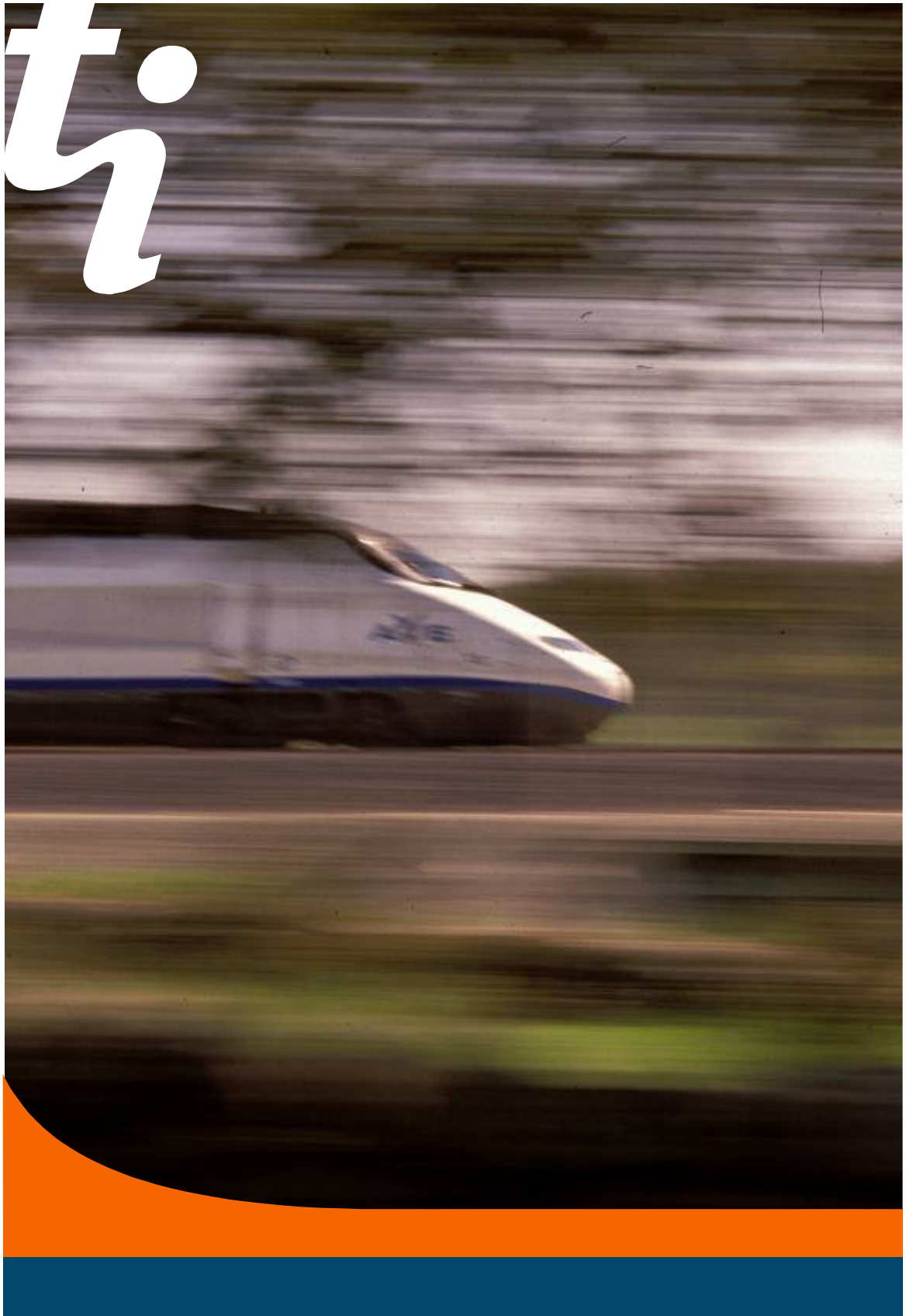


eptisa

WE DO IT FOR YOU



ENGINEERING

Our experience in the sector spanning more than 50 years and our company's strength allow us to deal with any challenge

Eptisa is an international company that provides management, consultancy and design services for all aspects of civil engineering.

In the course of its 50 years of operation, Eptisa has demonstrated time and again its ability to respond to the demands of a market that has become increasingly complex and challenging, and the company has successfully positioned itself as the leading engineering firm based in Spain.

Its commitment to comprehensive, client-oriented services has made it a global player, not just in the engineering industry but also in the fields of information technology and public health.

Eptisa sees its activities as essential to the sustainable development of the society that it serves, transcending the mere concept of technology and actively engaging in the social network. This has allowed the company to play a decisive role in determining the future direction of the industry as well as in the development of infrastructure in the countries where it is completing projects.

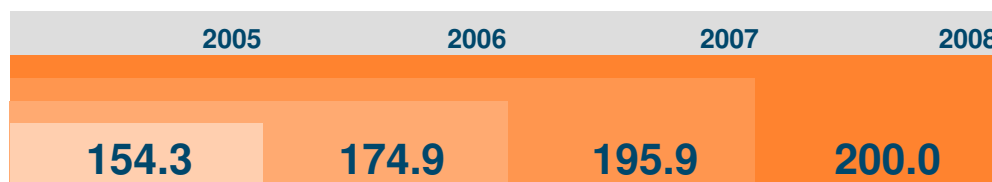
Eptisa is today a reference in the markets in which it operates:

- Transport Infrastructure
- Buildings
- Water and the Environment
- Government
- Development Cooperation
- Industry
- Energy, Telecommunications and Networks
- Defence, Security and Emergencies
- Financial Sector

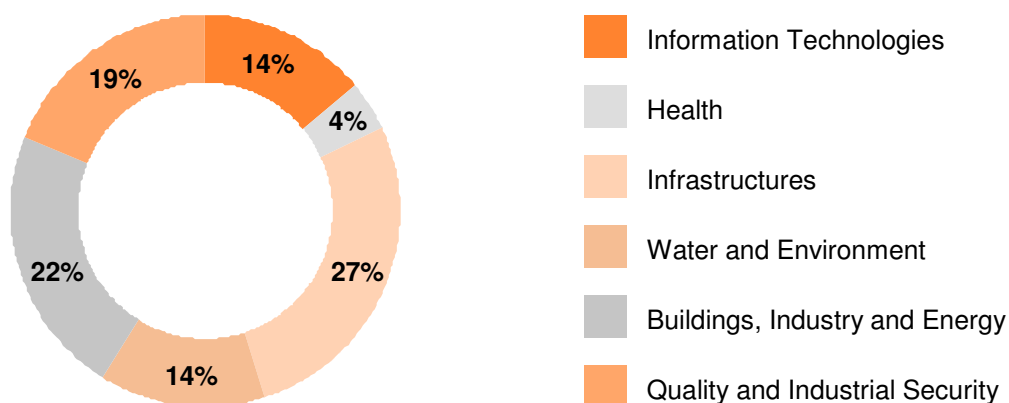
Every sector has its own requirements and challenges. Eptisa has teams of sector experts who are dedicated 100% to solving problems and moving forward in their respective industries.

Eptisa finished fiscal year 2008 with a gross **income of 200 million Euros**. In terms of human resources, the total number of employees rose to 2,216.

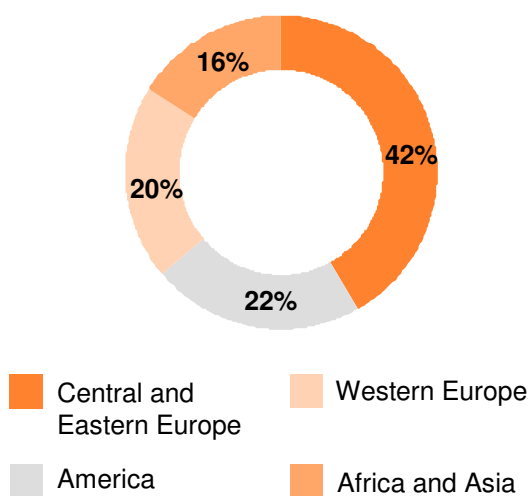
Gross Income



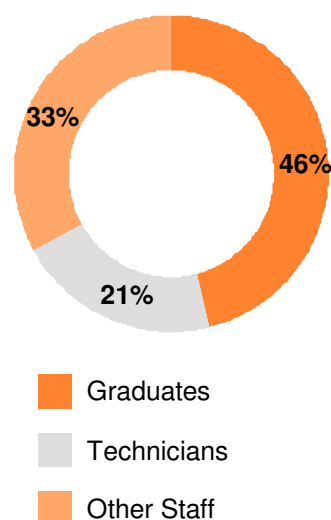
Sectors



Geographic Distribution of International Activity



Human Resources





Projects in the World

America

- Costa Rica
- El Salvador
- Guatemala
- Honduras
- Nicaragua
- Mexico
- Panama
- Dominican Republic
- Argentina
- Brazil
- Chile
- Ecuador
- USA
- Venezuela

Europe

- Bosnia i Hercegovina
- Bulgaria
- Slovakia
- Slovenia
- Ireland
- Kosovo
- Montenegro
- Portugal
- Rumania
- Serbia

Africa

- Angola
- Egypt
- Mauritania
- Morocco
- Namibia
- Tunisia

Asia

- China
- Israel
- Jordania
- Palestine
- Syria



Specialists in infrastructure. Solutions, information systems and services that guarantee security in Transport.

- **Infrastructure Projects**

Eptisa offers an extensive range of services to support water management and transportation companies

- **Supervision and Control**

We satisfy all our clients' needs by applying the principles of Quality and respect for the Environment

- **Infrastructure Monitoring**

We offer monitoring plans that will confirm the viability of projects in terms of safety and help in the optimization of the construction process

- **Quality Control for Public Works and Construction**

Eptisa has the largest network of accredited laboratories in Spain. We also operate laboratories outside of Spain

- **Geographic Information Management**

The capture, manipulation, analysis and visualization of geographic information in order to solve complex planning and management problems

- **Environmental Consulting**

Eptisa has a team of specialists in Industrial Environmental Consulting, Environmental Management and Natural Resources

- **Development Consulting**

Over 30 years of experience in the completion of Cooperative projects outside of Spain

- **Industrial Equipment, Facilities, Maintenance and Processes**

We offer monitoring technologies and industrial process automation as an R+D related service

- **Trimble Devices**

We are exclusive distributors of various Trimble devices for the acquisition and capturing of field data

- **Agronomy and Land**

Eptisa completes projects in the fields of expropriation, inventory, property, surveying, land re-allocation and forestry





Since its incorporation in 1956, Eptisa has participated in countless projects related to railway infrastructures.

Eptisa was one of the pioneering engineering consultants in High Speed projects in Spain, by means of its participation in the → Madrid – Seville High Speed line.

The work consisted of diverse designs, studies and technical assistance for the project in most of the sections of the line.

Since then, Eptisa has participated and it takes part in the Design, Site Supervision, Quality Control and Monitoring and geo-technical applications in all of the High Speed axes of the High Performance Railway Map in Spain. It is important to note that Eptisa, in addition to the railway projects related to High Speed services, has also taken part numerous projects relating to the diverse Spanish infrastructures, highlighting:

- Adapting of existing Conventional Lines to High Speed lines
- Renewal of Conventional Lines
- Track duplication in Conventional Lines
- Construction of new Regional Lines
- Conventional Underground Lines
- Light Railway Lines
- Elimination of level crossings
- Passenger stations

Railway Activities of Eptisa

–Studies and Projects on platforms, super-structures, electrification and signalling:

- Feasibility Studies
- Studies of Prognosis of traffic, demand and profitability
- Basic Design
- Detailed Design

–Geo-technical, Environmental and Hydro-geological Studies

–Technical Assistance of Projects

–Control and Quality of Projects

–Instrumentation and Monitoring

LINE NAME
•MAIN EPTISA PROJECTS

OURENSE-SANTIAGO LINE
•SECTION OURENSE-LALIN
•ACCES TO THE OURENSE STATION

NORTH-NORTHWEST HIGH SPEED CORRIDOR
•SECTION: SOTO DEL REAL-SEGOVIA
•GUADARRAMA TUNNELS
•SECTION MATAPOZUELO-VALDESTILLAS
•SECTION SEGOVIA-GARCILLÁN

LISBON-MADRID LINE
•SECTION POCEIRAO-CAIA

SUBCANTÁBRICO RAILWAY CORRIDOR
•LEÓN-PONFERRADA- MONFORTE DE LEMOS- LUGO Y LA CORUÑA

MADRID-SARAGOSSA-BARCELONA- FRENCH BORDER
•SECTION LLEIDA-VILAFRANCA DEL PENEDES
•SECTION HOSPITALET-LA TORRASA
•SECTION GELIDA-SANT LLORENÇ D'HORTONS

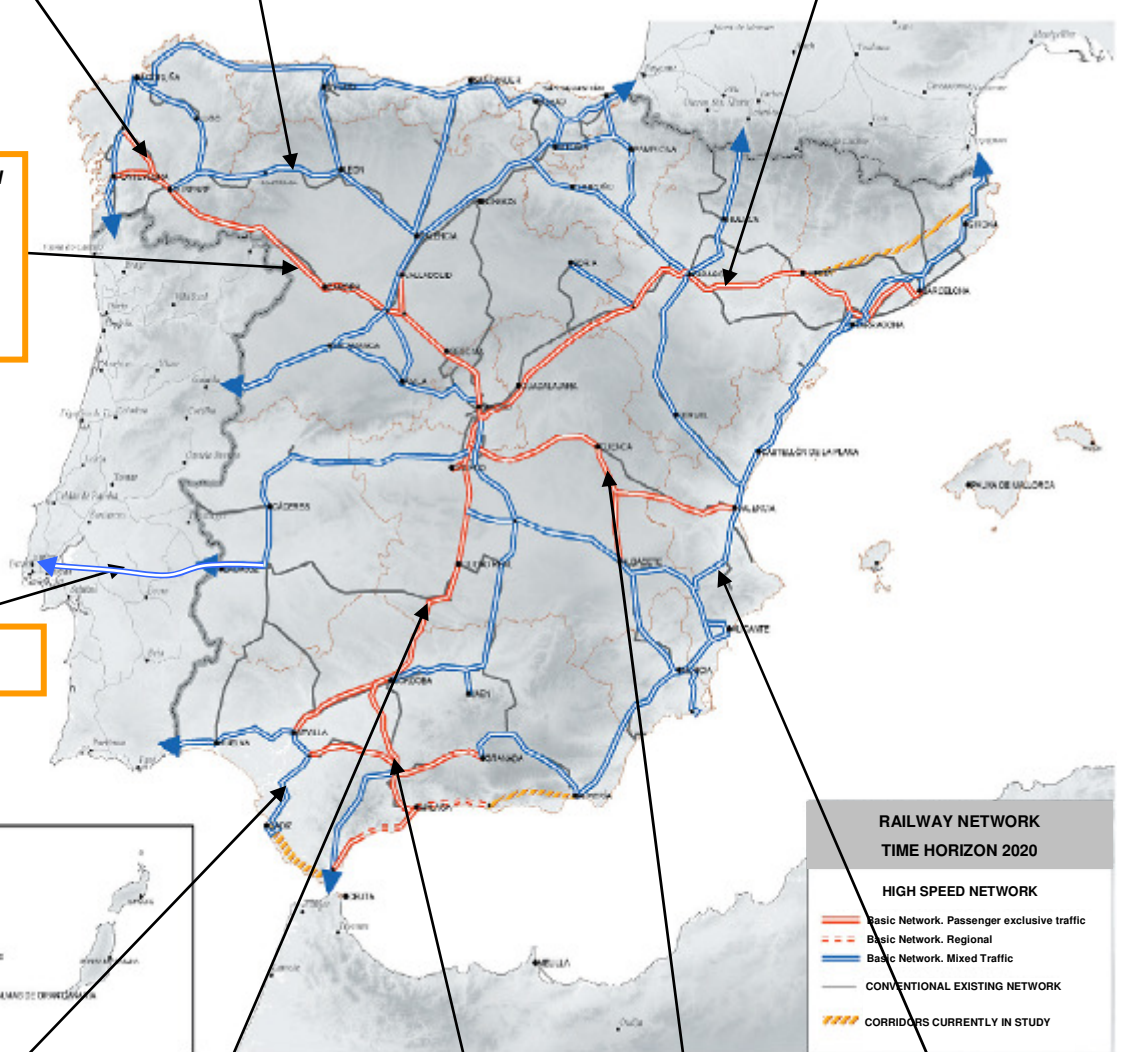
CÓRDOBA-MÁLAGA LINE
•SECTION ÁLORA-CÁRTAMA
•SECTION GUADALCÁZAR- FUENTE PALMERA

NEW RAILWAY ACCES OF HIGH SPEED OF LEVANTE
•SECTION NUDO DE LA ENCINA- JÁTIVA

SEVILLA-CÁDIZ LINE
•SUBSECTION: BAHÍA SUR

NEW RAILWAY ACCES TO ANDALUCÍA. MADRID-SEVILLA LINE
•SECTION BRAZATORTAS-ALCOLEA
•SECTION ADAMUZ- VILLANUEVA

MADRID-CASTILLA LA MANCHA-VALENCIA- MURCIA LINE
•SECTION CHESTE-ALDAYA
•SECTION MOTEAGUDO DE LAS SALINAS-SOLERA DE GABALDÓN



PLATFORM CONSTRUCTION PROJECT OF NORTH-NORTH-WEST HIGH-SPEED CORRIDOR, ORENSE-SANTIAGO AXIS, SECTION: ACCESS TO THE ORENSE STATION

Client: Administrador de Infraestructuras Ferroviarias (ADIF)

Amount of the contract:

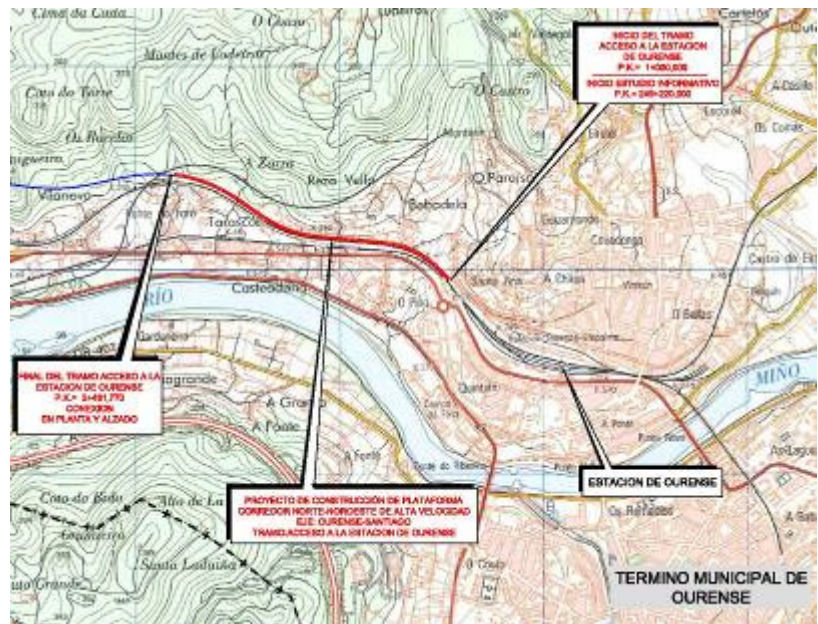
Project: € 403,753.43

Date of execution:

Project: February 2009 – September 2009

Geographical location:

Orense Province. Autonomous Community of Galicia. Spain



Length	1.46 Km
Project Speed	140 Km/h
Minimum radius	750 m
Earth movement Embankment Levelling	54,196.8 cu.m. 101,031.50 cu.m.
Structures Lower steps	4
Railway Repositioning Monforte-Vigo Line Zamora-Coruña Line	973.13 m 1,708.7 m

The works considered in this project are those corresponding to the High-Speed North-Northeast Corridor, Orense-Santiago Axis, with the section running wholly through the municipal district of Orense, and with the total length of the section being 1,460 m. This stretch belongs to the future High-Speed Network of Spain.

As regards the new High-Speed Line, only the platform is defined in the project, up to the sub-ballast layer (included), with the track super-structure being the subject of a specific study. In addition, those actions are defined that relate to the railway installations which it is appropriate to carry out simultaneously with the work on the platforms (pipes and cable crossings, earthing and anchoring of posts in viaducts).

This section displayed the particular feature that there were two lines of conventional width in service in the scope of the work, the Zamora-Coruña Line, and the Monforte-Vigo Line and that the platform of the new HSL ran practically the whole length of the Zamora-Coruña Line, which made it necessary to move it. Therefore, the repositioning of both lines was also carried out.

In this case, the work covered the infrastructure, the track, the electrification and the safety and communications installations, as well as all of the provisional railway situations necessary in order to guarantee the viability of the construction process.

Detailed design of high speed rail line Madrid – Galicia. Section: Ourense-Santiago. Subsection: Lalín (Abeleda)-Lalín (Baxán)



Client: DRAGADOS-VÍAS JV

Contract Value: 680,000 € Design
77 million € Construction

Contract Dates: Construction start: January 2006
Design: April 2004 – July 2005

Location: Pontevedra province. Galicia. Spain (northwest)

Eptisa's responsibilities:

- Ground investigation contract supervision
- Detailed Design

Description of services provided:

Prior to this contract, EPTISA collaborated with the DRAGADOS-VÍAS JV in the preparation of the Tender Design. Once the contract was awarded, EPTISA carried out the following activities:

Alignment alternatives study based on Preliminary Design

Conceptual Design of the best solution based on technical, economical and environmental criteria.

Detailed design of the infrastructure, ballast included (the superstructure –installations - is defined in a different contract although the design of the services enabled during the construction is also provided – earthing cables, cable crossings, posts anchors in viaducts, etc.)

Works Technical Data:	Length	9.76 Km	Bridges lengths	
	Design speed	350 Km/h	- CH 0+248 - CH 0+533	285 m
	Minimum radius	6,500 m	- CH 1+721 - CH 1+918	197 m
	Earthworks		- Abeleda	368 m
	- Fill	500,000 m ³	- Deza	913 m
	- Cut	3,275,000 m ³	- CH 5+776 - CH 5+836	60 m
	Concrete	87,000 m ³	- Riadigos	253 m
	Steel	10,500,000 kg	- Portos	858 m
	Passes		Tunnels	
	- Overpasses	6 No	- Abeleda	489 m
	- Underpasses	1 No	- Vila	503 m



Client: Ministry of Public Works, General Railways Board

Amount of the contract: 362,188.06 Euros.

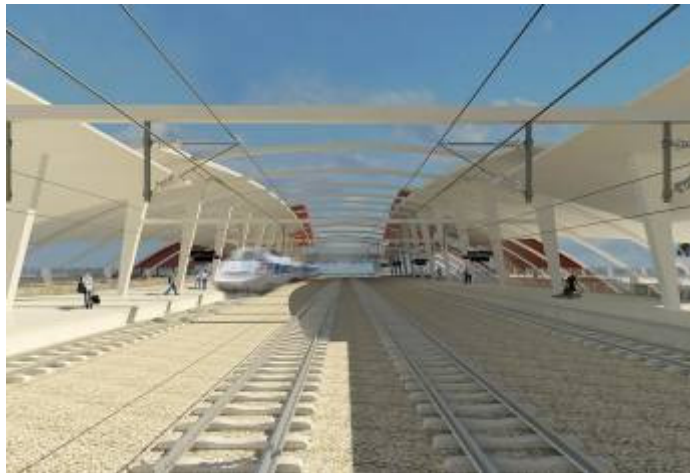
Date of execution: The project is presently at the work stage.

OBJECT OF THE WORK:

The Studies considers the following contents:

- The coordination of the Informative Studies
- The follow-up and review of the Informative Studies
- Thematic consultancy.
- The analysis of transport demand and its prognosis, in the Corridor.
- The evaluation of profitability, from the social-economic and financial viewpoint, for the alternatives proposed in the Informative Studies.
- Support in complementary services

HIGH SPEED RAILWAY LINE. POCEIRAO – CAIA STRETCH. LISBON-MADRID AXIS



Client: U.T.E. CINTRA-MERIDIAM-HAGEN-CONDURIL-TECNOVIA-NOVOPCA

Amount of the contract: Work: € 1,400 million - Project: € 1,500,000

Date of execution: Work: June 2009 - Project: June 2008– October 2008

Geographical location: Portugal

Technical details:

Supervision of the geo-technical campaign.

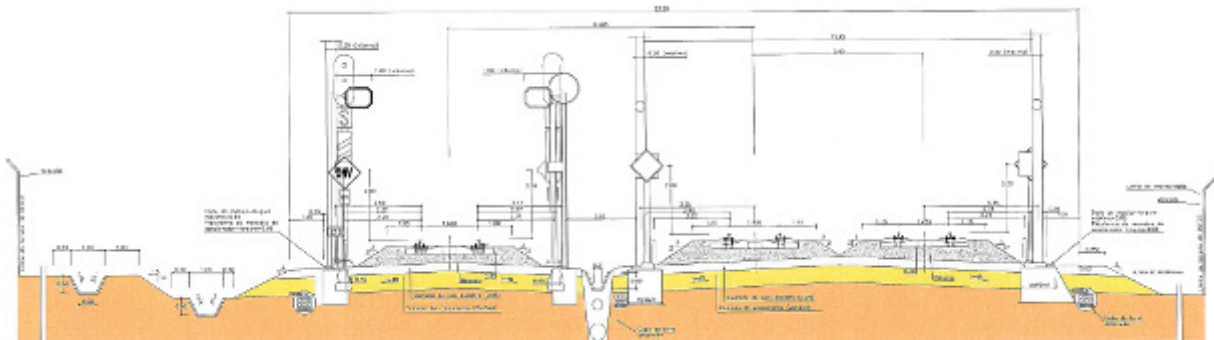
Drafting of the Project of the bid for the Invitation to Tender of the Project, Work and Public Concession.

Notable characteristics of the work undertaken:

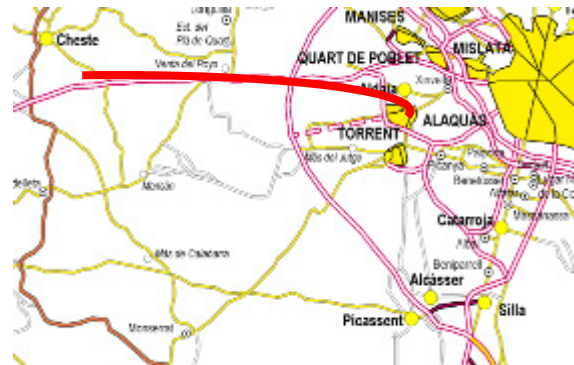
This is a work pertaining to the Badajoz-Lisbon High Speed axis. Specifically, the section that is the subject of the project runs between the towns of Poceirao and Caia, both in Portuguese territory. It consists of making use of a high-speed double rail of over 170 km which provides continuity to the adjacent sub-stretches. Likewise, the high-speed platform is attached to an Iberian width rail of a length of some 80 Km, from Evora to the end, in Caia. In inter-modal station is planned on the outskirts of Evora which connects to the city via an existing railway branch line of some 9 km, in which it is projected to carry out the tasks of renovating the track and the elimination of level crossings.

As other particular features, the project has 4 Posts for the Passing and Parking of Trains and 2 Intermediate Beacons Posts, on the international-width high speed line. There are 3 PIBs on the Iberian width rail.

Three areas for the maintaining and parking of units are designed with axle width switch installations, so that they can be used by trains that are compatible with this technology.



Design and site supervision of the new high speed rail line Madrid – Valencia-Murcia (Spain)
Section: Cheste - Aldaya



- Client:** Administrador de Infraestructuras Ferroviarias (ADIF)
(Spanish high speed rail procurement agency)
- Contract Value:** 900,000 € Design and site supervision
50 million € Construction
- Contract Dates:** Design: May 2004 – Julio 2005
Construction: November 2005
- Location:** Valencia. Spain (east)
- Project brief description:** This detailed design comprises the infrastructure of the new high speed rail line, between Cheste and Aldaya municipalities, both located in the Valencia province. This section belongs to the future Spanish High Speed Rail Network
- Eptisa's responsibilities:**
- Conceptual Design
 - Detailed Design
 - Site Supervision
- Description of services provided:**
- Alignment alternatives study based on Preliminary Design
Conceptual Design of the best solution based on technical, economical and environmental criteria.
Detailed design of the infrastructure, ballast included (the superstructure – installations - is defined in a different contract although the design of the services enabled during the construction is also provided – earthing cables, cable crossings, posts anchors in viaducts, etc.)

Works Technical Data:	Length	12.4 Km	Steel	8,750,000 kg
	Design speed	350 Km/h	Passes	
	Minimum radius	6,500 m	- Overpasses	6 No
			- Underpasses	6 No
	Earthworks		Bridges lengths	
	- Fill	1,860,000 m ³	- Barranco de la Canaleja	479 m
	- Cut	420,000 m ³	- Road CV-424	91 m
	Concrete	51,500 m ³	- Barranco de Gallego	482 m
			- Motorway A-7	241 m

Design and site supervision of the new high speed rail line Madrid-Valencia-Murcia (Spain) Section: Monteagudo de las Salinas-Solera de Gabaldón



Client:	Railway Infrastructure Administration, Spain (Gestor de Infraestructuras Ferroviarias (GIF))		
Contract Value:	1,1 million € Design and site supervision 32 million € Construction		
Contract Dates:	Design: Feb 2002 – Sep 2003 Construction start: Jul 2004		
Location:	Cuenca province. Castile La Mancha. Spain		
Project brief description:	The scope of this detailed design included the infrastructure of the high speed rail line to the East of Spain Madrid-Valencia-Murcia. Section: Monteagudo de las Salinas-Solera de Gabaldón, with a total length of 11,680 m. This section belongs to the future Spanish High Speed Rail Network		
Eptisa's responsibilities:	• Conceptual Design. • Detailed Design • Site Supervision		
Description of services provided:	Alignment alternatives study based on Preliminary Design Conceptual Design of the best solution based on technical, economical and environmental criteria. Detailed design of the infrastructure, ballast included (the superstructure – installations – is defined in a different contract although the design of the services enabled during the construction is also provided – earthing cables, cable crossings, posts anchors in viaducts, etc.)		

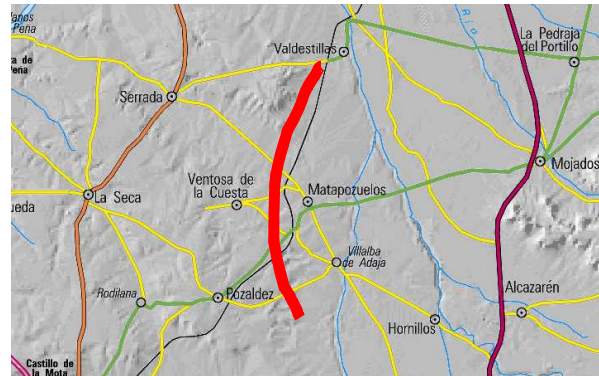
Works Technical Data:	Length	11.68 km	Steel	3,305,000 kg
	Design Speed	350 km/h	Passes	
	Minimum Radius	8,000 m	- Overpasses	6 No
			- Underpasses	11 No
	Earthworks		Bridges lengths	
	- Fill	992,462 m ³	- Road CUV-7123	43 m
	- Cut	776,712 m ³	- Valdemembra	668 m
	Concrete	34,190 m ³		

Design and site supervision of the high speed rail line Madrid-Saragossa-Barcelona-France.
Section: Gelida-Sant Llorenç d'Hortons



- Client:** Railway Infrastructure Administration,
Spain (Gestor de Infraestructuras Ferroviarias (GIF))
- Contract Value:** 1,1 million € Design and site supervision
21 million € Construction
- Contract Dates:** Construction start: Nov 2002
Design: Jan 2002 – Apr 2002
- Location:** Barcelona province. Catalonia. Spain (northeast)
- Project brief description:** The scope of this Detailed Design includes the infrastructure of the high speed rail line Madrid-Saragossa-Barcelona-France. Section: Gelida-Sant Llorenç D'Hortons, with a total length of 3,040 m. This section belongs to the future Spanish High Speed Rail Network.
- Eptisa's responsibilities:**
- Conceptual Design
 - Detailed Design
 - Site Supervision
- Description of services provided:**
- Alignment alternatives study based on Preliminary Design
 - Conceptual Design of the best solution based on technical, economical and environmental criteria.
 - Detailed design of the infrastructure, ballast included (the superstructure –installations - is defined in a different contract although the design of the services enabled during the construction is also provided – earthing cables, cable crossings, posts anchors in viaducts, etc.)

Works Technical Data:	Length	3 km	Passes	
	Design Speed	350 km/h	- Overpasses	3 No
	Minimum Radius	7,500 m	Bridges lengths	
	Earthworks		- Salt de la Suissa	87 m
	- Fill	366,059 m ³	- Rierussa	318 m
	- Cut	1,073,809 m ³	- Sant Joan	150 m
			- Can Bargalló	87 m



Client: Ministry of Public Works

Contract Value: 1,562,289.64 €
100,000,000 € Construction

Contract Dates: 2000-2003

Location: Spain

Description of services provided: This project also includes the design, Environmental Impact Assessment and construction project. The activities carried are:

- Detailed Design & Construction Project Elaboration
- General Technical Assistance to the Works Direction Unit
- Supervision and qualitative follow-up of the works and the constructor's quality assurance plan
- Quantitative follow-up
- Surveillance of the fulfilment of environmental impact restrictions
- Assessment and control in quality of materials
- Surveillance in the fulfilment of safety and health restrictions

The design preparation/review phase in this project had an input of 20 men-months.

Works Technical Data: The High-Speed train Madrid-Segovia-Medina del Campo, section Segovia-Valladolid, Subsection VI has 10,5 km of double track (European gauge). The connection from Madrid to Valladolid will be reduced from 3 hours to 1 hour. Some characteristics of this project:

Geometric Data	
- Section Length	10,500 m
- Platform width	16 m
- Projected Maximum Radius	8,250 m
- Projected Speed	350 km/h
.....	
Earthworks	
-Excavation	413,013 m3
-Ramparts	1,414,356 m3
.....	
Viaducts:	
-Two viaducts	170 m and 35 m long
-Underpasses	6
-Overcrosses	2
.....	

TACS of the works of the New High-Speed Railway Access of Levante. Madrid-Castille la Mancha- Valencian Community-Region of Murcia. Section: LA Encina-Játiva Node. Phase I. Sub-section: La Encina-Mogente



Vallmelós Ravina Viaduct



Santa Bárbara Tunnel

Client	Ministry of Public Works. Administrador de Infraestructuras ferroviarias.	
Date of execution	2008-	
Budget	€ 85,452,862.8	
Description	Technical Assistance for the Control and Surveillance of the high-speed line works. Geographical location: La Encina-Játiva Node.	
Activities	•Supervision and monitoring the implementation and undertaking of the contractor's quality assurance plan. •Monitoring and comparison of the qualitative control of the work. •Qualitative control of the work carried out. •Surveillance and monitoring of the conditions of the environmental impact declaration. •Monitoring of compliance with the provisions in force concerning health and safety at work.	
Technical Details	▪Main project units: Length of the section: 18.8 Km <u>Viaducts</u> -El Puig Ravine -Rambla Cañoles -Vallmelós Ravine -Cañarel Ravine -El Gallo Ravine -Future HSL -Ramal A-35 -La Fos Ravine <u>Tunnels</u> -Santa Bárbara (325 m) -Mogente (885 m)	▪Most significant elements of the sub-section: -The current railway line which will be transformed into the UIC width line. -Almansa-Xátiva A-35 Motorway which is crossed on three occasions by overhead crossings -El Puig, Vallmelós, Cañarel, Gallo y Fos and Rambla Cañoles Ravines, crossed by viaducts.

Technical assistance for works supervision at high speed railway Construction. Section Álora – Cártama.
Cártama Tunnel (Málaga)



Client:	GIF
Contract Value:	1,763,195 € 54,190,140 € Construction
Contract Dates:	2002 - 2002
Location:	Spain
Description of services provided:	Supervision and Works control of the implantation of the quality assurance plan established by the contractor • Qualitative supervision of the works • Quantitative supervision of the works • Control and surveillance of the environmental impact assessment. • Supervision and control of the work and hygiene conditions of the works

Works Technical Data:

Technical assistance for works supervision and control. Works details:

- Lengths:
 - Tunnel length: 2431.6
 - Total Works length: 3.019,072
- Project section: double railway
- Platform width: 14 m
- Railway width: 1.435 mm
- Minimum radius: 7.250 m
- Maximum peralte: 140 mm
- Exceptional maximum peralte:
- Maximum slope: 25 mm/m
- Exceptional maximum slope: 30
- Maximum speed: 350 km/h

Most significant elements of the project:

- Excavation: 594.123 m³
- Excavation in tunnel: 287.305 m³
- Embankment: 39.031 m³
- Shape cover: 3.913 m³
- Subballast: 2.653 m³
- Concrete: 54.278 m³
- Projected concrete: 23.789 m³
- Steel in armour structures: 329.159 kg



Client:	GIF
Contract Value:	1,505,376 € 37,955,903 € Construction
Contract Dates:	Nov 2001 – Dec 2003
Location:	Spain

Description of services provided:	• Technical assistance to the world direction, inspection and Works supervision. • Geometric and quantitative control. • Qualitative control and quality controls supervision
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Works Technical Data:

Technical assistance for works supervision and control Works details:

- Section Length: 8.450,653 m
- Convoy speed: 350 Km/h
- Axis width: 4,70 m
- Platform width: 14 m

Most significant elements of the project:

- Viaduct Marota: 381 m. long
- Viaduct Guadalmazán: 471 m. long
- Construction of 5 upper bypasses
- Construction of 4 lower bypasses
- Construction of a concrete box led under gas duct (14 m x 11,3 m)
- Earth movements:
- Excavation: 2.258.787 m³
- Refills: 1.212.718 m³
- Subbalast: 33.400 m³

TASC of the building works of the new Railway Access to the North and North-west of Spain. Section: Soto del Real-Segovia. Infrastructure and track. Lot number 4.



Ariel view of the ring segment manufacturing plants. Boca Sur.



Herrenknecht tunnel boring machine cutting wheel.

Client	Administrador de Infraestructuras Ferroviarias (ADIF)	
Date of execution	2002-2007	
Budget	€ 4,095,290.27 (JV: Eptisa-Euroestudios-Eurocontrol)	
Description	Technical Assistance for the Control and Surveillance of the management of the project.	
Activities	•General technical assistance to the Site Management. •Supervision and monitoring of the implementation and undertaking of the contractor's quality assurance plan. •Monitoring and comparison of the qualitative control of the work. •Qualitative control of the work carried out. •Surveillance and monitoring of the conditions of the environmental declaration. •Monitoring of compliance with the provisions in force concerning health and safety at work.	
Technical Details	TUNNELS •Length: 28,377 m. •Excavation diameter: 9,45 m. •Inner diameter: 8,50 m •Separation between axles: 30 m. EXCAVATED MATERIAL SOUTH MOUTH Tunnel 1: 1,054,350 cu.m. Tunnel 2: 940,270 cu.m.	NORTH MOUTH Tunnel 3: 940,270 cu.m. Tunnel 4: 1.054.350 cu.m. LINING Thickness: 0.32 m Volume: 15.2 cu.m./ring (9,48 cu.m./m of tunnel) Side path: 90 kg/cu.m.of concrete Total number of rings: 35,472 Total no of ring segments: 248,304 Total mortar volume: approx. 212,832 cu.m.

Madrid – Valladolid high-speed railway line. Section Soto del Real- Segovia. Túneles de Guadarrama (North Entrance)

Client: U.T.E. Túneles de Guadarrama (FCC – FERROVIAL- ACS)

Contract Dates: March 2003 – October 2008

Description of services provided:

The Guadarrama tunnels fell within the project for a high-speed railway connection between Madrid and Northwest Spain, specifically the section between Soto del Real in the province of Madrid and Segovia.

The project involved the construction of two, parallel tunnels with a total length of 28.377 km, connected together by transverse passageways every 250 metres. Execution of the construction project was carried out by excavation of the tunnels with 4 TBM, placed from the existing mouths. The Guadarrama tunnels were divided into 4 sections, sections 3 and 4 being carried out from the North Mouth. These sections are approximately 13.400 km and 15.000 km long, respectively.

The tunnels were excavated with double-shield TBM, and roof support was carried out using reinforced concrete ring segments.

An Auscultation Plan was defined in the project design stage to control execution of the work. The plan's purpose was to measure variations in certain parameters inherent to the work and the extent of its influence on the environment, by installation and monitoring of a series of devices, to make it possible to ensure that the calculation models and postulates assumed during the design work were adhered to.

The following different kinds of control were carried out:

- Extensive control:

- Controls from the interior of the tunnel.
- Surface control

- Intensive control: real-time control, 24 hours a day during the progress of the excavation through the fault passes, both for surface elements and those used in the interior of the tunnel.

Data transmission and the results obtained from the instruments were included in weekly reports, including automatic data sheets.

Monthly reports, including the weekly results and a summary of all readings taken during the month, were also issued.



Client: GIF - INECO

Contract Dates: October 2000 – June 2004

Description of services provided:

The Madrid-Barcelona-French Border high-speed railway line is a linear work carried out in various sections and subsections within the High-Speed Railway Infrastructure Plan. T

The Madrid-Lleida section was the first to be constructed, with a length of 473.8 km running through the provinces of Madrid, Guadalajara, Soria, Zaragoza and Lleida. According to the inventory of existing platform elements, there are 483 cuttings, 593 embankments, 516 technical blocks and 20 tunnels.

Where the geological environment, geometric parameters or the building process made elements problematic, they were controlled by instrumentation installed in the execution phase.

To make the instrumentation installed as useful as possible, it was necessary to establish whether the measurements recorded conformed with predicted figures, or whether irregular patterns were emerging which required detailed study to decide whether any action was necessary. The Line Maintenance Auscultation Plan was defined for this purpose.



Client: SACYR – CAVOSA – NECSO – OHL

Contract Dates: March 2002 – November 2002

Description of services provided:

The building works for Subsection VIII of the Lleida – Martorell section of the Madrid-Barcelona-French border high-speed railway line were divided into three different subsections, each built by a different construction company. At the request of these companies, Engineering, Instrumentation and Control carried out the instrumentation work on the platform's various geotechnical elements.

For auscultation of Subsection VIII, the most suitable parameters and equipment were included according to whether the construction elements being controlled were embankments or tunnels.

Embankments:

- Control of foundations: in the zone of contact between the embankment and the ground. Installation of hydraulic cells.

Tunnels:

- Control of radial movements in the tunnel support and surroundings by installation of rod extensometers.
- Control of pressure changes in the contact between the ground and the support, by installation of radial pressure cells.
- Control of load changes in the caps of bolted joints, using load cells.
- Control of load changes in bolted joints, with the installation of extensometric bolted joints.
- Control of tension strain in support joists using vibrating wire extensometers.



Client: ADIF

Contract Dates: January 2003 – June 2004

Description of services provided:

The Lleida – Martorell section of the Madrid – Barcelona – French border railway line had two highly complex subsections of great difficulty:

- Subsection IVb (which includes the Camp Magre and Lilla tunnels)
- Subsection V (which includes the Puig Cabrer tunnel)

After excavation of these tunnels, floor breaks were detected. The two construction companies commissioned CIE to carry out the corresponding geotechnical instrumentation work.

Lilla Tunnel

- Control of 12 sections of 3 radial total pressure cells (RTPC) placed in the vault and three RTPC in the counter-vault.
- Another 15 sections of 3 RTPC in the counter-vault were placed to complete the ground-to-counter-vault pressure control.
- A new Auscultation Plan was prepared to control deep vertical shifts in the ground, changes in contact pressures between the ground and the roof support, changes in the tangential pressure in the counter-vault cladding concrete, and interstitial pressure in the ground.
- Installation of 3 control sections ordered by the geotechnical advisor. Each section consisted of 6 incremental extensometers.
- Instrumentation for each experimental phase, with installation of RTPC and TTPC.

Puig Cabrer Tunnel

- Instrumentation for the experimental stages, with the same objectives as in Lilla Tunnel.
- Design of summary sheets for faster delivery of results and their subsequent analysis.



Client: U.T.E. Hospitalet (OHL, GUINOVART & OSHSA)

Contract Dates: July 2005 – May 2007

Description of services provided:

The Hospitalet – La Torrassa subsection is part of the route of the high-speed railway line to its first stop in the city at Sants Station, consisting of a 2.7-km tunnel between screen walls.

The geology is typical of the Llobregat Delta and is characterized by alternating layers of saturated, loose sand and of mud with little load-bearing capacity.

The urban area around the works has a great variety of kinds of building, among which the most significant are undoubtedly the towers over 50 m high which are very near the line of the screen walls. These two conditioning factors made construction of this section very highly complex.

Because of the effect construction of the tunnels could have on the urban surroundings, ADIF decided that a real-time control system should be implemented for the buildings and RENFE's existing tracks near the new tunnel, complementing conventional auscultation of the tunnel and buildings.

To meet ADIF's control requirements. CIE chose the highest performing total station on the market now, Leica's TCA 2003 total station.

- The number of total stations required to control an area of buildings or tracks depends on their height, geometry and the visual lines that can be drawn between the sites and the points to be controlled.
- Placement of theodolites and prisms for detection of any movements in the structure.

**Auscultation of the behaviour of the vibration curtain on the Ebro Viaduct.
Madrid-Saragossa-Barcelona- French Border high-speed railway line**

Client: GESTOR de Infraestructuras Ferroviarias (GIF)

Contract Dates: April 2002 – November 2002

**Description of
services provided:**

For GIF (Gestor de Infraestructuras Ferroviarias), CIE carried out the implementation of an auscultation system intended for measurement campaigns for control and verification of the various track section types defined on the Ebro Viaduct of the Madrid-Barcelona-French Border high-speed railway line under real operating conditions, to determine the significant dynamic behaviour parameters in these characteristic sections. This makes it possible to compare the values used for calculations and behaviour forecasts directly with real parameters and responses. In this way, by checking measurements and comparing them with the design figures, it is possible to determine the real behaviour of the various track elements when loads are applied and compare it to the theoretical figures.

Instrumentation was implemented for a section in the area of the access embankment to abutment E-2, the behaviour of which was to be used as reference for the other sections instrumented, located on the transition ramps to the viaduct (at 12m from abutments E-1 and E-2) on the deck of the structure. In the latter case, there are different sections located in the middle of the spans, the intermediate pillar support sections and the E-2 abutment support. That made a total of nine instrumentation sections.

In the first four sections, a single control point was defined, while in the other sections one control point per line track was defined. The total number of instrumentation points was, therefore, fourteen.

Each point chosen involved these measurements:

- Internal instruments.
- External instruments.
- External track parameters.

In each section, all the sensors comprising both the internal and external sensors were connected to a single connection and transmission box, located next to track 1 of the viaduct deck...

From the connection and transmission boxes, signals are sent to local centralization cabinets, one at the foot of the embankment leading to the viaduct by abutment E-1, the other at the top of the embankment leading to the viaduct by abutment E-2.



Client: ADMINISTRADOR DE INFRAESTRUCTURAS FERROVIARIAS (ADIF)

Contract Dates: 2003-2007

Description of services provided:

Performance of the main inspections and static and dynamic load tests for reception of the railway structures on the Lleida – Vilafranca del Penedés section of the Madrid – Saragossa – Barcelona – French Border high-speed railway line.

From the main inspections carried out, the corresponding technical documentation for integration of the structures in ADIF's Infrastructure Management System was generated. Specifically, the sheets for the Ministry of Development's Register of Bridges (ITPF-05) and the control sheets identifying the bridges' "Zero Status" before being put into service were completed.

After preparation of the static and dynamic load test project plans by Control and Instrumentation Engineering's technical office, the tests were carried out on railway material supplied by ADIF. This meant the static tests included in these plans and dynamic tests at different speeds, with sampling of up to 1000 samples per second at all control points installed: measurement of deflection, unit deformation and acceleration.

Technical Assistance and Consulting consisting of the following:

- Collection of Project Design and Construction Information.
- Main Inspection of Structures
- Design of static and dynamic load test plans, with structure modelling using programs of finite elements.
- Performance of load tests in the field
- Preparation of the Final Technical Decision on the functional condition of each structure/bridge.



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