

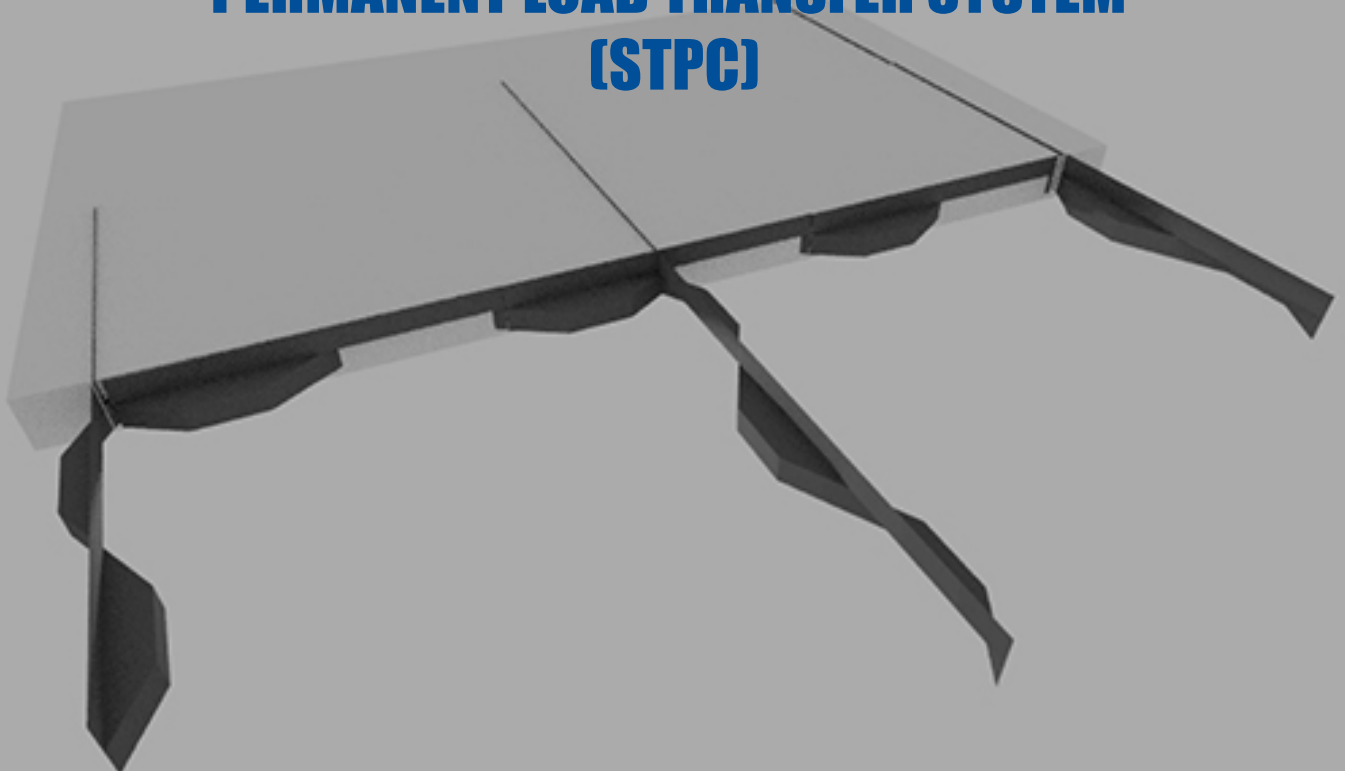
FAROBEL JRI+ JOINTS

TECHNOLOGY FOR CIVIL ENGINEERING

Technology for the Design and Implementation of Pavements



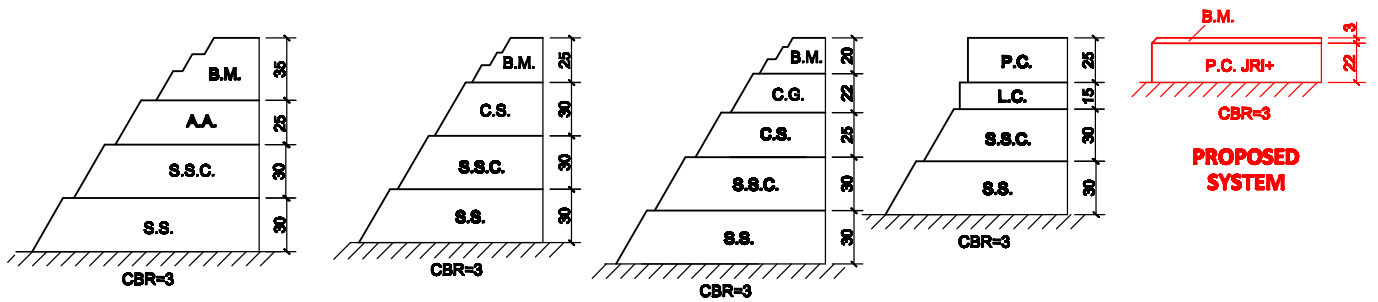
PERMANENT LOAD TRANSFER SYSTEM (STPC)



JRI+ embedded in concrete

ROAD SECTIONS: HIGHWAYS WITH ESPLANADES E0

SECTIONS	6.1-IC Norm						JRI+ System	
	0031		0032		0033		0034	003
USEFUL LIFE	50 years		120 years		150 years		100 years	250 years



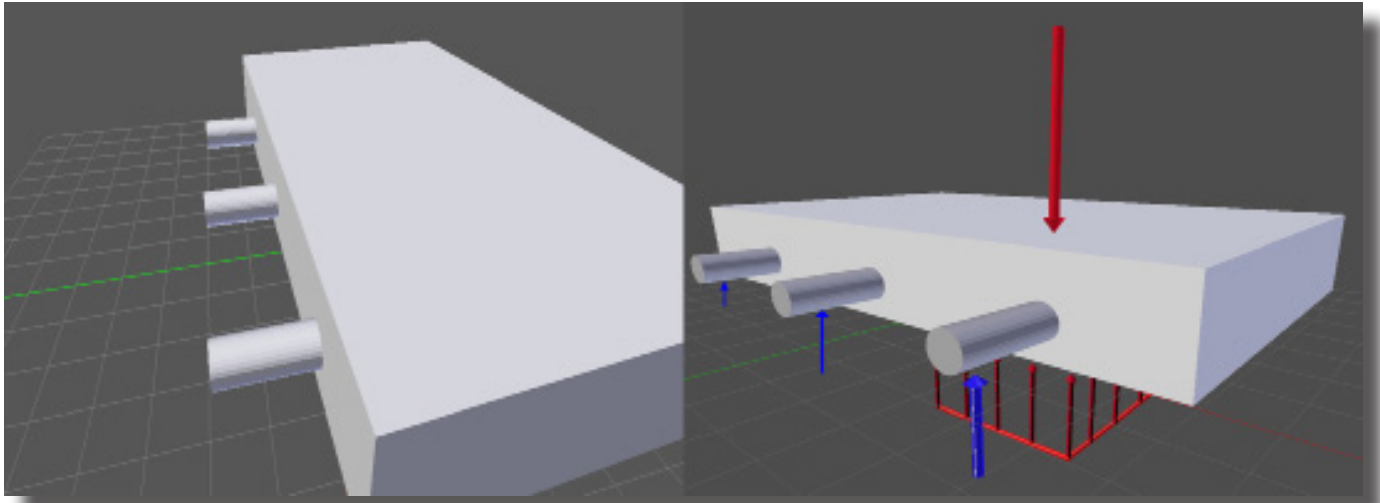
- B.M. Bituminous Mix
- A.A. Artificial Aggregates
- S.S. Selected Soil (CBR>=12)
- S.S.C. Soil Stabilized with Cement
- C.S. Cement Soil
- C.G. Cement Gravel
- P.C. Pavement-grade Concrete of 4.5 MPa to Flexotraction
- L.C. Lean Concrete of 150 Kg/cm² at compression
- P.C. JRI+ Pavement-grade Concrete of 4.5 MPa with edges JRI+ supported in 2.5x3.0x0.22 (m) slabs

Summary

- Technical fundamentals
- JRI+
- Advantages of STCP
- Benefits for the Industry
- Cost comparison
- Fields of application
- Our services
- International presence
- Technological evolution
- Implemented projects

Technical fundamentals

THE TRADITIONAL SYSTEM



In traditional concrete pavements, the load transfer is obtained through the placing of dowels connecting one slab to the next. That implies the design of high quality layers of significant thickness, capable of providing the elastic environment needed to induce an adequate reaction of the terrain, through the dowels, on the concrete slab.

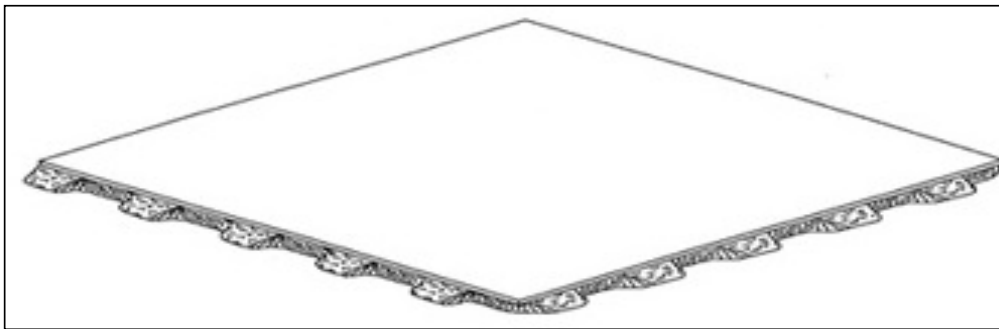
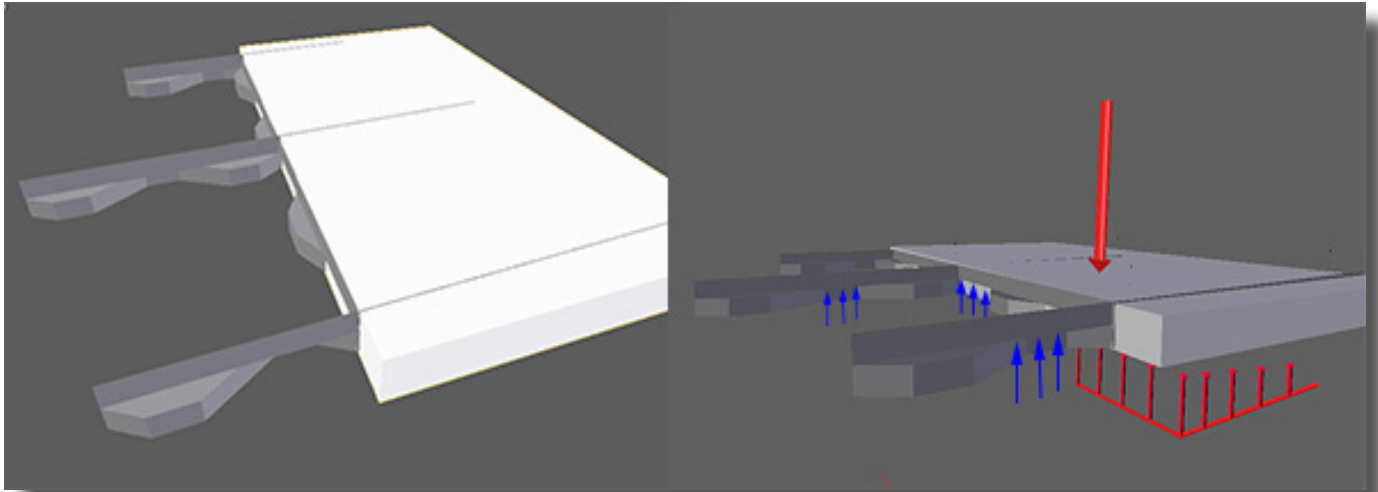
This traditional solution poses a set of problems which determine the maintenance needs and duration of the pavement, due to the following factors:

- High punctual stress in the contact areas between the slab edges.
- Plastification of the concrete in concrete-dowel contact areas.
- Rusting of the dowels in the long run.
- High thermal stress peaks, given the usually large slab measures.
- The cutting and sealing of the joints is mandatory, as well as its maintenance.
- A strong firmness of the soil is required.

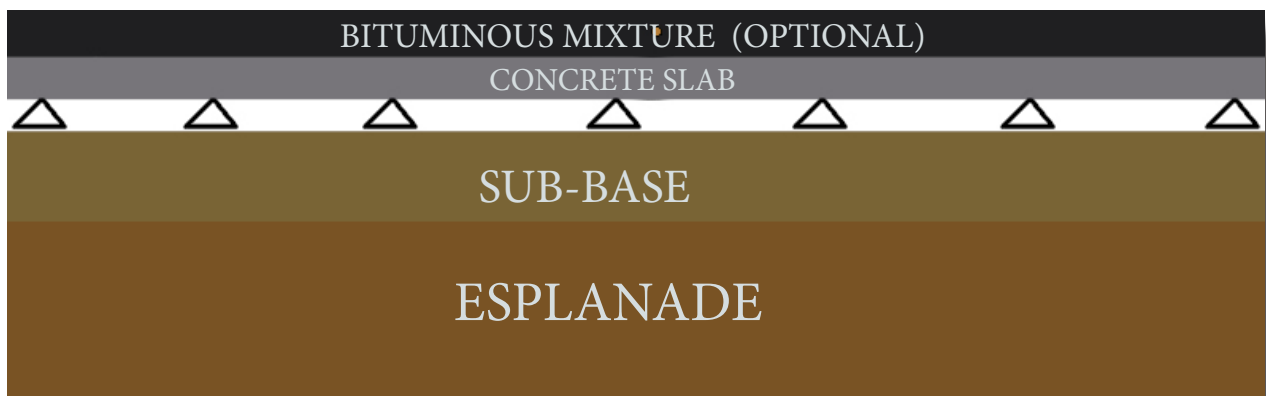


Traditional pavement structure

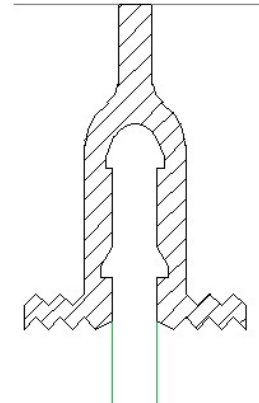
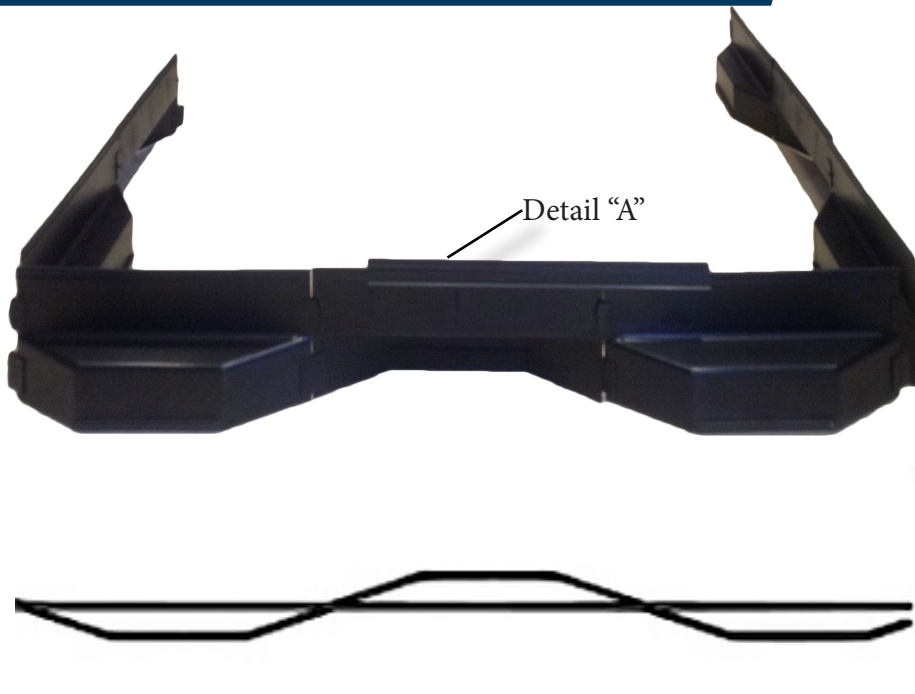
PERMANENT LOAD TRANSFER SYSTEM



Our solution consist in the permanent load transfer between concrete slabs, that support themselves one in another. As the pavement can be divided into a greater number of slabs, the resulting structure resembles a continuous beam, drastically reducing the stress supported by each individual slab. The critical load is at the center of the slab, and not at the edges.



The load transfer is induced from the surface of the concrete “teeth” of the different slabs, as it produces a substantial increase of the load transfer areas compared to the traditional solution.



RUBBER SEALS IN JOINT TOP
(Detail "A")

Long life polypropylene.

Joints are inserted in the fresh concrete. Thus the fissures will be controlled and will appear in the weakness line created in concrete.

Fissures will be waterproof thanks to the rubber seals that cover the top of the Joint. The Joint's total height is lower than the slab's thickness.

This alternating support generates horizontal platforms which are responsible for the load transfer. Each slab is supported by the adjacent ones.

It is not anchored to the terrain.

Is put in position from gradient into the fresh concrete, by means of a pusher provided with vertical needle vibrators.

It avoids the stand out between adjacent slabs, and therefore any breaking of the slab's edges.

Our exclusively designed hydraulic device for inserting the JRI+ Joint into the fresh concrete makes use of vertical needle vibrators and a pusher for each tooth, making possible a precise positioning of the Joint inside the concrete mass.



The STPC advantages

The SYSTEM of PERMANENT LOAD TRANSFER presents considerable advantages compared to the traditional model:

- It eliminates the need for dowels.
- It eliminates cutting and sealing.
- Reduces the pavement's concrete thickness, as it drastically reduces the stresses supported, due to the fact that the slabs length can be shorter than in traditional solution.
- Drastic cost reduction of the surface maintenance.
- Longer useful life of the pavement.
- Optimization of the return on investment.

Benefits for the Industry

ENGINEERING FIRMS

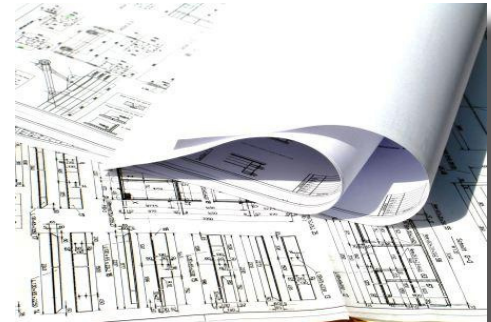
Easy in situ implementation of the design.

Longer durability and less maintenance-demanding solution.

The system allows for a design that drastically reduces the thickness of the supporting layers.

The permanent load transfer between slabs makes possible the reduction of its size, thus facilitating a substantial decrease in the maximum stress supported by the slab, and permitting the designer to minimize its thickness.

The slab may not rest in the soil, totally or in part, depending on loads, temperatures or seats; but each slab will always rest on the adjacent slabs. This ability of permanently leaning on the others allows for a completely different design of concrete pavements.



CONTRACTORS AND CONCESSIONAIRES

Easy and fast installation.

Ready for use, with no additional assemblies.

Reduction in the cost of material (savings up to 50% in roadbeds), and of installation.

Shortens the execution schedule.

Easy supply and distribution.

Minimizes the maintenance costs.



CLIENTS

Lower cost, and thus less investment.

Longer durability solution, with less and less frequent maintenance.

In public works, less impact and inconvenience for the citizens, due to shorter schedules.



MAXIMIZATION OF THE RETURN ON INVESTMENT
OPTIMIZES THE TECHNICAL USE OF RESOURCES

Costs comparison

	Ground pressure	Thickness	100 Cost base
Bituminous mixture	0,1 kg/cm ²	40 cm	100
STPC Concrete	0,1 kg/cm ²	20 cm	40-60

Technical problem to be solved

Non-permanent load transfer with the usage of dowel bars.

Consequences on concrete:

- 1- Base layers.
- 2- Noise with "tac tac".
- 3- Fine aggregates pumping.
- 4- More than one layer of asphalt.

Disadvantages in concrete and asphalt roadbeds:

- 1- High construction costs.
- 2- Limited durability.
- 3- Repairing or replacing surface layer.
- 4- Slow construction process.
- 5- High material, power and transport consumption, high CO₂ generation.
- 6- Greater thickness requirements.

Proposed technical solution

Permanent load transfer on slab's edges.

Advantages:

- 1- Cost. (50%)
- 2- Life. (250 years)
- 3- Low rolling surface maintenance.
- 4- Speed of construction. (1/3)
- 5- Ecologic. (one layer)
- 6- IRI kept constant.
- 7- Asphalt rolling layer. (optional)

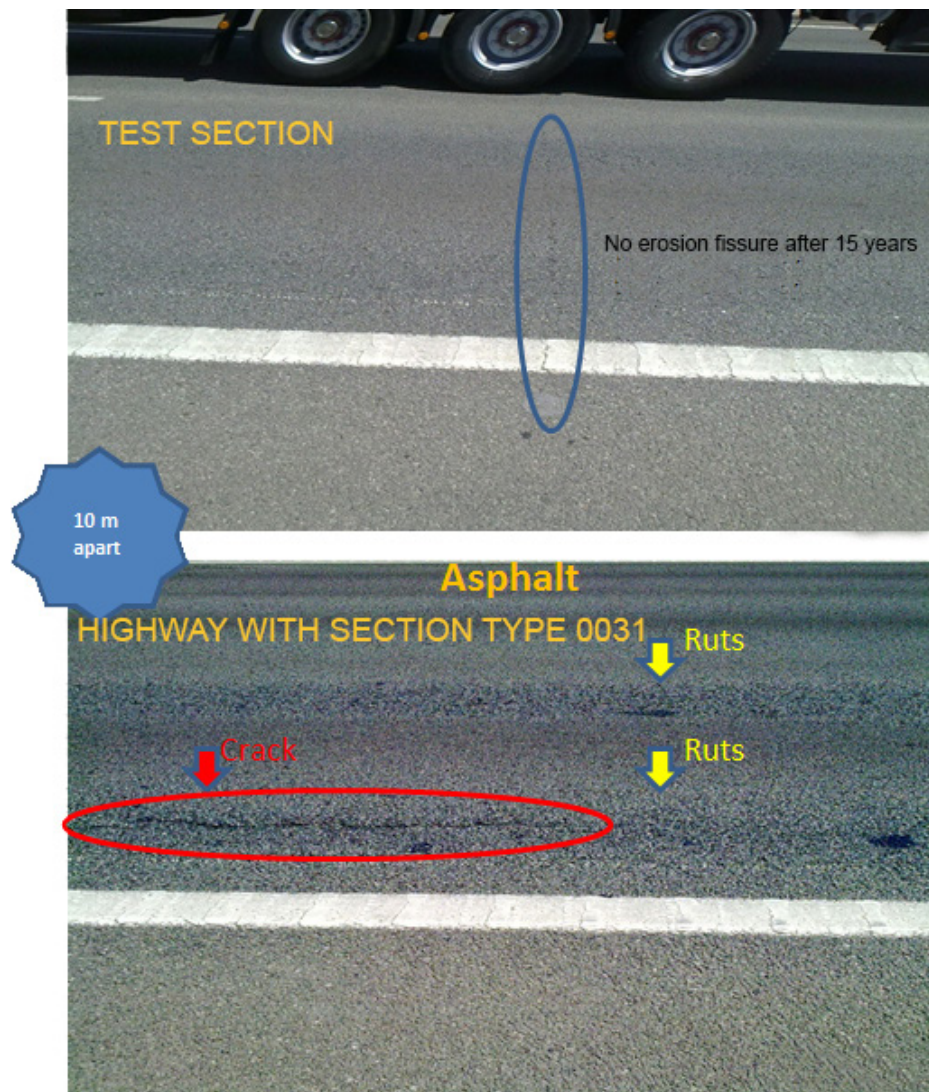
More beneficial:

economically &
technically

Road surface comparative test: Asphalt and Permanent Transfer System

Data:

- 1- A-2 Highway (3 lanes each direction). Spain
- 2- Traffic T00: Average Daily Traffic (ADT)>100.000
- 3- Ministry of Fomento (formerly MOPT)
- 4- Year of construction: 1997
- 5- Test section: Km. 598 of Highway A2 (Madrid - Barcelona). Slabs: 20cm of 3x3.5m, and 4cm asphalt, on aggregates.
- 6- A2 Highway road surface in Pallejá (Barcelona):
35cm of asphalt, on aggregates. Section 0031 of Spain's norm 6.1 I-C.



Fields of application

The System applies to roads and freeways/highways. Is also optimum for harbor esplanades, airports, rail tracks, streets and any transport infrastructure laid on the soil. Can easily replace the traditional pavement systems of rigid concrete and flexible asphalt, due to the savings and durability provided by its design.

Roads and freeways/highways



Airport esplanades



Rail tracks



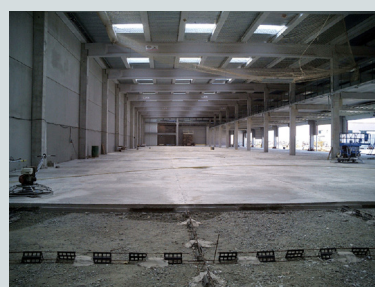
Industrial parkings



Streets



Industrial pavements



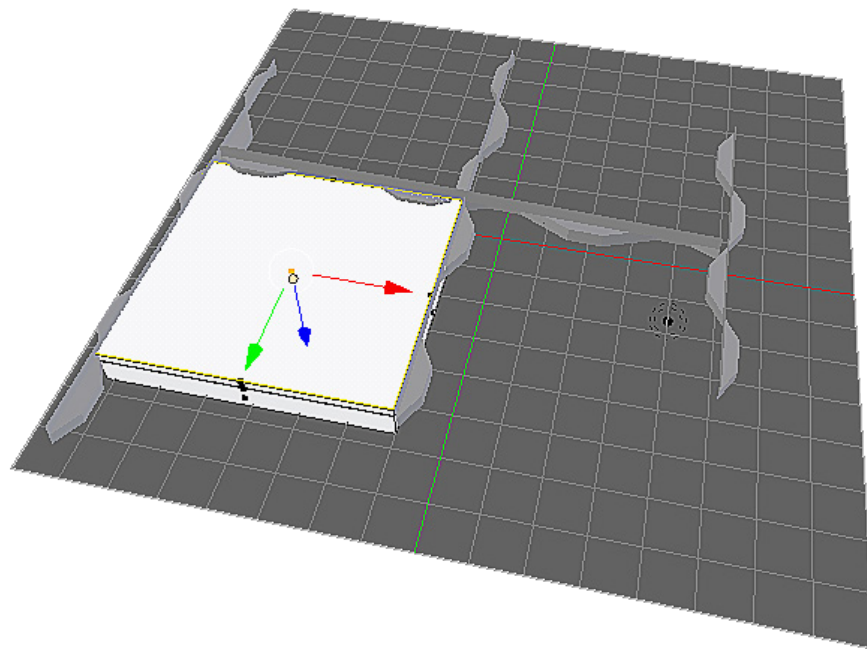
Channels



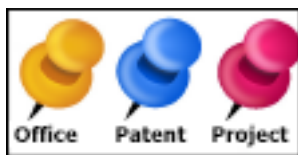
... any concrete
surface laid on
the soil

Our services

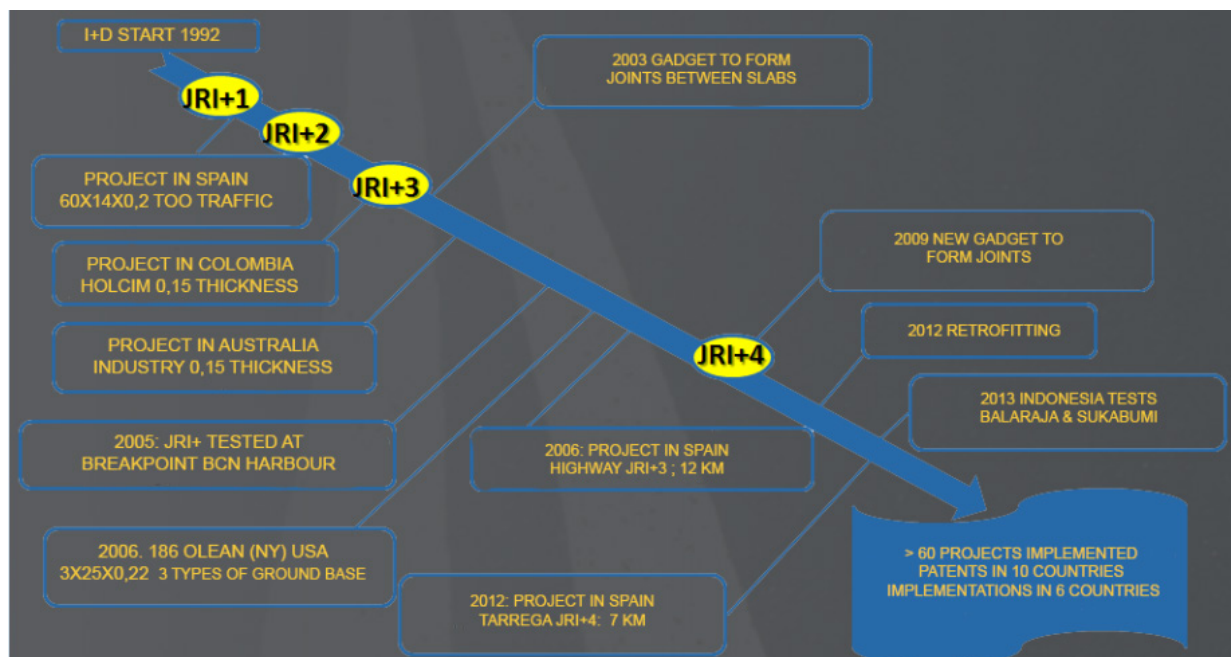
- Engineering development of design for the complete pavement section.
- Joints installation during the construction process by our own means.



International presence



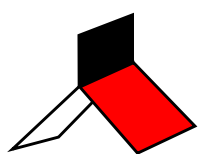
Technological evolution



Implemented Projects

EXECUTED PROJECTS WITH JRI+ LOAD TRANSFER SYSTEM

	PROJECT	TYPE	CLIENT	CONTRACTOR	YEAR
JRI PROTOTYPE	Las Palmas	Harbor esplanade	PORT AUTHORITY	NECSO	1998
	Castellbisbal	Road	GISA	FREYSSINET	1998
	Vigo	Harbor esplanade	PORT AUTHORITY	COVSA	1999
	Barcelona	Industrial esplanade	ZAL	CORSAN-CORVIAM	1999
	Barcelona	Harbor esplanade	PORT AUTHORITY	SATO RUBAU	2000
	Sant Carles de la Ràpita	Harbor esplanade	CATALONIA PORTS ADMINISTRATION	LUBASA	2000
	Ajalvir	Road	MADRID AUTONOMOUS GOVERNMENT	FERROVIAL	2000
JRI +	Cardedeu	Esplanade	ATLL	BECSA	2001
	Santiago de Compostela	Esplanade	RENFE (Spanish Rairoads)	ALDESA	2001
	Barcelona	Street	PORT AUTHORITY	UTE DRAGADOS SATO RUBAU	2002 2003
	El Goloso	Drive in Road	MADRID AUTONOMOUS GOVERNMENT	A.C.S.	2002
	Barcelona	Harbor esplanade	PORT AUTHORITY	RUBAU	2003
	Barcelona	Industrial esplanade	PORT AUTHORITY	RUBAU	2003
	Vilanova y la Geltrú	Harbor esplanade	CATALONIA PORTS ADMINISTRATION	SATO	2003
	Barcelona Baix Llobregat	Tramway	ATM Barcelona	UTE COMSA-FCC-NECSO-ALSTOM	2001 2003
	Bogotá (Colombia)	Street	HOLCIM	HOLCIM	2003
	Barcelona (Besòs)	Tramway	ATM Barcelona	UTE COMSA-FCC-NECSO-ALSTOM	2003 2004
JRI +	Roses (Girona)	Maritime promenade	CATALONIA PORTS ADMINISTRATION	F.C.C.	2004
	St.Carles de la Ràpita	Harbor esplanade	CATALONIA PORTS ADMINISTRATION	CISTERÓ	2004
	Barcelona	Truck Parking	PORT AUTHORITY	RUBAU	2004
	Barcelona	Esplanade	Z.A.L.	CORSAN-CORVIAM	2004
	Valls (Tarragona)	Road	GISA	ROMERO POLO	2004
	Tortosa (Tarragona)	Highway	GISA	RUBAU	2004 2005
	Bogatell (Barcelona)	Esplanade	CITY COUNCIL de Barcelona	UTE ESTRUCTURES	2004
	Victoria (Australia)	Industrial esplanade	POLYROAD S.A.	POLYROAD S.A.	2004
	Valls (Tarragona)	Esplanade	GISA	VICSAN-TEYCO	2004
	Barcelona	Airport Esplanade	AENA	RUBAU	2004 2005
	Barcelona	Esplanade	ZAL	BENJUMEA	2005
	Badalona	Harbor esplanade	CITY COUNCIL, Port Authority	FCC Construcciones	2005
	Barcelona	Esplanade	ZAL	CORSAN-CORVIAM	2005
	Mahón (Menorca)	Road	CONSEJO INSULAR	UTE ACSA - TOLO PONS	2005
	St. Feliu de Llobregat (Barcelona)	Tramway	ATM Barcelona	UTE COMSA-FCC-NECSO-ALSTOM	2005
	Barcelona	Street	Port of Barcelona	MEPSA	2005
	Bellvei (Tarragona)	Esplanade	GISA	RUBAU	2005
JRI +	Parla (Madrid)	Tramway	CITY COUNCIL	FCC-ACCIONA	2006
	Gijón	Road	PORT AUTHORITY	FCC	2006
	Olean (New York)	Highway	New York State	Surianello	2006
	Madrid (M503)	Highway	MADRID AUTONOMOUS GOVERNMENT	DRAGADOS	2006
	Barcelona	Street	Puerto de Barcelona	COPISA	2006
	Sagunto (Valencia)	Harbor esplanade	Puerto de Sagunto	ECISA	2006
	Mollerusa (Lleida)	Esplanade	GISA	ACSA-SORIGUÉ	2006
	Sevilla	Tramway	CITY COUNCIL	UTE METRO CENTRO	2006
	Mexicali (México)	Road	Secretaría Transporte de México	Secretaría Transporte de México	2006
	St.Feliu Buixalleu (Girona)	Racetrack	Autodromo S.L.	Autodromo, S.L.	2007
	Murcia	Tramway	CITY COUNCIL	STREETCAR MURCIA UTE	2007
	Barcelona	Tramway (Section)	ATM Barcelona	FCC- Construcciones	2008
	Argelaguer (Girona)	Urban road	Ministry of Public Works (Fomento)	Servia-Cantó	2008
	Estepona (Málaga)	Bicycle Path	CITY COUNCIL	U.T.E. BECSA-ITUVAL	2009
	Polígono Segre (Lleida)	Esplanade	GISA	Cisteró-CobraROGASA	2009
	Castellar del Vallès	Esplanade	GISA	ROGASA	2009
JRI + 4	Tàrrega (Lleida)	Urban road	CITY COUNCIL	Dragados	2009
	Castellfollit de la Roca	Urban road	Ministry of Public Works (Fomento)	MOVITERRA (FCC)	2009
	Llobregat	Waste Water Treatment Plant Pool	GISA	U.T.E. Rio Llobregat	2009
	Alpicat (Lleida)	Highway	Ministry of Public Works (Fomento)	FCC	2009
	Tortosa	Residential area	CITY COUNCIL	UTE VICSAN-Hidrocanal	2010
	Zaragoza	Tramway (Section)	CITY COUNCIL	FCC	2010
	Málaga	Tramway – Metro	Andalucía Govmnt- City Council.	UTE Metro- Málaga	2010
	Mallorca	Tramway – Train	Balearic insular Council	Dragados, Ferrovial, FCC	2010
	Tàrrega	Parking	CITY COUNCIL	Dragados	2010
	Alcoletge (Lérida)	Esplanade – Private pool	Private	Innoferti	2010
	Huelva	Streets	PORT AUTHORITY	ECISA	2012
	Balaraja (Indonesia)	Highway	Roads 4th Region	FAROBEL	2013
	Sukabumi (Indonesia)	Road	Roads 4th Region	FAROBEL	2013
	Barcelona	Esplanade	Private	Cic3	2013
	Madrid	Esplanade	MADRID AUTONOMOUS GOVERNMENT	SERANCO	2014
	Lliçà D'Amunt	Esplanade	Private (MANGO)	CRC	2014
	Torroella de Montgrí	Esplanade	GISA	COPISA	2014



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