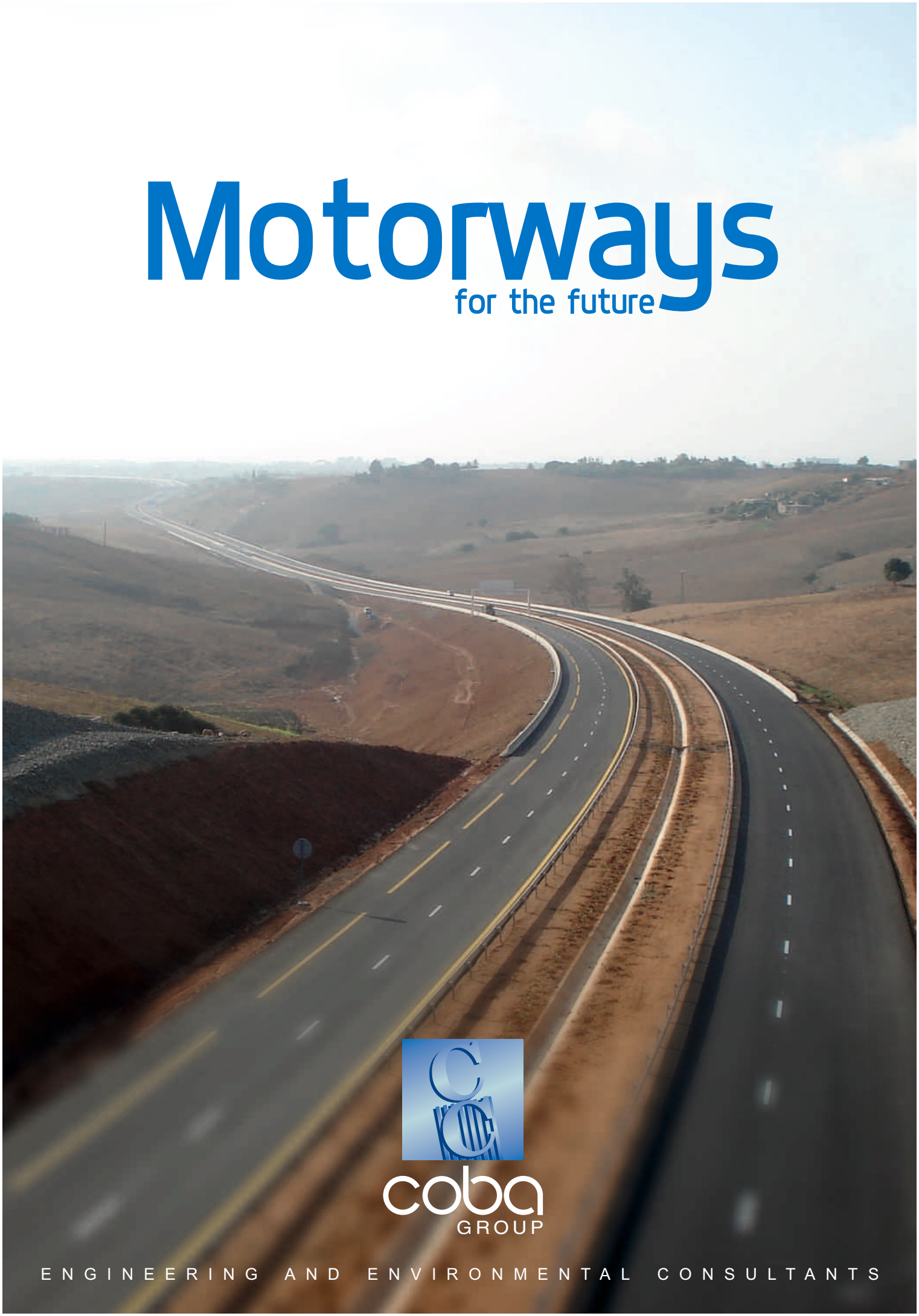
# Motorways

## 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.

## ROAD INFRASTRUCTURES ACTIVITY

Road activity in COBA has a long way since the late 60's when the development of the company justified the existence of a specialised sector to comply with the requirements of studies and projects of road networks associated to the large hydro-agricultural and hydroelectric projects in charge of COBA at that time both in Portugal and overseas.

During the seventies, the award of two important road contracts and the involvement of COBA if the first highways constructed in Portugal were decisive for the creation of a specialised sector centralised in the Road Department and the hiring of multidisciplinary teams. To support the studies, a soils mechanic laboratory has been created inside the Department. The former designs were already accompanied by landscape and environmental protection studies.

The different specialties involved in road design and the type of training provided at the time in the different engineering colleges implied a great effort for in-house training. It is worth mentioning that most of Portuguese road consulting engineers have their former training with COBA as its employees.

In the last two decades, as an extension of the traditional services provided under contracts with road state authorities, private organisations were granted time-limited opportunities to finance, design, build, operate and collect revenues from transportation facilities. In the 90's Road Authorities also encouraged public-private partnerships for the development of infrastructures. This new policy triggered off an enormous activity in the motorway sector and, as a consequence of this and the respectful name of COBA in the area, led to intensify its action in the transport infrastructures, being, nowadays, the major Portuguese engineering consultancy with wide activity in Portugal, Ireland, Algeria, United Arab Emirates, Mozambique, Congo Republic, Senegal, Brazil, etc.. Its name is associated to thousands of roads, motorways, bridges, viaducts and current engineering structures, which mobilize some 80 specialists, engineers and technicians.

**Range of services**

The services provided by COBA are basically: regional and urban planning of road networks; traffic studies and surveys; feasibility studies of roads including environmental impact assessment and economic analysis; road alignments assisted by specific computer programmes; design of interchanges; study of safety equipment for roads and motorways and traffic signing; design of transverse and longitudinal drainage systems of roads; pavement design and strengthening; preparation of specifications and tender documents; technical assistance to the construction works; construction supervision and project management.

## 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.

# A1 - NORTHERN MOTORWAY LINKING LISBON TO OPORTO | PORTUGAL

**Client/Owner:** BRISA – Auto-estradas de Portugal, S.A
**Basic Design, Final Design and Technical Assistance:** 1977 / 1991
**COBA designed 6 sections of the motorway:**

Pombal / Condeixa
Torres Novas / Fátima
Mealhada / Águeda
Aveiro / Vila da Feira
Aveiras de Cima / Santarém
Coimbra / Mealhada

**Technical Data:**
- 130 km long
- 139 bridges and viaducts
- 6 interchanges
- 94 relocations
- 6 toll plazas

# A2 – SOUTHERN MOTORWAY LINKING LISBON TO ALGARVE | PORTUGAL

## ALMODÔVAR - S. BARTOLOMEU DE MESSINES SECTION

**Client/Owner:** BRISA – Auto-estradas de Portugal, S.A.
**Feasibility Study:** 1998
**Preliminary Study:** 1999
**Final Design:** 1999/2000
**Technical Assistance:** 2000 / 2002

**Technical Data:**

- 28 km long
- 13 rural roads
- 22 viaducts with lengths between 47 m and 766 m

This section of the A2 motorway crosses the entire Caldeirão Mountain Range and ends after crossing the Gavião River, therefore crossing an area with topographical and environmental difficulties that resulted in a significant number of bridges.

# A23 - "BEIRA INTERIOR" MOTORWAY | PORTUGAL

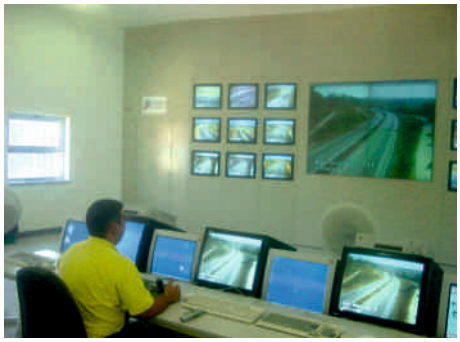
**Cliente/Owner:** ACESTRADA - Construção de Estradas, ACE / EP - Estradas de Portugal, S.A. (Portuguese Roads Authority)
**Preliminary Design for a DBFO Tender:** 1998
**Final Design and Technical Assistance:** 1999 / 2003
**Investment Cost:** 520.000.000,00 €

**Technical Data:**

- 132 km of motorway sections, divided among the following sections: IP6 - Mouriscas/Gardete (28 km); IP2 - Castelo Branco / Gardete (47 km); Teixoso (Belmonte) / Alcaria (22 km); Guarda / Teixoso (Belmonte) (33 km);
- Doubling of the Gardunha Tunnel (3 000 m);
- Ramela Tunnel with 2 galleries with 265 m each;
- Barracão Tunnel with 2 galleries with 325 m each;
- Bridges: Bridge across the Ribª das Eiras Stream with 369 m; Bridge across the Ribª das Boas Eiras Stream with 264 m; Avessada Bridge with 200 m; Bridge across the Frio River with 229 m: Bridge across the Rib.º da Velha Stream with 89 m; Caria Bridge with 194 m; Bridge across the Ribª de Caria Stream with 334 m; Bridge across the Ribª do Minho Stream with 260 m; Qtª da Madeira Bridge with 369 m; Qtª da Raposa Bridge with 194 m; Bridge across the Zêzere River with 299 m; Talhadas Viaduct with 200 m; Líria Bridge with 46,3 m; Bridge across the Diz River with 320 m; Viaduct V1 with 410 m; Viaduct V2 (Noeme River) with 470 m; Viaduct V2 (Fonte Boa) with 439 m; Viaduct V3 with 260 m; Viaduct V4 (Western lane) with 170 m; Viaduct V4 (Eastern lane) with 200 m; Viaduct V5 with 140 m and Viaduct V6 with 140 m.
- Fratel, Guarda, Fundão, Abrantes and Castelo Branco Service Areas;
- Envendos, Lardosa and Belmonte Assistance and Maintenance Centres.







# "DOURO LITORAL" MOTORWAY CONCESSION | PORTUGAL

**Client/Owner:** DLACE – Douro Litoral, ACE (Group of Contractors: Teixeira Duarte/Alves Ribeiro/Zagope/Construtora do Tâmega) / EP - Estradas de Portugal, S.A. (Portuguese Roads Authority)
**Preliminary Design for a DBFO Tender:** 2005
**Assistance during the Negotiations Phase:** 2007
**Final Design and Technical Assistance:** 2008 / 2011

**Technical Data:**
- 128 km long;
- 42 relocations of the existing road network;
- 1 tunnel (Seixo Alvo) with 2 unidirectional galleries, with 3 lanes each, over an extension of approximately 260 m;
- Covelo Tunnel with two galleries: 1 with 415 m and another with 449 m;
- 28 overpasses;
- 23 underpasses;
- 6 tolled interchanges with the local network;
- 2 interchanges between motorways (interchange with motorway A41 and interchange with motorway IP1);
- 1 service area in the Feira city vicinities;

# A17 - MARINHA GRANDE / MIRA MOTORWAY | PORTUGAL
## Sections Monte Redondo / Louriçal; A14 / Quiaios and Linking of Highway IC8 to the A1 Motorway

**Client/Owner:** LACE – Litoral Atlântico, Construtores ACE / EP - Estradas de Portugal, S.A. (Portuguese Road Authorities)
**Final Design and Technical Assistance:** 2002 / 2007

**Technical Data:**
- 33 km long
- 5 junctions, 2 trumpet: Guia and Louriçal
- 1 viaduct over the Mata da Cana steam with a length of some 130 m
- Several overpasses
- 2 toll plazas: Guia e Louriçal
- 52 relocations

# IC17 – CRIL - LISBON INNER RING ROAD | PORTUGAL

**Client/Owner:** Junta Autónoma de estradas (JAE) / EP - Estradas de Portugal, S.A (Portuguese Roads Authority)

## BURACA / PONTINHA SECTION

**Technical Data:**

- 3,4 km long
- several multi level interchanges

CRIL – Lisbon Inner Ring Road is one of the major roads with very heavy traffic connecting Algés (nearby the Tagus River) to the Northern Motorway and to the Vasco da Gama Bridge over the Tagus River.

As this road crosses a very high density population area, the design has been developed along some years in order to find out a layout compatible with the land occupation and the interests of the concerned municipalities. The final design corresponds to a layout almost entirely in tunnel (cut and cover) and its cover has been used for urban requalification of much degraded areas.

Another great difficulty associated with this cut and cover project was the crossing of piped streams and the need to preserve the "Aqueduto das Águas Livres", an historic aqueduct in the city of Lisbon that is one of the most remarkable examples of 18th-century Portuguese engineering.

## PONTINHA / OLIVAL DE BASTO SECTION

**Technical Data:**

- 7 km long
- 4 interchanges
- 18 over and underpasses

In spite of being longer, it crosses urban areas with lower density of population than the previous section.

The design also included the regulation of a section of the Odivelas stream.

# NEW CONNECTION BETWEEN VASCO GIL AND FUNDOA AT LEVEL 500 | MADEIRA ISLAND, PORTUGAL

**Client/Owner:** RAMEDM - Região Autónoma da Madeira, Estradas da Madeira, S.A.
**Preliminary Study, Final Design and Technical Assistance to the Construction Works:** 2005 / 2009

**Technical Data:**

- 12 connections to the existing road network and 1 parallel connection, totalling 2 185 m of new roads;
- 5 roundabouts;
- 6 relocations of the existing road network;
- 7 tunnels , one of which a "Top-Down" tunnel, and an emergency gallery, with a total length of approximately 2 113 m;
- 8 viaducts with a total length of about 1 269 m;
- 4 culverts;
- 3 overpasses;
- 1 underpass;
- 1 pedestrian crossing;
- 4 culverts;
- About 55 retaining structures
- 10 bus stops;
- cross-section - 1.0 (shoulder) + 7.0 (carriageway + 1.0 (shoulder);
- longitudinal profile – maximum inclinations of 8% in viaducts and 12% in the tunnel; longitudinal profile – maximum inclination of 22% in road connections and 30,2% in relocations.

# REFORMULATION OF THE ROAD NETWORK WITHIN THE ALFRAGIDE COMMERCIAL ZONE | PORTUGAL

**Client/Owner:** Grupo Jerónimo Martins / IKEA
**Preliminary Study, Final Design, Management and Supervision of Construction Works:** IKEA
**Entities Involved:** Amadora and Oeiras Municipalities and Instituto de Estradas de Portugal (IEP) (Portuguese Road Authority)
**Date:** 2001 / 2005
**Investment Cost:** 11.000.000,00 €

**Description:**

The studies pertain to the Reformulation of the Road Network within the Alfragide Commercial Zone, comprising the new access roads and infrastructures associated to the establishment of the first IKEA Shopping in Portugal.

Interventions mainly comprise reformulation of the existing network with a total length of approximately 6.690 meters, contemplating the construction of two viaducts – the IKEA viaduct (which crosses NR 117 and is about 235 m long) and the DECATHLON viaduct (over an existing roundabout), and the widening and duplication of an underpass in relocation 2.

A new 4-lane connection road was also considered that contours the IKEA building from the North, linking a roundabout situated in the Zambujal road to one located close to NR 117 and to the viaduct.

Additionally, the project included an exit from NR 117 (Lisbon / Amadora direction) with connection to this roundabout, allowing incoming traffic from Belém, Algés, Restelo, etc., via NR 177, a direct access to IKEA premises (existing and future) without overburdening the local road network.




# 4TH ALGIERS OUTSIDE RING ROAD (4ÈME ROCADE D'ALGER) | ALGERIA

**Client/Owner:** ANA – Agence Nationale des Autoroutes (Algerian Road Authority)
**Feasibility Studies, Detailed Design and Tender Design:** 2008 / 2011

**LOT 1**
**SECTION BETWEEN THE NR18 INTERCHANGE (AIN DELFA WILAYA) AND THE NR 1 (MÉDÉA)**

**Technical Data:**
- 73,5 km long
- 1 Tunnel: 6.400 m
- 19 bridges and viaducts
- 3 interchanges
- 1 rest area
- 3 toll plazas
- 1 assistance and maintenance center

**LOT 2**
**SECTION BETWEEN THE NR 1 (MEDEA MEDEA) AND THE NR8 INTERCHANGE (EAST OF DIRAH)**

**Technical Data:**
- 84 km long
- 15 bridges and viaducts
- 4 interchanges
- 81 relocations
- 4 toll plazas
- 4 service areas
- 4 rest areas
- 3 assistance and maintenance centers

# ALGIERS OUTSIDE RING ROAD (2ÈME ROCADE D'ALGER) | ALGERIA

**Client/Owner:** Teixeira Duarte, S.A./ ANA - Agence Nationale des Autouroutes (Algerian Road Authority)
**Final Design and Technical Assistance:** 2006 / 2009

**Technical Data:**
-10 km long
- 1 viaduct 278 m long
- 10 over and underpasses
- 5 interchanges

This motorway connects the cities of Zéralda and Boudoadou in the Great Algiers region. It comprises a major road infrastructure of great importance that links Morocco to Tunisia.

The studies included essentially: the road design, design of over and underpasses; design of the viaduct; geological and geotechnical study; geotechnical survey works; Technical Assistance during the construction phase.

# EAST-WEST MOTORWAY | ALGERIA

## OUED FODDA – KHEMIS MILIANA SECTION

**Client/Owner:** COSIDER (Leader of the G.R.A.K.M.O.F. Group) / ANA - Agence Nationale des Autoroutes (Algerian Road Authority)
**Construction Plans, Technical Assistance to Project Management:** 2005 / 2008

**Technical Data:**

- 73 km long

The services included: construction plans of road; expertise assessment of geological and geotechnical data of detailed design; supervision and control of topographic documents; checking of engineering structures; permanent technical assistance to the project.

## KHEMIS – MILIANA – HOCEINIA SECTION

**Client/Owner:** Agence Nationale des Autoroutes (ANA) (Algerian Road Authority)
**Preliminary and Detailed Design and Tender Documents:** 2005/2008

**Technical Data:**

- 23,00 km long + 9,00 km secondary roads
- 4 viaducts, one 200 m long and total length of 1299 m
- 23 over and underpasses
- retaining walls over 6 000 m






## REHABILITATION OF THE ROAD NETWORK IN THE LUANDA AREA | ANGOLA

**Client/Owner:** INEA - Instituto Nacional de Estradas de Angola (Angola Road Authority)
**Final Design:** 1996 / 1997
**Construction Supervision of Sections Luanda / Viana and Luanda / Barra do Kwanza:** 1998 / 2001

**Technical Data:**

- 117 km long

The project comprises the rehabilitation of four sections of asphalt roads totaling about 117 km: Luanda-Barra do Kwanza, Luanda-Viana, Viana-Catete and Catete-Kifangondo.

The sections were in much degraded state, due to the lack of maintenance and also due to the heavy traffic in densely populated areas with great problems associated to geological and drainage aspects. The rehabilitation consisted, on the one hand, on the total reconstruction of some sections and, on the other hand, on the pavement reinforcement with asphalt concrete.

## EXPRESSWAY LUANDA / VIANA | ANGOLA

**Client/Owner:** Odebrecht / INEA - Instituto de Estradas de Angola (Angola Road Authority)
**Final Design:** 2007 / 2008

**Technical Data:**

- 8 km
- Overpasses PS1 and PS2;
- Pedestrian Overpasses PP1 to PP4

The study contemplated the 3rd Section of the Luanda / Viana Expressway, in Luanda, the intersection between the Expressway and the Luanda Outer Ring Road, through a diamond interchange, as well as a section of the Luanda Outer Ring Road with approximately 950 m, including two unidirectional access branches.

The studies comprised essentially the drainage and bridge specialties.

# URBAN ROADS ENGINEERING PROJECTS - FORTALEZA | BRAZIL

**Client/Owner:** Prefeitura Municipal de Fortaleza - SMDT
**Feasibility Study, Preliminary Study and Detailed Design:** 2001 / 2004

**Description:**

For the purpose of restructuring the road system in the city of Fortaleza, one of the major cities in Brazil, with about 3 million inhabitants, a tender was open for 7 design lots corresponding to the administrative areas of the city. From these lots, COBA was awarded the feasibility study, preliminary study and detailed design of lots 01 and 03:

- **Lot 01** – transportation corridor linking the eastern to the western area of the City of Fortaleza, with a length of 12,33 km;
- **Lot 03** - transportation corridor linking the southwestern to the central of the City of Fortaleza, with a length of 15,28 km.

The studies have a broad nature, covering the great majority of the transportation problems. From the sub-systems forming the Fortaleza Transports System, a special emphasis was given to the Public Transports System and to the Non-Motorized Transport, this requiring the designs to make the approach of aspects ranging from the redesign of roads geometry, pavement and drainage.

For a better identification, analysis and improvement of the existing system, the 2 lots have been subdivided into geographical subsections, for which preliminary studies and detailed studies were carried out.

Given the interdependencies that an urban intervention requires, and particularly when the circulation scheme is

# TRANSBRASIL BRT CORRIDOR (BUS RAPID TRANSIT) | BRAZIL

**Client/Owner:** Rio de Janeiro City Hall
**Basic:** Design 2011 / ongoing

**Description:**

Implementation of a BRT Corridor (Bus Rapid Transit) TransBrasil for exclusive bus circulation between the Rio de Janeiro City Centre (Santos Dumont Airport) and Deodoro, in the northern zone, throughout the Brasil Avenue.

It is approximately 32 km long and includes 4 terminals and 29 bus stations. The overall and general traffic system adjacent to the exclusive bus corridor shall be adjusted and the new road alignment shall be composed of four sections.

The BRT corridor is included in the restructuring and rationalization of the passenger public transportation system by bus in the city of Rio de Janeiro. In articulation with other similar corridors, it comprises an innovative public transportation system, environmentally friendly and with high capacity that operates in separates lanes, extending quality of transportation upon rialto road transportation.

# RURAL ROAD REHABILITATION OF ROAD ER 405 FROM THE MAPUTO BORDER TO CHOKWÉ | MOZAMBIQUE

**Client/Owner:** ANE – Administração Nacional de Estradas
**Detailed Design and Tender Documents:** 2004 / 2005

**Description:**

The Rural Road Rehabilitation of road ER 405 from the Maputo Border to Chokwé has an extension of 31,7 km. It includes the Mazimechopes Bridge at km 2+900, with a unique 30 m-span. This road connects Chokwè to Magude and it is possible, from both locations, to connect with National Road NR, via Xinavane or Ressano Garcia (South African Border) through Moamba.

Rehabilitation activities essentially comprise the realignment of the road and the respective earthworks, the construction and replacement of longitudinal and transversal drainage, road paving through a base solution stabilized with an additive comprising 6% of cement (Class C4), topped by a sand seal and with a subbase made of selected materials.

The design also envisages the placement of guardrails with wooden posts, the treatment of embankment foundations and the protection of approach slopes of the bridge across the Mazimechopes River.

# MALICK SY – DIAMNIADIO MOTORWAY | SENEGAL

## PATTE D'OIE / PIKINE SECTION

**Client/Owner:** MSF – Moniz da Maia, Serra & Fortunato Empreiteiros, SA (Contractor)
**Preliminary Studies and Final Design:** 2008 / 2010

**Technical data:**

- 4,8 km long
- 2 interchanges
- 3 crossings
- Various relocations

## PIKINE / DIAMNIADIO SECTION

**Client/Owner:** MSF Concessões / MSF Empreiteiros / Mota - Engil / Brisa / BES Joint-Venture (Contractors and Financing Bank)
**Preliminary Design:** 2008

**Technical Data:**

- 20,8 km long
- 5 interchanges
- 10 relocations
- 6 toll plazas
- 1 service area
- 1 maintenance centre

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coba GROUP

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