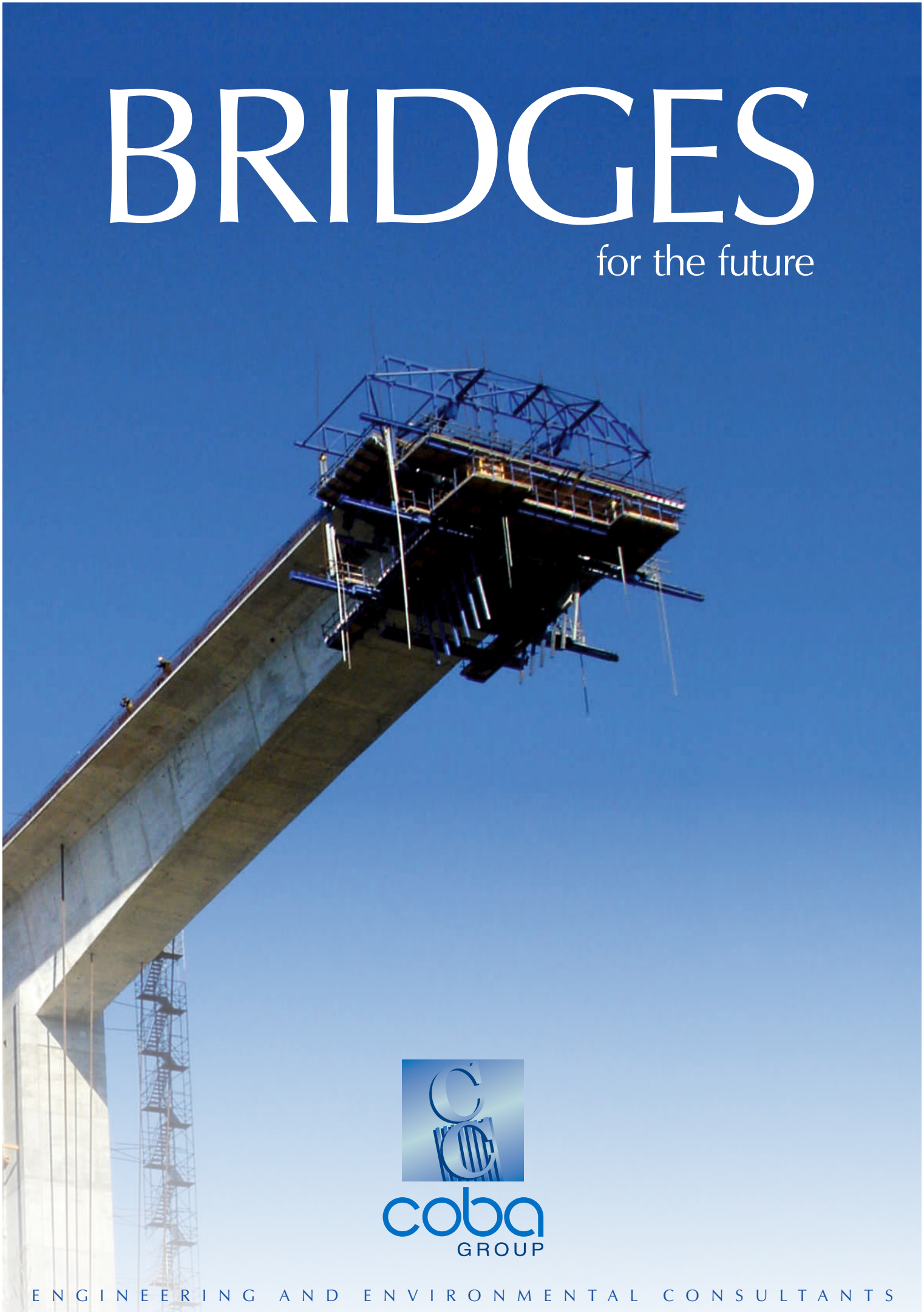
BRIDGES

for the future



coba GROUP

ENGINEERING AND ENVIRONMENTAL CONSULTANTS

PRESENTATION

COBA is a multinational and multidisciplinary group of Engineering and Environmental Consultants, founded in 1962.

The Group provides engineering consultancy services ranging from basic and planning studies, technical, environmental and economic feasibility studies, design and construction design as well as project management and works supervision, to operation follow-up and behaviour monitoring.

The Group has offices/subsidiaries in three continents and experience in more than fifty countries and encompasses several companies in accordance with functional specializations or geographical areas.

The competences acquired along the last six decades, together with the state-of-the-art employee expertise, the stability of its permanent staff and the comprehensive international experience allow to find out the best solutions for the full satisfaction of public and private Clients' needs and expectations.

During its existence, the Group has participated together with public authorities or private developers, in the feasibility of multidimensional projects, some of them being structuring projects and with major impacts on the improvement of peoples' life conditions in the several countries where it worked.

At present, the Group has a wide number of competences and technical areas that allow the composition of multidisciplinary teams who share knowledge and experiences in the execution of projects.

BRIDGES

COBA's Bridge Department was created in 80's mainly to support the Roads and Railways Departments. Quickly, the department gained a greater relevance within the company, participating in Portugal's most important bridge projects.

Like the company itself, it spread its activity through different countries - Portugal, Spain, Algeria, Angola, Senegal, Cape Verde, Congo Brazaville, Haiti, UAE - and fields - road bridges, railway bridges (including metro, light rail and high speed rail), airport bridges and bridge rehabilitation.

FIELDS OF ACTIVITY

HYDRAULIC UNDERTAKINGS
Concrete, Earth-fill and Rock-fill Dams. Weirs and Reservoirs Water Conveyance Systems. Hydraulic Structures.

POWER GENERATION AND TRANSMISSION
Hydroelectric Power Plants. Photovoltaic power plants and wind farms. Small Hydropower Plants. Power Plants Rehabilitation and Modernization. Substations High Voltage Transmission Lines. Cooling Water Systems for Thermoelectric Plants.

WATER SUPPLY AND WASTEWATER SYSTEMS
Catchment, Transport and Distribution of Potable Water. Water Treatment Plants. Drainage Systems. Wastewater Treatment Stations. Pumping Stations.

AGRICULTURES AND RURAL DEVELOPMENT
Irrigation and Drainage Systems. Rural Roads. Production Systems. Mapping and Basic Information.

TRANSPORTATION INFRASTRUCTURES
Roads and highways. Railways. Passenger and Freight Railway Stations. Metro and Light Rail. Airports. Bridges and other engineering structures.

ENVIRONMENT
Environmental Impact Assessment. Environmental Management, Monitoring and Auditing. Pollution Control. Landscaping. Land Management. Recovery of Degraded Areas. Waste Landfills.

GEOTECHNICAL STRUCTURES
Tunnels and Caverns. Slopes in Fill and Cut Section. Special Foundations Breakwaters. Embankment Works.

MARITIME AND FLUVIAL WORKS
Wharfs. River Training. Quay Rehabilitation. Flood and Flow Control.

MINING INDUSTRY
Environmental Studies. Design of Tailings Dams and Related Structures. Safety Assessment of Tailings Dams. Design Review of Tailings Dam Closure. Operations Maintenance and Monitoring Manual for Tailings Dams. Risk Analysis.
Mine Closure Plan. Training.

BUILDINGS
Residential and Services Buildings. Industrial Buildings.
Steel and Mixed Industrial Structures. Rehabilitation and Restoration of Ancient Buildings.

CARTOGRAPHY AND CADASTRE
Geographic Information Systems (GIS). Digital Cartography. Thematic Cartography. Thematic Cadastres. Land Acquisition.

SAFETY CONTROL AND REHABILITATION
Expertise, Monitoring. Inspection and Reinforcement of Dams and Transportation Infrastructures. Works Instrumentation. Project Maintenance and Operation.

PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION
Project Management. Cost Management. Site Supervision.
Quality Assurance/Quality Control.

LEZÍRIA BRIDGE | PORTUGAL

Client: TACE, ACE (Consortium of Contractors)
Owner: BRISA (Motorway Concessionaire)
Year: 2004/07
In association with: PC&A / Civilser / Arcadis, under COBA's leadership
Construction cost: 190 M €

The Lezíria Bridge crosses the Tagus River near the city of Carregado, in Portugal, connecting the A10 and A13 Motorways. It opened to traffic in 2007, after 23 months of construction.

With a length of approximately 11,7 km, it is Portugal's second longest bridge. It is 20 m wide and rises to a maximum height of 30 m above the river.

The Bridge over the Tagus River comprises a single post-tensioned concrete box girder with 130 m typical spans. The lateral cantilevers are supported by sloped tubular trusses that rest upon the box webs. Its construction was carried out through the cantilever method. The foundation is made through 2200 mm diameter piles.

Three main structures compose the bridge: a 1,5 km long Northern Viaduct, the Bridge over the Tagus River itself with a length of 970 m, and the Southern Viaduct with a length of 9,2 km.

The viaducts consist of prestressed/post-tensioned decks, with 36 m typical spans, supported by 50 m deep piles-piers with 1500 mm diameter.

The Northern Viaduct's deck is a post-tensioned ribbed slab cast-in-situ by means of launching girders, while the Southern Viaduct is composed by precast prestressed U-shaped beams.

WIDENING OF VALA DA ASSECA VIADUCT | PORTUGAL

Client/Owner: BRISA (Motorway Concessionnaire)
Year: 2003

The original Vala da Asseca Viaduct was 676.5 m long, 30.4 m wide and had an average height of approximately 15 m. Open to traffic in 1988, the structural solution of the viaduct was designed by COBA in collaboration with Prof. Edgar Cardoso.

The existing viaduct is a concrete structure, mainly composed by thin reinforced concrete mushroom slabs (420 mm thick), supported on small diameter piles at reduced transversal (4.50 m) and longitudinal (6.00 m) spacing. Special 3D trusses were included at regular intervals to resist seismic loads.

The upgrading of the motorway created the need to increase the viaduct's width to accommodate one new 4.35 m wide lane on each carriageway.

Taking into consideration these conditions and given the existing structure's uniqueness, it was chosen to keep the same solutions in the widening design, in order to preserve the aesthetic and structural value of the viaduct as a whole.

An analysis of the existing viaduct's safety conditions showed that the existing piers had strength insufficiencies in regards to the seismic loads presently defined by the code. In order to avoid strengthening interventions in the existing piers, it was decided to design the new structural members with enough capacity to compensate the existing deficits.

Special attention was paid to differential shrinkage effects, resulting in the introduction of a pour strip between the new and the existing deck and the prescription of special controlled shrinkage concrete.

VASCO DA GAMA BRIDGE | PORTUGAL

The Vasco da Gama Bridge is a cable stayed bridge spanning the Tagus River in Lisbon, Portugal. It was opened to traffic in 1998, after 18 months of construction, in time for the World's Exhibition Expo 98, celebrating the 500th anniversary of Vasco da Gama's discovery of the sea route from Europe to India.

With a total length of 18 km, including access viaducts, it is the longest bridge in Europe. The span of the cable stayed structure is 420 m.

It was built on a build-operate-transfer scheme by the consortium Lusoponte, which got a 40-year concession for the tolls of both Lisbon main bridges.

The bridge has a life expectancy of 120 years, having been designed to withstand wind speeds of 250 km/h and an earthquake 4.5 times stronger than the historical 1755 Lisbon earthquake.

The project included the interchanges linking to the existing road network. These were particularly complex on the highly urbanized Lisbon's riverbank. COBA was assigned with several missions within the project:

- Leadership of the design consortium
- Road layout design
- Geological and geotechnical studies
- Bridge and viaduct design for Lisbon's riverbank interchanges
- Design of signing, safety, lighting, traffic control and toll equipment
- Environmental impact and monitoring studies

Client/Owner: Consortium Lusoponte / Gattel

Year: 1993 / 98

Consortium: COBA / EEG / Proponte / Kvaerner, under COBA's leadership

Construction cost: 900 M€

VIDIGUEIRA BRIDGE | PORTUGAL

Client/Owner: Mafra Atlântico
Year: 2004 / 2007

The Vidigueira Bridge is included in the A21 Motorway between Ericeira and Malveira, in Portugal. It crosses a very large and deep valley, with agriculture aptitude and very steep slopes. In the valley, several water capitations area located and the concessionaire was very restrictive as to the ground occupation.

As result of this, it was adopted a structural solution of 140 m spans decks, that crosses the valley 70 m above ground.

The bridge is 480 m long and 26,2 m wide and is composed by two twin continuous post-tensioned concrete box girders , with spans of 100 + 2x140 + 100 m.

The box girders have variable depth section between a maximum of 8,50 m over the piers and a minimum of 3,50 m at mid span.

The decks are supported by 60 m high voided concretes piers.

Shallow foundations were adopted with the exception of the central pier that is founded by 2 m diameter piles.

MATINHA VIADUCT | PORTUGAL

CLIENT: CP (Portuguese Railways)
Year: 1994 / 1998

The Matinha Viaduct integrates the Alternative EN10 Road. It overpasses the Northern Railway Line and the Matinha railway branch and ensures the access to the Portela Interchange and the Nations Park, in Lisbon, Portugal.

The bridge is composed of three structurally independent decks: two of them carry the Alternative Road and a branch bifurcation; the third carries the same branch over the Northern Railway Line.

The two main post-tensioned reinforced concrete decks are 467 m long with typical spans of 35 m and variable width between 31 m and 37 m. They consist in two 1500 mm deep longitudinal ribs linked by a concrete slab and extended laterally by cantilevers. Both decks are continuous between the abutment and the transition pier, where a third independent deck, with similar characteristics, starts.

The decks are supported by 1600 mm diameter circular piers, one per rib.

A23 MOTORWAY | PORTUGAL

Client: Consortium SCUTVIAS /ACESTRADA - Construção de Estradas, ACE
Year: 2000 / 2003

The viaducts integrated in this Motorway correspond to standardized solutions adopted throughout the entire Concession, in order to achieve uniformity aiming and cost-effectiveness and speed of construction.. Henceforth, throughout the motorway sections included in this Concession, one can identify structures with typical 30 or 35 m spans and precast decks.

WIDENING OF THE ENTRECAMPOS RAILWAY VIADUCT | PORTUGAL

Client/Owner: REFER (Portuguese National Railway Network Company)
Years: 1994 / 99

The project consisted in the widening of the Entrecampos Railway Viaduct, which supports the Entrecampos Railway Station and spans two of Lisbon's major avenues, República Av. and 5th October Av., in view of doubling the existing railway tracks and upgrading the existing station.

The structure of the widening is independent from the existing one and consists in two decks, each being 229.4 m long and 5.35 m wide and supporting the two additional tracks.

The decks are formed by a 1500 mm depth U-shaped section in fully post-tensioned concrete.

The project had to take into account the stringent conditions due to the traffic circulation in the crossed avenues, the existing utility networks and the regular operation of the existing station and railway lines


MULTIMEDIA

MOSTEIRÔ BRIDGE

Client/Owner: EP (Portuguese Road Authority)
Year: 2005/09

The Mosteirô Bridge is integrated in the national road EN321 and crosses the Douro River in the Carrapatelo Dam's reservoir backwater curve. It was designed by one of the most relevant Portuguese bridge engineers, Mr. Edgar Cardoso, and completed in 1973.

It is one of the most remarkable bridges in the country, for its beauty and structural solution.

The deck is a continuous post-tensioned concrete box-girder, with variable depth and truss webs, spanning a maximum of 110 m. It is supported by masonry piers, which belonged to the old Mosteirô Bridge existing at the same location and that were retrofitted for that purpose.

COBA's first intervention consisted in doing a structural assessment of the existing structure.

As some problems were observed in the visual inspections and insufficiencies were encountered in the structural analysis, in regards to the higher traffic and seismic loads presently defined by the codes, COBA's mission was extended to include the design of the bridge's repair and retrofit.

This included the installation of new post-tension cables and carbon fiber reinforcement in the central span, new connections between the deck and the abutments (for vertical and seismic loads) and general smaller repair works.

ALGIERS 2nd RINGROAD VIADUCT | ALGERIA

Client: Teixeira Duarte
Owner: ANA - Agence Nationale des Autoroutes (National Motorway Agency)
Year: 2007/09

This viaduct is included in Algiers 2nd Ring Road (2ème Rocade Autoroutière d'Alger) and spans an oued (transitory river).

The viaduct is composed by two twin composite decks, 15.4 m wide and continuous over the 7 spans of the structure. The total length is 278 m, with typical spans of 42 m.

Each deck includes a top concrete slab (200 mm high) and two longitudinal 'I' steel beams with constant height of 2080 mm. The beams are braced by cross beams above the supports. The connection between slab and beams is ensured by studs.

The deck is supported by concrete piers of rectangular voided section founded by pile groups.

The beams were erected through launching and the slab was cast in situ with 70 mm thick precast concrete slabs being used as formwork.

BRIDGE OVER THE RHUMEL RIVER VALLEY | ALGERIA

Client: Odebrecht, SA
Owner: Public Works Direction of Constantine Wilaya
Concept Design for Design and Build Tender
Year: 2008
Consortium COBA/Arcadis

The bridge is part of a 4 km-long double carriageway road in the city of Constantine. This road connects Bellevue to Mansourah areas and includes the Rhumel River Valley crossing.

Due to the bridge's high visibility from the old town and from the valley, as well as its exceptional dimensions - 670 m long, with the deck 80 m above the river - it will become the largest bridge in the city, thus becoming a new symbol of Constantine in the 21th century.

The huge environmental and seismic constraints identified for the area were taken into account.

The concept design pointed towards a cable-stayed bridge with three towers rising 50 m above the deck, solution that proved to be the most adequate in view of the valley dimensions.

Moreover, this type of bridge is a tradition in Constantine, already known as the “city of the suspended bridges”.

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coba GROUP

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