



## WASTE WATER TREATMENT PLANTS

**S. JOÃO DA PESQUEIRA,  
ERVEDOSA DO DOURO,  
TABUAÇO, ARMAMAR**

**LEOMIL, MOIMENTA DA BEIRA,  
VILAR / SERNANCELHE**

**RESENDE MIRÃO, CAMBRES,  
SANDE, TAROUCA**

**Client:**

Águas de Trás-os-Montes e  
Alto Douro, S.A.

**Construction Supervision  
and Quality Control:  
2004/2006**

*Works undertaken in association  
with EFIEFE  
(COBA Group)*

## STORM AND WASTE WATER SYSTEMS

Supervision

WASTE WATER TREATMENT PLANTS

PORTUGAL

### DESCRIPTION

These works pertain to the construction of the Lot A WWTP's (São João da Pesqueira, Ervedosa do Douro, Tabuaço and Armamar); Lot B (Vilar/Sernancelhe, Leomil and Moimenta da Beira); and 4 WWTP's (Resende/Mirão, Tarouca, Sande e Cambres), included in the Southern Douro Valley Waste Water Subsystems.

Works included the following fields of activity: mechanics, electricity, control, automation and monitoring, ventilation, instrumentation, foundations, structures, architecture and landscaping, according to the design and technical conditions established in the Tender Documents. The technical characteristics of these WWTP's are as follows:

Name		Population	High Season, Maximum admissible flow Year 30	Flow during the rainy season Year 30
4 WWTP's	Sande	1.374	34 m3/h	53 m3/h
	Resende – Mirão	3.694	82 m3/h	128 m3/h
	Tarouca	6.108	123 m3/h	179 m3/h
	Cambres	4.741	83 m3/h	116 m3/h
Lot A	S.J. Pesqueira	2.920	67 m3/h	102 m3/h
	Armamar	1.941	52 m3/h	62 m3/h
	Ervedosa do Douro	1.631	34 m3/h	47 m3/h
	Tabuaço	2.647	73 m3/h	114 m3/h
Lot B	Vilar	9.762	179 m3/h	223 m3/h
	Leomil	2.380	58 m3/h	80 m3/h
	Moimenta	3.099	81 m3/h	114 m3/h





## PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Upgrading, Road Rehabilitation, Pavement Management

MR 4 UPGRADING. SECTION BETWEEN LUYENGO AND SICUNUSA

SWAZILAND

### MAIN ROAD 4 UPGRADING. SECTION BETWEEN LUYENGO AND SICUNUSA

**Client:**

Ministry of Public Works and  
Transport

**Design Review:**

1997/1998

**Monitoring and Supervision:**

1999/02

**Financing:**

African Development Bank

*Studies Undertaken in  
Association*

**Investment Cost :**

18.120.000,00 Euro

### DESCRIPTION

The MR4 Luyengo-Sicunusa road is located in the west of the country and lies entirely in the highveld ecological zone of Swaziland. The project included the upgrading of the existing MR4 road for about 39 km and the construction of a new 8 km section connecting the MR18 to the MR4, three bridges over the Usuthu, Mhlatane and Rowela rivers and 10 retaining walls, with heights from 3 to 15 m. The cross section is 2 x 3,65 m and paved shoulders with 2 m.

Due to the mountainous characteristics of the site, especially during the first 8 km section, the road involved important earthworks volumes (some 1,5 million cubic meters), implying longitudinal gradients of the road up to 9-10%, where the typical cross section is reinforced by climbing lanes.

The pavement structure is formed of a stabilized soil-cement sub-base, a crushed aggregate base and a double seal surface dressing wearing course. On steep longitudinal gradients, embedment of chippings was applied at the upper bituminous dressing layer, providing an additional pavement roughness.





**MASSINGIR DAM AND  
SMALLHOLDER  
AGRICULTURAL  
REHABILITATION PROJECT  
(MDSAR)**

**Client:**  
Ministry of Public Works and  
Housing

**Review, Design of Drainage  
Infrastructures:**  
2003/05

**Construction Supervision:**  
2005/..

Studies carried out in  
Association

**Financing:** AfDB – African  
Development Bank



Ponela Irrigation Canal

**DESCRIPTION**

The Xai-Xai Irrigation and Drainage scheme is located in the lower basin of the Limpopo river, in the vicinities of the Xai-Xai city (170 000 inhabitants), capital of the province of Gaza and located some 200 km to the north of Maputo. The National Highway passes through the scheme (south-east), linking Maputo in the south to Inhambane/Maxixe in the north.

The irrigation scheme disposed of a great deal of infrastructures, although by 1993 it was not yet entirely utilized, and is subdivided in three irrigation units – Magula, Chimbonhanine and Ponela (550 ha, 400 ha and 200 ha in 1993), being each one of these units served by a large pump station

**STUDIES CARRIED OUT**

**Phase I: Review and Design**

- Study existing documents and drawings
- Review the current situation of the existing structures and define rehabilitation measures and works
- Soil suitability assessment
- Prepare the design documents
  - Irrigation conveyance and distribution systems
  - Drainage collectors and Drains
  - Pumping stations
  - Roads
  - Improvement of flood protection dykes
  - Power supplies
  - Operation and maintenance
  - Organization and Management
- Assistance on Tendering Process, analysis of Tenders, assistance during negotiation and signing the Contractor's contract.

**Phase II: Construction Supervision**



Magula pumping station's Water Intake



## PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Roads and Highways

REHABILITATION OF THE ROAD NETWORK IN THE LUANDA AREA

ANGOLA

### REHABILITATION OF THE ROAD NETWORK IN THE LUANDA AREA (about 117 km)

#### CLIENT:

INEA - Instituto Nacional de Estradas de Angola

#### Final Design:

1996/97

**Supervision of Sections:**  
**Luanda – Viana and Luanda – Barra do Kwanza:**  
1998/01

**Financing:**  
World Bank

*Studies undertaken in association*

**Investment Cost:**  
17.500.000,00 Euro



#### OBJECTIVE

Preparation of the engineering studies, traffic and economic analysis as well as the Tender Documents for the construction works.

#### SUMMARY DESCRIPTION

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 are in a very 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 consists, on the one hand, on the total reconstruction of some sections and, on the other hand, on the pavement reinforcement with asphalt concrete.

The engineering studies included:

- Geology and geotechnics
- Drainage
- Pavement reinforcement
- Rehabilitation of bridges

The project mobilized a team of specialists who, during some months, assessed "in situ" the roads and bridges. This team also supervised the execution of Benkelman deflexion tests, DCP tests and the necessary laboratory tests for the studies of the pavement reinforcement.

COBA was in charge of all the engineering studies as well as the tests undertaken with the support of the technicians and equipment of the Engineering Laboratory of Angola.





## REHABILITATION OF THE JABURU I DAM

### Client:

Secretaria dos Recursos  
Hídricos do Estado do Ceará

**Final Design, Tender  
Documents and Procurement  
Processes:**  
1998/2000

**Supervision and Monitoring  
of Construction Works:**  
2002/04

**Financing:**  
World Bank

**Investment Cost:**  
9.000.000,00 Euro

## HYDRAULIC DEVELOPMENTS

Dams

JABURU I DAM

BRAZIL

### DESCRIPTION:

The Jaburu I dam, built between 1981 and 1983, is located at the Ibiapaba mountain range, Tianguá municipality, northeast to the State of Ceará, near the border with the State of Piauí.

The main objective of this dam is public water supply and irrigation.

Within the scope of this project inspection visits to the dam and several basic studies were carried out, these including hydrological studies, topographical surveys and a mechanical investigation campaign, which comprised as well the installation of hydraulic piezometers at the dam's embankment and foundation. These studies were the basis of the reconnaissance and diagnosis of the main problems and deteriorations of the work and of the further analysis and detailing of the envisaged rehabilitation solutions.

### MAIN CHARACTERISTICS

- Type: Zoned earthfill
- Height: 47 m
- Crest length: 770 m
- Reservoir capacity: 210 hm<sup>3</sup>
- Maximum flood flow: 1 224 m<sup>3</sup>/s (T = 1000 years)
- Spillway: formed of a channel 450 m long, a 29 m wide "low-ogee" control weir and channel ranging from 5 to 10 m wide. Q (T = 1000 years) = 158 m<sup>3</sup>/s.
- Water intake: steel pipe under the dam's embankment, with downstream control.



**IRAI DAM****Client:**

SANEPAR, Companhia de  
Saneamento do Paraná

**Tender Design/Final Design,  
Tender Documents and  
Procurement Processes:**  
1996

**Technical Assistance, Works  
Supervision and  
Management:**  
1996/99

**Behaviour and Safety  
Analysis:**  
1999/02

**Financing:**  
International Bank for  
Reconstruction and  
Development (IBRD)

**Investment Cost:**  
10.350.000,00 Euro

**DESCRIPTION:**

Located in the Curitiba Region, the Iraí dam envisages the reinforcement of the water supply to the Curitiba metropolitan area and the downstream flood control.

**MAIN CHARACTERISTICS**

- Type: TE
- Height: 19 m
- Crest length: 1 220 m
- Volume of Dam:  $786 \times 10^3 \text{ m}^3$
- Reservoir capacity:  $58 \times 10^6 \text{ m}^3$
- Maximum flood flow:  $1\,005 \text{ m}^3$
- Spillway:  $80 \text{ m}^3/\text{s}$ , shaft with non-controlled weir
- Bottom outlet:  $16,2 \text{ m}^3/\text{s}$ , gallery





## PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Roads and Highways

REFORMULATION OF THE ROAD NETWORK WITHIN THE ALFRAGIDE

PORTUGAL

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

#### CLIENT:

Feasibility Study:  
**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 Directorate)

#### Date:

2001 / 2005

#### Investment Cost:

11.000.000,00 Euro

#### DESCRIÇÃO:

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 Store 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.

Besides these two viaducts and in articulation with the latter, a new 4-lane connexion road was considered. This new road 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, thus enabling access to the existing shopping stores and, eventually, to the Miraflores and Carnaxide suburbs.

Additionally, the project contemplated an exit from NR 117 (Lisbon / Amadora direction) with connexion to this roundabout, allowing incoming traffic from Belém, Algés, Restelo, etc., via NR 177, a direct access to all stores (existing and future) without overburdening the local road network, namely the Southern Alfragide Roundabout and the Makro Roundabout.





## PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Dams

**GARGAR DAM**

ALGERIA

### GARGAR DAM

**Client:**

Agence Nationale des Barrages  
(ANB)

**Final Design and  
Construction  
Supervision:**

1985/89

**DESCRIPTION:**

The Gargar dam is located in the Oued Rhiou. Its purpose is water supply and irrigation.

**MAIN CHARACTERISTICS:**

- Location: Oued Rhiou
- Type: TE
- Foundation: Karstic Limestone Formations
- Height: 90 m
- Crest Length: 400 m
- Volume of Dam:  $4\,309 \times 10^3 \text{ m}^3$
- Reservoir Capacity:  $450 \times 10^6 \text{ m}^3$
- Maximum Flood Flow:  $4\,800 \text{ m}^3/\text{s}$
- Spillway:  $4\,700 \text{ m}^3/\text{s}$  - Channel, Ski Jump
- Bottom outlet:  $100 \text{ m}^3/\text{s}$
- Volume fill:  $4\,000\,000 \text{ m}^3$





## PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Roads and Highways

### SUPERVISION OF THE AIN-SMARA – AIN EL BEY HIGHWAY SECTION

ALGERIA

#### EAST-WEST HIGHWAY.

#### AIN SMARA – AIN EL BEY SECTION

**Client:**

ANA – Agence Nationale des Autoroutes

**Revision of Final Design of Engineering Structures:**  
1997/98

**Monitoring and Supervision:**  
1997/2003

**Investment Cost:**  
35.000.000,00 Euro

**Financing:**  
African Development Bank

*Studies undertaken in association*



#### DESCRIPTION

Supervision of the construction works of the motorway 11 km long, 4,8 km of secondary routes, one cloverleaf + trumpet junction 5,8 km long, 11 current over and underpasses and 20 retaining walls.

The works consist essentially of:

- Earthworks
  - . Cutting: 1 100 000 m<sup>3</sup>
  - . Embankment: 3 200 000 m<sup>3</sup>
- Carriageways:
  - . Sandy separation layer and draining layer 10 to 20 cm thick
  - . Coated macadam: 188 862 t
  - . Reinforced concrete: 8 300 m<sup>3</sup>
- Drainage and sewerage
- Placing of a crushed graded aggregate base 25 cm thick and graded bitumen base 18 cm thick
- Bitumen concrete dressing 8 cm thick
- 20 retaining walls
- 23 culverts
- 11 over and underpasses and 1 bridge
- Signalling equipment, portals, safety fences, game fences
- Oued Rhumel training over 450 m and width between the crests of slope of 45 m





## PROJECT MANAGEMENT AND CONSTRUCTION SUPERVISION

Roads and Highways

NORTHERN LITTORAL MOTORWAY CONCESSION

PORTUGAL

### TECHNICAL ASSISTANCE TO EUROSCUT NORTE.

### NORTHERN LITTORAL MOTORWAY CONCESSION

#### Client:

EUROSCUT NORTE –  
Sociedade Concessionária da  
SCUT do Norte Litoral, S.A.

#### Design Review and Supervision:

2003/05

#### Investment Cost:

306.000.000,00 Euro

*Works undertaken in  
association with Euroestudios*

### DESCRIPTION:

A28 Motorway Sections: Porto / Viana do Castelo and Viana do Castelo / Caminha and A27 Motorway Section between Viana dos Castelo and Ponte de Lima, integrated in the Northern Littoral Motorway Concession.

#### Technical Data:

- Length: 111 km (70 km under operation and 41 km new construction)
- Interchanges: 11
- Bridges (Overpasses and Underpasses): 54
- Retaining Walls: 2
- 500 m long Tunnel
- 5 cut-and-cover Tunnels

The construction works comprise:

- Earthworks:
  - . excavations: 12.170.000 m<sup>3</sup>
  - . embankments: 10.166.000 m<sup>3</sup>
- Pavement: Bitumen macadam; classic asphaltic concrete; wearing course





## STORM AND WASTE WATER SYSTEMS

### Drainage Systems

#### São Jacinto Sea Outfall

PORTUGAL

### MULTIMUNICIPAL SEWERAGE SYSTEM OF THE RIA DE AVEIRO REGION. SÃO JACINTO SEA OUTFALL

**Client:** SIMRIA - Saneamento  
Integrado dos Municípios da  
Ria

**Supervision of the  
Construction Works: 1997/99**

Activity carried out in  
Association



### DESCRIPTION

The Ria de Aveiro Multimunicipal System aims at the collection, interception and conveyance of domestic and industrial waste water of the Ria de Aveiro region, serving a population of about 595 000 inhabitants in the project horizon (2038), to which corresponds a maximum flow of 3,8 m<sup>3</sup>/s. It comprises an intercepting system, two wastewater treatment stations and a sea outfall.

The main elements of the system are:

- North and Vouga intercepting sewers - collection and conveyance to the North waste water treatment station (WWTS)
- South interceptor - collection and conveyance to the South WWTS
- North and South WWTS
- Sea outfall

The outfall has an extension of about 3320 m (3000 m for the drainage channel and 320 m for the diffuser) and is located about 3 km North of the North pier of the Aveiro estuary. The location of the drainage channel results from the need to guarantee the stability of the sea outfall and to preserve the water quality at the beaches.

The outfall is composed of a high-density polyethylene piping with an exterior diameter of 1600 mm. The diffuser comprises 3 sections of high-density polyethylene pipe with decreasing diameters: 1600 mm, 1200 mm and 710 mm with a total length of 320 m.

The following services were provided:

- Revision of the Final Design of the outlet chamber and outfall
- Control and Supervision of the manufacturing and welding process of the high density polyethylene piping
- Control and Supervision of the pre-manufacturing of the anchor blocks and sinking rings
- Supervision of the construction of the outlet chamber
- Supervision of the construction of the outfall (drainage channel and diffuser)