of the most rugged areas in the Basque Country and France. In this complex geological context, the study examines the nature and depth of the excavations required, the volume of waste and the location of deposits. The work emphasises the importance of encouraging the reuse of waste and the use of materials as raw material. The aim is to preserve natural resources, given the limited capacity of the land for the deposit of surplus materials. In those cases where it is necessary to introduce dumping sites, a strict environmental integration methodology has been applied. European legislation establishes that the EU as a whole must be able to guarantee disposal of its own waste. It is desirable for each Member State to aim individually to fulfil this objective.«

### Solutions in Spain

■ Thus, in the Spanish section, viable locations were analysed and characterised for this waste given its surplus character, while in the French section, which has surplus between Bayonne and Bidasoa, and deficit between Dax and Bayonne, a massive reuse has been planned from one area to another relying on temporary storage.



### The crossing of the Bidasoa river

■ Among the significant works on this section, a highlight is the design of the viaduct over the Bidasoa river which makes up the border crossing, the geometric linkage of which has required the study of numerous alternatives in order to reconcile the appropriate territorial insertion of the crossing by Biriattou with the difficulties posed by the shallow nature of many parts of the Lumaberde/Biriattou tunnel.

Longitudinal profile of the route

The profile shows the route from San Marcial Tunnel, through the Bidasoa River viaduct, to the Biriattou/Lumaberde Tunnel.



# AIRE projects to improve the environment

## Ineco leads OPTA-IN, a study promoted by Europe and the United States

By **Peter Lubrani** (ATM & Environment Senior Technical Manager) and **Irene Pomares** (ATM Management and Planning Area), aeronautical engineers



**Palma de Mallorca airport has been selected for these tests whose aim is to reduce the environmental impact of aviation. The test will run for 2 years and has a total budget of 440,000 euros.**

**O**PTA-IN (Optimized Profile Descent Approaches Implementing Windows) belongs to a specific initiative of the SESAR Joint Undertaking (SESAR JU-SJU) for performing test flights in the airspace of the terminal area of Palma de Mallorca by late 2013, with a view to subsequent implementation. Its purpose is to minimise emissions and fuel consumption by allowing continuous descent approaches or CDA, also known as ‘green landings’.

Ineco leads this project, which began last September, as part of a consortium formed with Air Europa, Crida, Aena and Indra. The company is also responsible for the communication and awareness plan and is jointly responsible for environmental evaluation, development support and operational assessment. This project arises as part of the AIRE framework (Atlantic Interoperability Initiative to Reduce Emissions), developed by the Federal Aviation Administration (FAA) of the United States and the European Commission, and as a continuation of the OPTA project, with the same purpose of reducing the environmental impact of aviation.

### Project scope

After validating the OPTA procedure, the OPTA-IN project aims to provide support to the CDA implementation plan in Spain.



Continuous descent approach or ‘green landing’.

For this purpose, Indra has joined as the industrial partner to develop a prototype that integrates the SRAT speed adjustment tables, to simplify the use of OPTA without increasing the workload of pilots and controllers. The OPTA project (pre-

vious to OPTA-IN) defined an operational scenario with a minimal impact on aircraft and ATC, simplifying continuous descent operations in medium and medium-high traffic density conditions, also at Palma de Mallorca airport.

### Ineco’s technological contribution

■ **In the OPTA project, Ineco provided the procedure design, contributed to the operational concept and gave support to the preparation of real time simulations. The company was also in charge of evaluating safety, economic costs and environmental impact/benefits. The tangible result of this work is a**

**methodology that can be exported to any airport with medium traffic density. In addition, an air traffic control technique has been developed that allows the number of CDO’s to be maximised, maintaining safety and capacity levels, and improving environmental and economic performance.**

The scope of the OPTA-IN project is limited to studying a minimum of 50 test flights, identifying costs, impact and benefits. The flights will perform a continuous descent using the most efficient engine thrust in accordance with the surrounding conditions, and will be characterised by speed-altitude windows that allow a more flexible sequencing of aircraft by ATC through the use of speed control techniques.

The conclusions will allow a step towards the industrialisation and deployment of the procedure in order to maximise the number of CDO’s (Continuous Descent Operation) in airports with medium traffic density.

*The continuous descent procedures, or ‘green landings’, reduce CO<sub>2</sub> and NO<sub>x</sub> emissions.*

OPTA-IN also proposes the development and construction of a prototype to improve ATC control tools and help monitor OPTA procedures.

The previous OPTA project, which lasted two years and in which Aena, Crida, Ineco, Boeing and Air Europa all took part, generated a solution that maximised the number of ‘green landings’ in the short term and with medium traffic density, without requiring changes in the air traffic management system. The environmental benefits of OPTA-IN are estimated to represent a 22 to 30% reduction in CO<sub>2</sub> emissions and a 50% reduction in NO<sub>x</sub> emissions. The noise reduction also estimated is around 3 to 6 dB per flight (for more information go to [opta.ineco.es](http://opta.ineco.es)).«



### Kick-off meeting

■ **The OPTA-IN kick-off meeting was held last September 2012 in Palma de Mallorca, with the presence of the SJU Environment Officer together with all the consortium members: Air Europa, Crida, Aena, Indra and Ineco. The above picture shows a moment during the visit to the Air Europa installations.**



# A way stop in Miranda

The new bus station was inaugurated

With the collaboration of **Ángel Ranz**, architect (Head of the Architecture Department) and **Miguel Moreno**, industrial engineer (Head of Installations-Department of Railway Maintenance and Equipment)



The big roof of the new station.



Lobby and ticket counters.



## THE NEW STATION

The unique roof covers five orthogonal prisms, offset with respect to one another and connected by a transit axis that runs from the entrance to its end at the lobby, leading to the bus bays. These five prisms house the specific uses of the station: shops and businesses, toilets and ticket counters.

**The new Miranda de Ebro station, the project and construction management of which were executed by Ineco, and which completes the important communications hub in the city, promoting intermodality between trains, buses and taxis.**

**M**iranda de Ebro has a population of almost 40,000. It is a city in the north of Spain with a strong industrial and logistical character. It is within the province of Burgos, 80 km from the capital city of Burgos and strategically close to other large cities such as Vitoria-Gasteiz (33 km), Logroño (60 km)

and Bilbao (90 km). Regional and local authorities see in its location an untapped logistical potential, also due to its proximity to the ports of Bilbao, Pasajes and Santander, and the cargo airports of Foronda (Vitoria-Gasteiz), Loiu (Bilbao) and Villafria (Burgos). Since the Middle Ages this town, crossed by the Ebro river to which it owes part of its name, has had a strong business activity as shown by its numerous conventions, industrial parks and road networks, as well as its architectural heritage. The train station and its comprehensive railway facilities was, in past centuries, an important incentive for the establishment of many industries. In short, the city has

played a significant role as a point of transit and distribution of travellers and goods between the Castilian plateau and the east and north of the Iberian Peninsula, as well as in their connection to the rest of Europe. This has turned Miranda de Ebro into a significant infrastructure enclave, both in terms of roads, as it connects to some of the most important highways and roads in the country (AP-1, AP-68, N-1,

*Miranda is a hub at which the main traffic routes of the Iberian Peninsula converge and, by extension, its European connection*

N-232, etc.), and railways, as the Madrid-Irún-Paris, Lisbon-Irún-Paris, Bilbao-Barcelona, and Madrid-Bilbao lines pass through it.

### Overdue and highly anticipated project

In this context, the new bus station inaugurated last November was an overdue and highly anticipated project in which Adif (Spain's railway infrastructures administrator) has invested 3.9 million euros. Ineco drew up the construction project, the modified project and was in charge of construction management for the building works for Adif. The City Council of Miranda will be responsible for its management for the next 20 years, and to this end will

require all public and private transport to use these facilities.

The complete intervention involved remodelling the Station Square, the station itself, rearranging the urban surroundings, restoring the old train station and building a new car park for 57 vehicles.

The bus station has been designed from the image of a large roof with a shape that adapts from its lowermost part at the access to the pedestrian stairway to its uppermost part, in response to the scale required by the buses. In short, it is a design that is sensitive to the different kinds of spaces it covers.«

## The built complex

Surface distribution	
Building	739.1 m <sup>2</sup> (not including canopy, overhangs)
Auxiliary building	66.0 m <sup>2</sup>
Bus access bays	325.0 m <sup>2</sup>
4 docks + bus manoeuvring area	1,181.3 m <sup>2</sup>
Access from public square	76.3 m <sup>2</sup>
North area (not including outside facilities)	252.7 m <sup>2</sup>
Car park (for 57 vehicles)	1,394.0 m <sup>2</sup>
Station Square	859.9 m <sup>2</sup>
GROSS FLOOR AREA	
Total	4,894.6 m <sup>2</sup>



# Crossing the Víboras river

## The design of a complex infrastructure on unstable ground

By José Manuel Sáez, civil engineer (Department of Roads)

The construction of the Olivar highway will benefit over 90 municipalities in the interior of Andalusia. Ineco has executed the project for a complex stretch that will contribute to the social and economic development of a region with an important industrial network.

The Olivar highway, with a total length of 170 kilometres, will connect 90 municipalities in the interior of Andalusia between Úbeda (Jaén) and Estepa (Sevilla), passing through the city of Jaén, and will provide outstanding support for linking many medium-sized towns that are experiencing increasing economic growth. The new highway will bring the surrounding municipalities to within 25 minutes from a high-capacity road. In addition, local residents will gain convenient and quick access to social, educational and health services based in the larger towns. Currently, road A-316 has an average daily traffic (ADT) density of 5,710 vehicles, of which about 10% are heavy vehicles.

The project has been prepared by Ineco in a JV with the Andalusian consultancy firm NAVIER, with a 65/35% share. The work is based on works along a 10 kilometres segment of road A-316, from the intersection with road A-6051 to road N-432 (Alcaudete) of the Olivar highway. In addition to specifying the materials, the geometrical definition and the technical characteristics of each work, the study takes into account technical and economic aspects, both in the construction stage and in the preservation and operation stages.«



### Alcaudete link

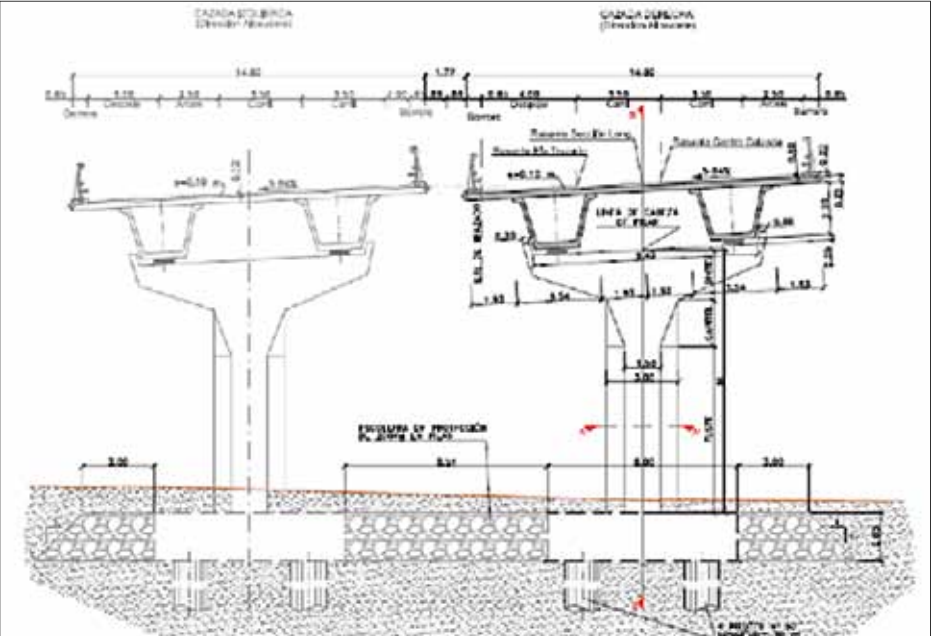
■ In the segment planned by Ineco, the Alcaudete link connects the Olivar highway with the future Badajoz-Córdoba-Granada highway and the access ways to roads A-316 and N-432, which will remain as frontage roads. It has a 'trumpet' style preliminary design, with direct trunks in the Jaén-

Córdoba (both directions) and Granada-Jaén movements, leaving a loop in the Jaén-Granada movement. Access to frontage roads is enabled by an inverted 'diamond' dumbbell intersection over the axis of the Olivar highway, at a point very near the intersection of the A-316 and N-432 roads.



### HEC-RAS SIMULATION

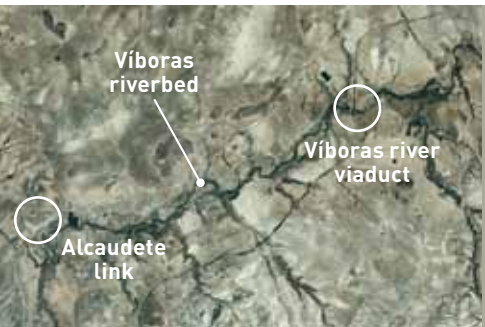
To assess the behaviour of the river (it is currently a flood plain), it has been modelled over 6.8 kilometres –including the planned viaduct– using the HEC-RAS software.



### Viaduct over the Víboras river

■ In this design, the double structure stands out, one for each carriageway, made of prestressed concrete with a curved alignment in a plan view, a length of 159 metres, banked and sloped. It is a structure with a box type platform formed by two beams on which a compression slab is placed. These beams create spans

40 metres in length. With this design supports are placed near the riverbed, with deep foundations. The objective is that the structure settle, due to the bearing capacity of the ground used as foundation and to the settling of the embankment itself.



### VÍBORAS RIVER PLAINS

In order to match the type and final length of the viaduct, a hydraulic analysis of the river was necessary, determining its flood discharges, which were determined by calculating a unitary hydrograph (using the HEC-HMS software).

### Geological and geotechnical studies

Nearly all the ground on which this segment runs is used for olive grove cultivation. The region has a hilly morphology, with gentle relief, except on the banks of the Víboras river and the Jamputa creek. From a geological-geotechnical standpoint, the segment is quite complex as it is comprised of different materials, among which the clays, gypsums, Trias dolomites and sandstone are of particular note. The right bank of the Víboras river is particularly delicate, as the terrible intrinsic characteristics of the ground are compounded by significant slopes that facilitate instability and landslide events. The tributary creeks to the river must overcome a great difference in altitude over a very short length, leading to headwater erosion phenomena.

The main design challenge, in view of the low quality of the materials and their high changeability in contact with water, was to study, calculate and plan a coherent and comprehensive infrastructure to both ensure the crossing of the water intercepted by the canal (transverse drainage) and the evacuation of runoff water from the road bed and slopes (longitudinal and underground drainage, preventing the possibility of water filtration and, if it does occur, capture and evacuation out of the embankment core and base layers. In addition, due to the natural instability, rockfill containment walls have been calculated at the start of the land clearing.«



# More alive than ever

In only one decade, the Spanish biotechnology sector has emerged as one of the most dynamic sectors.

The OECD defines biotechnology as “the application of science and technology to living organisms, as well as parts, products and models thereof, in order to alter living or non-living materials for the generation of knowledge, goods and services”. For example: anticancer drugs made from marine organisms, gene therapies, metallic nanoparticles able to repel bacteria, foods enriched with microorganisms that protect persons with coeliac disease from the harmful effects of gluten, biofuels manufactured with algae, blood derivatives, plague-resistant plants, microbes that devour pollutants from spills...

## New market niches

These are only some of the products and services developed by Spanish companies making use of some biotechnological process which, in 2010, according to data from the Spanish Association of Biocompanies (ASEBIO), amounted to more than 1,700, almost 13% more than the previous year. “A great number of companies use some type of microorganism to manufacture their products; for example, beer, wine, dairy products,” pointed out Rafael Camacho, an expert in biotechnology and former director of Fundación Genoma España. “There are about 600 dedicated to biotechnology, of which about two thirds are focused on the health care sector: developing drugs, advanced therapies and diagnosis devices”.

Curing or preventing diseases using stem cells or modifying genes and repairing tissues “are, in many cases, already clinical realities”, he added. This view is shared by Jorge Barrero, assistant president of ASEBIO, underscoring Spain’s leading position “in niches such as blood derivatives, advanced therapies, biofuels, personalised medicine or the discovery of drugs of marine origin”. In Europe, according to ASEBIO and Fundación Genoma, Spain ranks sixth as a pharmaceutical power. The pharmaceutical industry represents

19.8% of total private investment in R&D in Spain, which also ranks fifth by number of clinical tests, with a cost per patient 30% lower than in countries such as the United States. It is also a leader in agricultural biotechnology, growing 80% of the genetically modified maize produced in the European Union.

Indeed, according to a study by the American Society of Gene and Cell Therapy published in 2012, Spain is the European country where the most advanced therapy projects are being developed, a total of 49, ahead of the UK with 37, Germany with 36, and the US with 21, making it the European leader in this field. Spain also leads the ranking by number of sponsors (29) who, as

Yondelis (Trabectedin) is an anti-tumour agent of marine origin found in the colonial tunicate *Ecteinascidia turbinata*.

PHOTO: PHARMA MAR

## SECTOR OVERVIEW

**1,715 companies, 617 of which have biotechnology as their main or only activity, almost 30% more than the previous year**

**2010 turnover: 60,122 million euros, 11% more than in 2009**

**Share of GDP: in 2012 it is estimated that it will reach 1.8% (almost double that in 2009)**

**Employment: 163,526 workers, 3.8% more than in 2009**

**Private internal investment in R&D: 568 million euros, an 11.2% increase**

**Strong foreign outlook: in 2010, 70% of Spanish companies formed alliances with foreign companies. Although European nations continue to be the main partners (65%) firms from the US have increased their share and now represent 21%**

**Challenges: the fall in public investment in the past two years and the low number of patents**



Abengoa plant for the production of ethanol from biomass in Babilafuente, Salamanca.

indicated by Camacho, are “mostly hospitals, universities and research centres”.

## The pharmaceutical industry

As regards drugs, according to the latest annual report by ASEBIO, there are currently 32 Spanish companies developing 89 new drugs, two of which –one for prostate cancer and another for nocturnal enuresis– are ready for market. A further 49 drugs are being developed by the Spanish subsidiaries of six multinational companies. Cancer, cardiovascular and neurological diseases make up 50% of the projects, although bioproducts are also in different stages of development for ailments such as Crohn’s disease, inflammatory diseases, diabetes, etc. Likewise, 14 drugs for animals are also being developed.

*Spain is the European country that develops the highest number of advanced therapy projects, ahead of the UK and Germany*

In addition to medications, the Spanish biotech sector also produces a great variety of products and technologies for all types of uses: diagnosis kits (61 projects) or blood derivatives; food industry (manufacturing processes, conservation processes, etc.); agricultural and farming products (biofertilisers, biopesticides, growth of genetically modified plant varieties, feed, etc.), environmental protection (bioremediation), etc. Of particular note in this field are the 40 biofuel projects being developed by different Spanish companies.<<

## Success cases

Fundación Genoma published in 2011 a selection of ten success cases of Spanish biotech firms: Biofrabri, Biomedal, Biópolis, Biotools, Gendiag, Ingenasa, Lipotec, NeuronBio, Oryzon and Progenika, all of them with over 5 years in existence and a healthy financial situation. A decade ago now, the firm Pharma Mar, from Grupo Zeltia, based in the region of Galicia, was one of the pioneers in the sector with an anticancer drug developed from a marine organism, Yondelis, which nowadays is sold worldwide. Also of note is the Catalanian firm Grifols, the third most important company in the world in the production of plasma-derived biological medications, and Abengoa Bioenergía, a Spanish multinational that is a world leader in biofuels.



Grifols is listed in the stock exchange and, in 2011, acquired the US firm Talecris for 3,300 million euros.



Packaging of the anticancer drug Yondelis from Pharma Mar.

PHOTO: PHARMA MAR

## Double digit growth

Despite its small size in absolute terms, the sector’s dynamism has remained strong in both turnover and number of companies and projects since 2002: a true ‘golden decade’ for biotechnology in Spain. Both the business volume and number of companies are growing at a rate above 11%, as well as international alliances, to which many companies turn for marketing or distributing their products. In this sense, the spokesperson for ASEBIO indicated that “the foreign market is key in a sector in which suppliers, competitors and customers are distributed globally” and in which Spanish companies have managed to “make a niche for themselves with great effort”. The main challenges, he adds, are now to “attract foreign risk capital, recruit international talent or find partners in leading markets, such as the US or Japan”. Currently, Spanish companies are present in 30 countries worldwide.



Two thirds of Spanish biotech firms focus on the health care sector.



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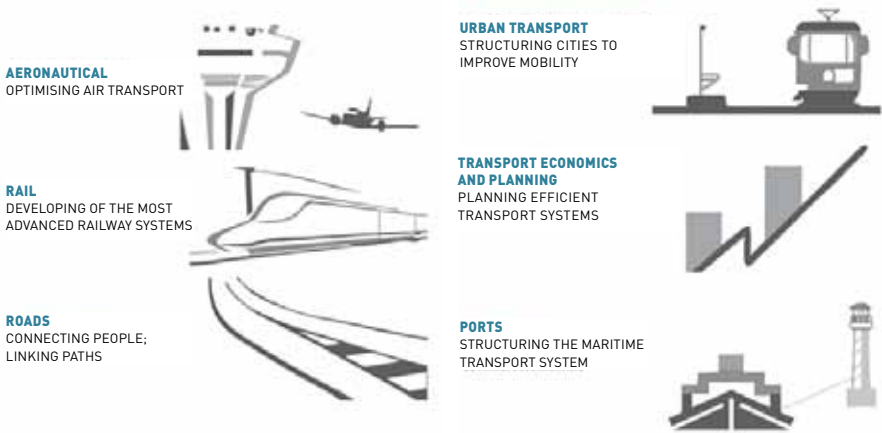
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