NEW INTERNATIONAL AIRPORT OF ANGOLA (NAIA)

2007-2012

Location
Bengo, Angola

Client
Casa Militar do Presidente da República/Gabinete de Reconstrução Nacional (Military Staff of the President of the Republic/ National Reconstruction Office of Angola)

Estimated Cost
3 billion EUR

Stage
Detailed Design

Area
1980 ha

The New International Airport of Angola (NAIA), located 40 km southeast of Luanda, was designed as an alternative to the 4 de Fevereiro Airport.

Inserted into the adjacent context of the current general master plan, the project's proximity and easy access to the projected new urban infrastructures was a point of concern. Thus, it takes into account the fundamental strategic vectors that will contribute to the territorial consolidation of this new urban infrastructure. The design equally factors in the construction and improvement of the Luanda–Cacuaco–Viana–Cabolombo motorway, which will connect these cities, as well as those of Samba and of Kilamba Kiaxi, to the new airport. In terms of public transportation, the design includes a direct link between the airport and the railway line located north of the motorway.

The airport complex was designed to meet the urgent needs that resulted from Angola's substantial increase in passenger air traffic, a consequence of the strong economic growth that the country registered over the past years and which is expected to continue. At the same time, the country's rising exposure to foreign countries has made it necessary to equip it with modern and efficient infrastructures.

The area that was available for the construction of NAIA was of approximately 8000 ha, while the area reserved specifically for the NAIA project was of approximately 1324 ha, of which 1111 ha corresponded to the airport itself. This project area includes all airport operations zones, namely: circulation areas, passenger terminals, cargo facilities and complementary infrastructures, as well as areas destined for activities not directly related to aviation.

OVERVIEW OF THE NAIA

CONTROL TOWER AND TECHNICAL BLOCK

PASSENGER TERMINAL

The presented solution for the revision of the airport master plan was based on a set of choices that allowed the segregation of certain service areas and a much more rational organisation.

The proposed master plan, designed for an expected 30 years of service, includes a system of two parallel runways, oriented in the same direction as the main runway of the 4 de Fevereiro Airport (05-23), which allows the execution of mixed independent operations in conditions of low visibility and low hanging clouds.

The eastern runway, 4200 m long and 75 m wide, is prepared to serve the largest aircrafts in operation—the Airbus A380. The western runway, 3200 m long and 60 m wide, is capable of serving aircrafts of up to class E. Both runways possess the necessary equipment to conduct simultaneous landing operations in low visibility conditions.

This airport was designed to become the visiting card of a country that wants to be in the forefront of development.

PRESIDENTIAL TERMINAL

CARGO TERMINAL

Among the proposed infrastructures, we highlight the passenger terminal, a building of 178 000 m^2 prepared to accommodate national and international flights and integrating a set of 12 jet bridges, two of which meant for A380 aircrafts.

The presidential and protocol terminal, destined to serve the Presidency of the Republic of Angola as well as eminent foreign dignitaries visiting the country, is another building worthy of note. Possessing its own dedicated jet bridge, it was designed with both airport functions and protocol requirements in mind, setting itself apart as an official entryway into Angola.

The scale and complexity of this enormous project prove that A1V2's great experience, multi-disciplinary competence, precision and dedication are factors that differentiate it from other companies and are determinant in its success. It also demonstrates A1V2's capacity for creativity on all scales and in the most varied types of infrastructures.

AIRPORT ACCESS AVENUE

BAGGAGE HALL

NEW INTERNATIONAL AIRPORT OF ANGOLA (NAIA)

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Estimated Cost
3 billion EUR

Stage
Detailed Design

Area
1980 ha

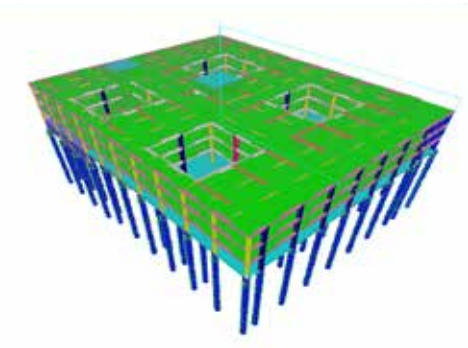
The design of the New International Airport of Angola (NAIA) was a true challenge to all involved expertises and the structural and foundations design required to make the bold and creative architectural concepts a reality was no exception.

The number and dimension of the various buildings, the need to ensure their compliance with the various functional and technical requirements, and the rigorous combination of all engineering and architectural expertises put A1V2's team to the test.

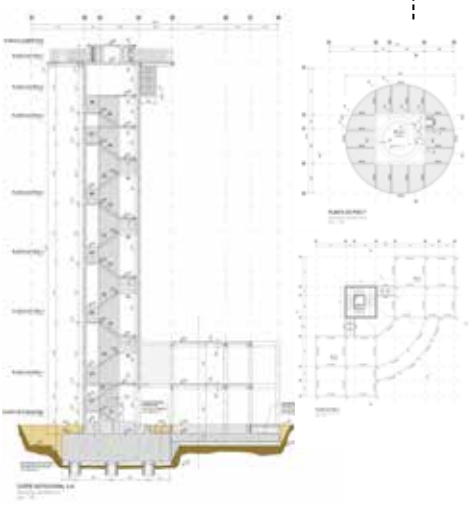
Other challenges lay in the handling of several constraints, such as the geotechnical properties of the ground, or the need to meet local standards and regulations and ensure that all structural solutions were feasible in accordance with the reality of the country. All this resulted in a showcase of structural solutions as varied as they are complex.

OPERATIONAL LANDSIDE VIEW

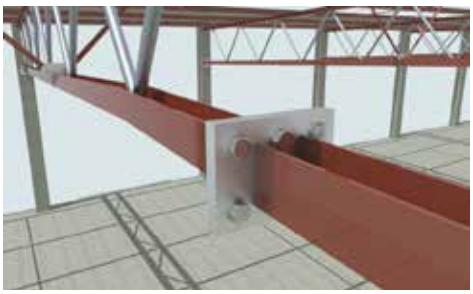
FINITE ELEMENT MODEL (SAP 2000)

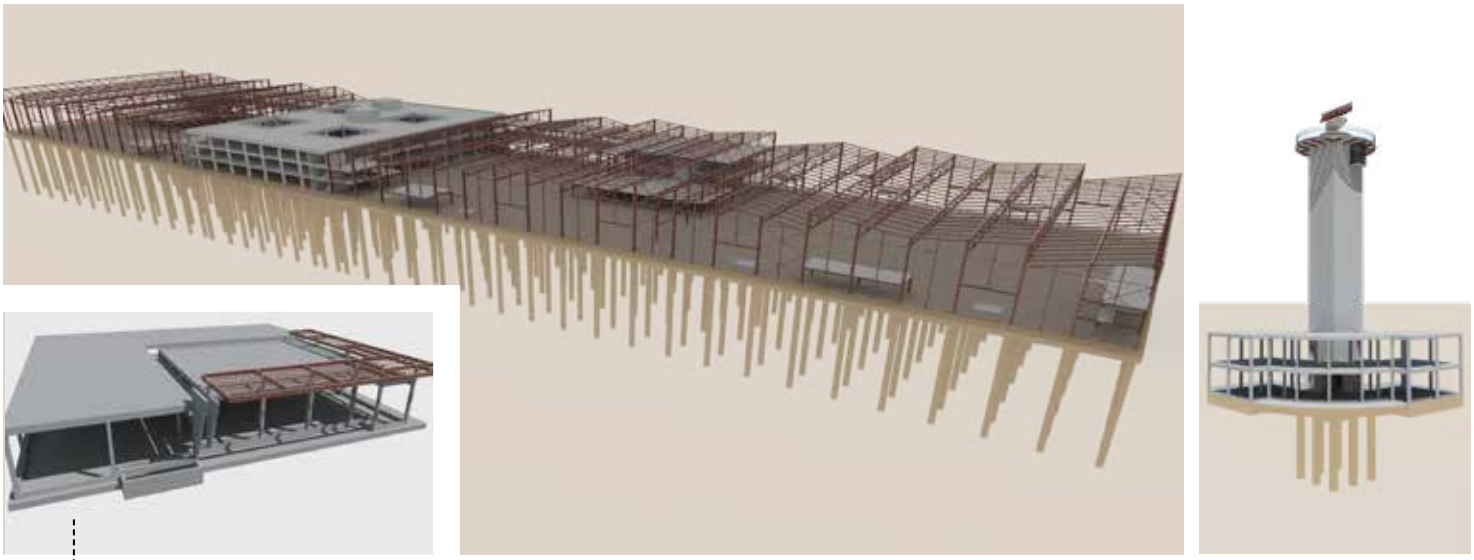


DRAWINGS RADAR TOWER



3D VIEW – STEEL CONNECTIONS





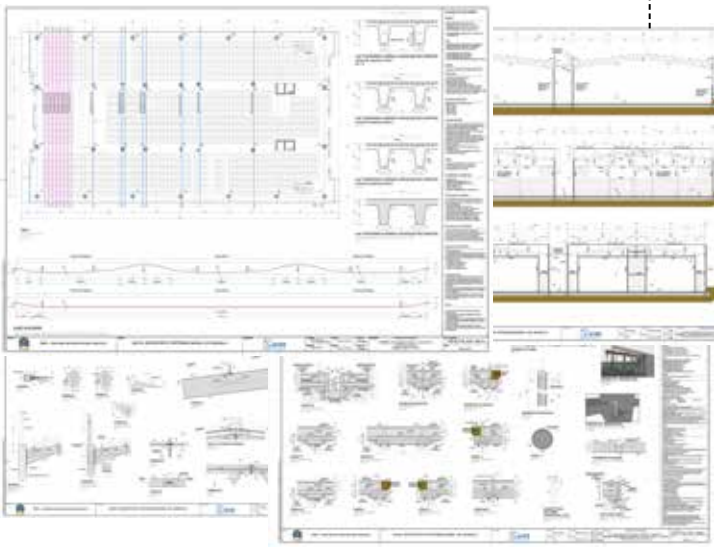
3D VIEWS – AIRCRAFT RESCUE AND FIRE FIGHTING BUILDING, ADMINISTRATION, CARGO BUILDING AND RADAR TOWER

The project includes several structural systems and materials—such as reinforced and pre-stressed concrete, steel and composite, wood and masonry—as well as various structural solutions—like flat slabs, flat plates, waffle and ribbed slabs, pre-stressed beams and slabs, composite beams and slabs, large spans and cantilevers, regular and irregular grids, shallow and deep foundations, among others.

There are various examples of the miscellaneous structural solutions: the 59 m-span steel trusses, precambered, in the cargo building roof; the pile foundations with piles of up to 1.20 m in diameter and depth greater than 20 m in various buildings; the 22 833 m^2 of total floor area of the catering building; the reinforced concrete shaft of the radar tower; the composite beams and slabs in the administration building; the pre-stressed beams and slabs in the communications, fire station and Vault buildings; the flat plates in the catering area; the hollow block slabs in the communications building; the waffle slab in the DEPMEC building. Finally, the pre-stressed waffle slabs and pre-stressed box girders used in the executive terminal are particularly worthy of note.

CAD ENVIRONMENT
GENERAL AND EXECUTIVE AVIATION TERMINAL

SAMPLE DRAWINGS



NEW INTERNATIONAL AIRPORT OF ANGOLA (NIAA)

2007-2010

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Bengo, Angola

Client
Casa Militar do Presidente da República/Gabinete de Reconstrução Nacional (Military Staff of the President of the Republic/ National Reconstruction Office of Angola)

Estimated Cost
3 billiion EUR

Stage
Detailed Design

Area
1980 ha

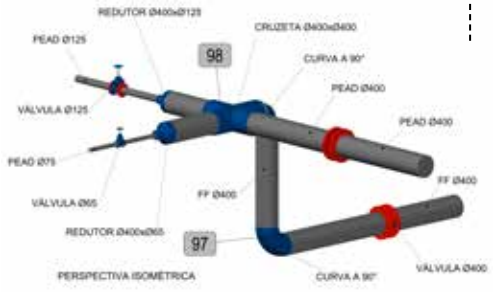
The detailed design of the New International Airport of Angola (NIAA) required the speciality of hydraulic engineering to develop complete infrastructures such as water supply and fire prevention networks, water storage tanks, a wastewater treatment plant (WWTP), and a network for wastewater.

The designed water supply and fire prevention networks ensure the distribution of water to the airport complex in its entirety, including all complementary infrastructures necessary for its efficient functioning.

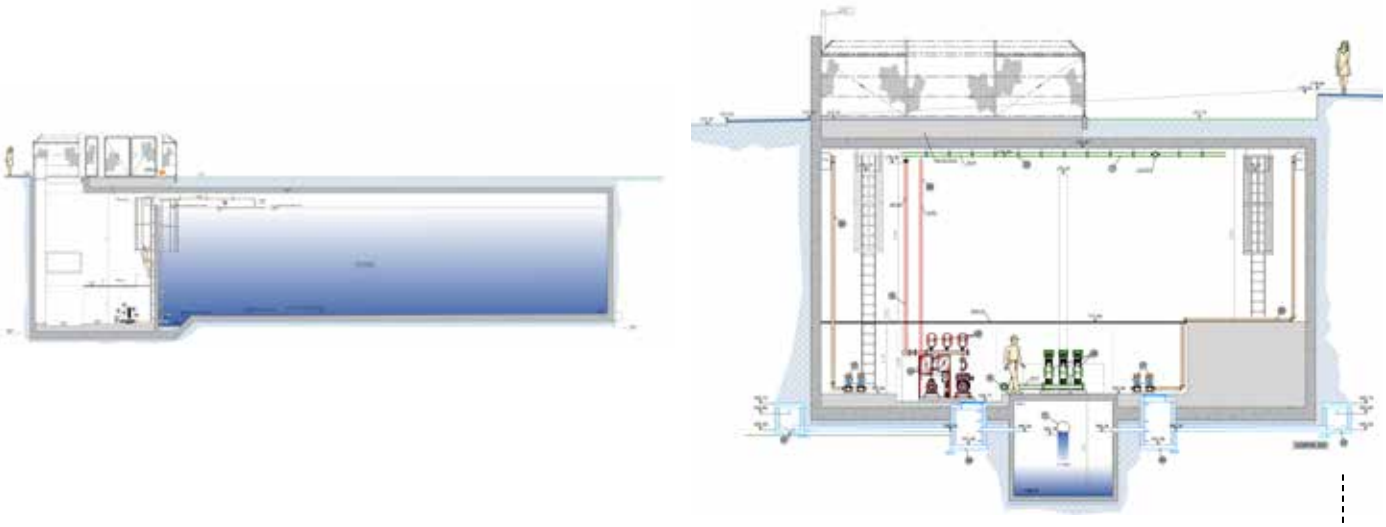
NIAA's public water supply and fire prevention networks are 28 000 m long, with a maximum diameter of 630 mm, made in high-density polyethylene (HDPE) and cast iron. The average expected water consumption was calculated to be at 10 959 m^3/day, with the addition of 156 fire hydrants.

The cost estimate for these networks is 5.3 million EUR.

DETAILS OF THE WATER SUPPLY NETWORK



MAIN FRONT OF THE PASSENGER TERMINAL

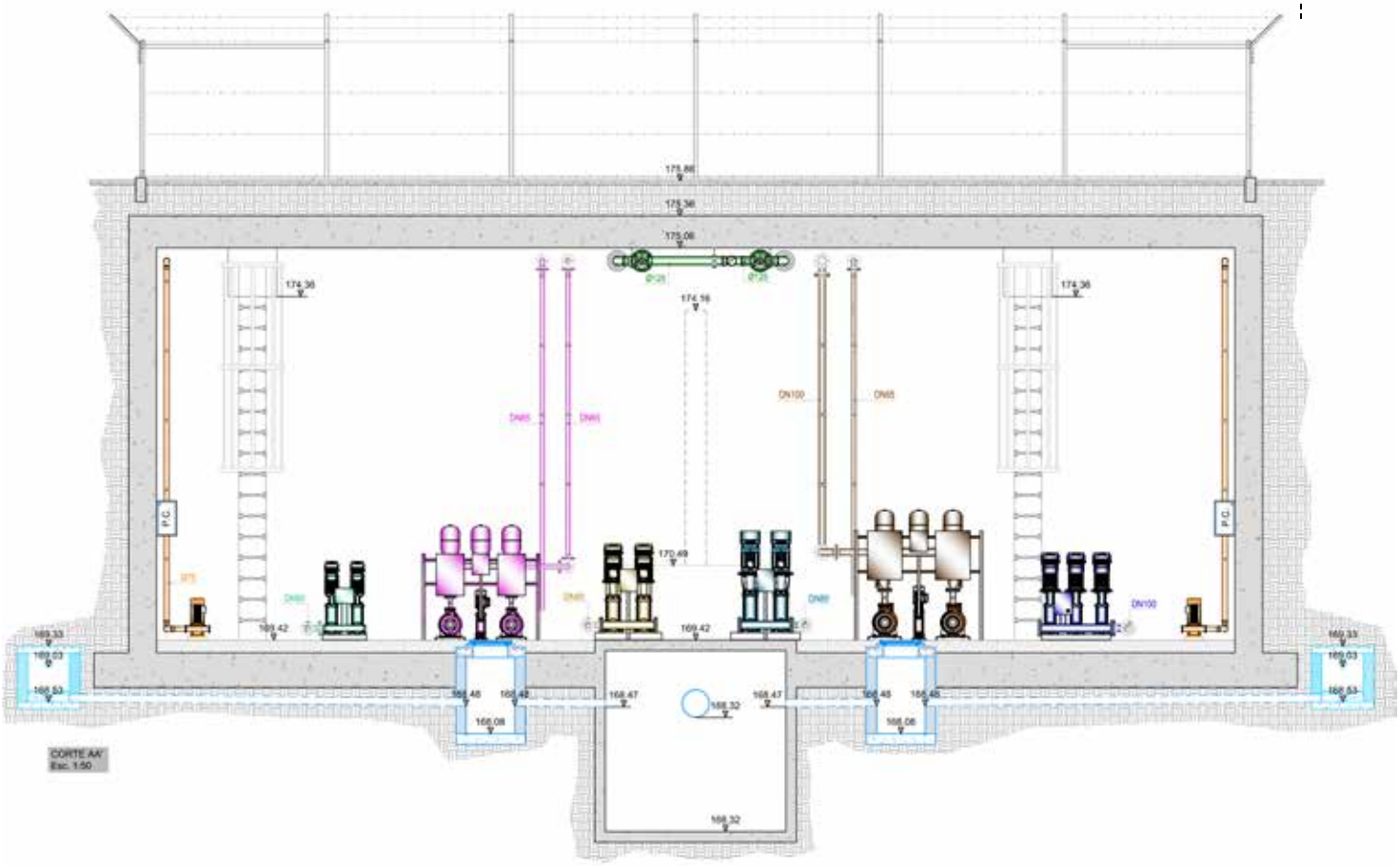


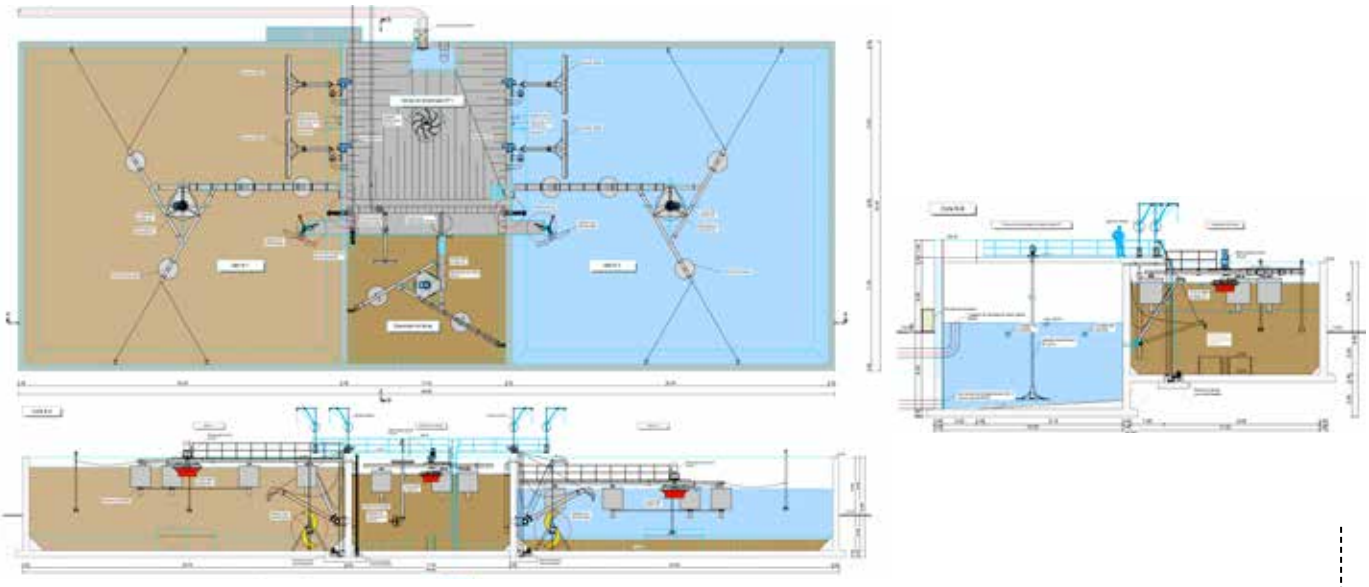
STORAGE TANK
CROSS-SECTIONS

Given the scarceness of water in Angola, there was also the need to safeguard sufficient water reserves, in order to ensure the effective functioning of all the equipment. Thus, seventeen water storage tanks were designed, to supply drinking water, irrigation water and water for fire prevention, making up a total volume of 19 875 m^3.

Manometric heads vary between 12.62 m H_2O and 79.1 m H_2O. Diameters of the lift column pipes vary between 50 mm and 200 mm.

STORAGE TANK CROSS-SECTION





SEQUENTIAL BIOREACTORS (SBR), SLUDGE THICKENER AND TREATED WASTEWATER STORAGE TANK

To manage the wastewater generated throughout the complex, a wastewater treatment plant (WWTP) was designed.

The selected treatment process was that of activated sludge in sequential bioreactors (SBR). The WWTP was designed in such a way that it is able to operate with a single treatment line, for the airport's opening or at times when the flow of people is lower.

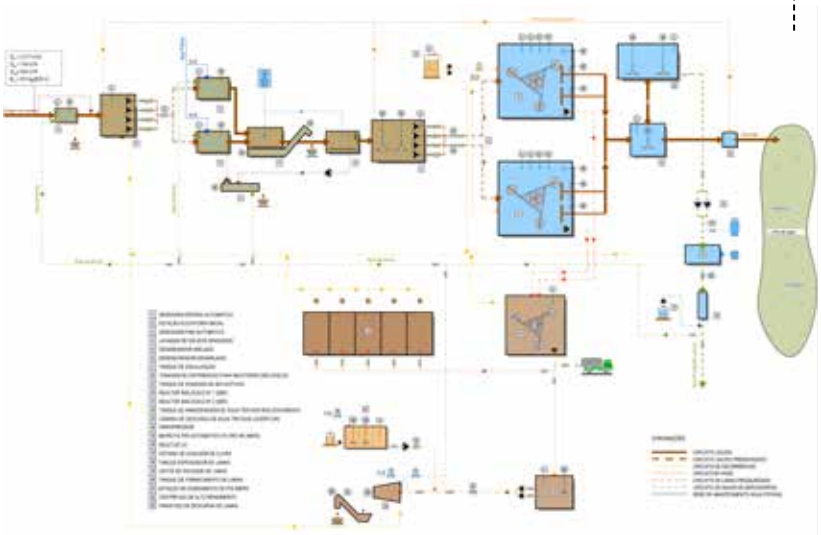
The WWTP includes a storage tank for biologically treated wastewater with a capacity of 2000 m^3.

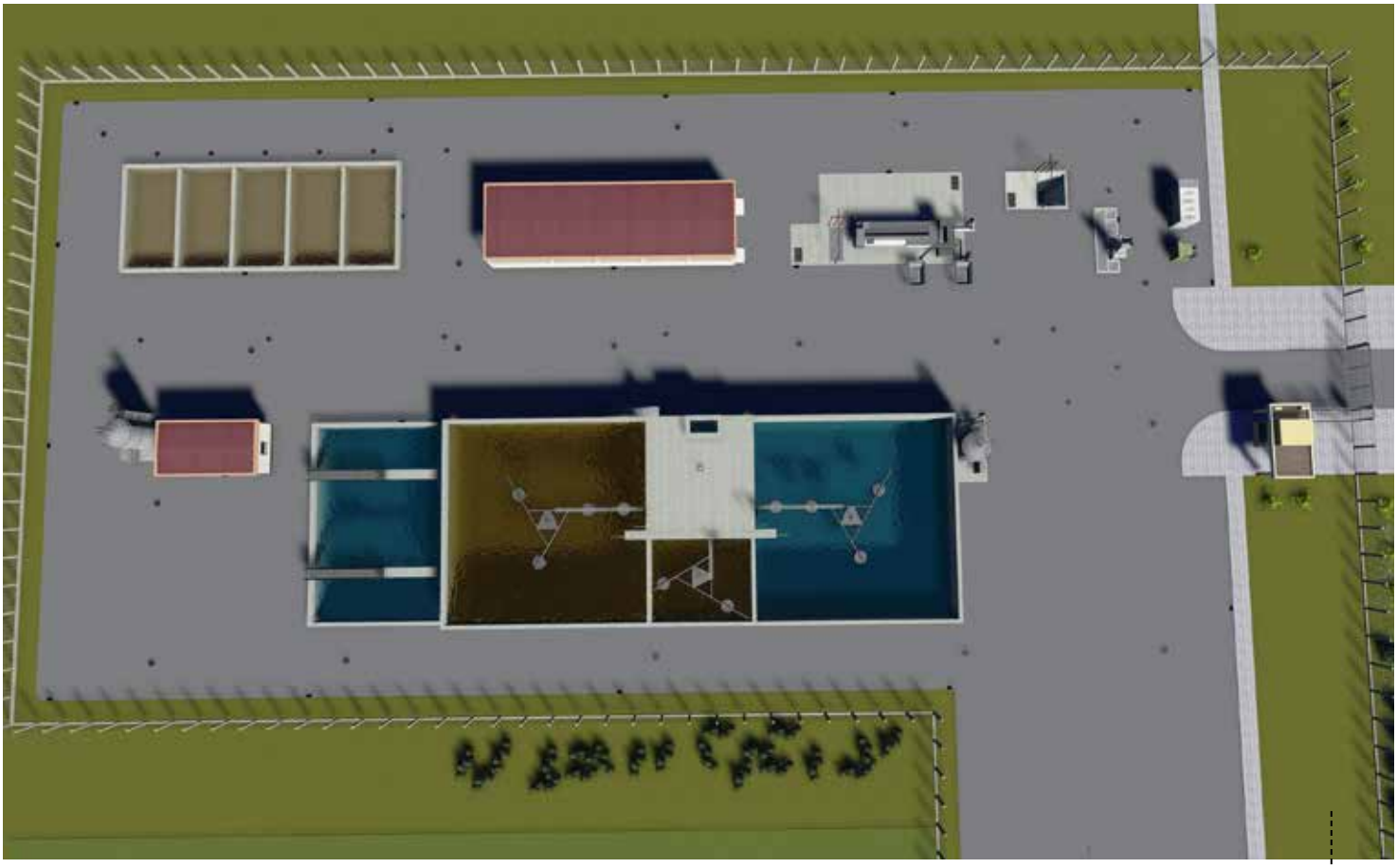
These waters, after tertiary treatment, are channeled for purposes of irrigation of green spaces and to provide service water. The collected flow from the secondary effluent storage tank has a minimum capacity corresponding to two days of the daily irrigation needs of the complex (910 m^3/d). The main distribution network extends along approximately 4747 m.

The cost estimate for this WWTP is of 1.81 million EUR.

LIFT STATIONS

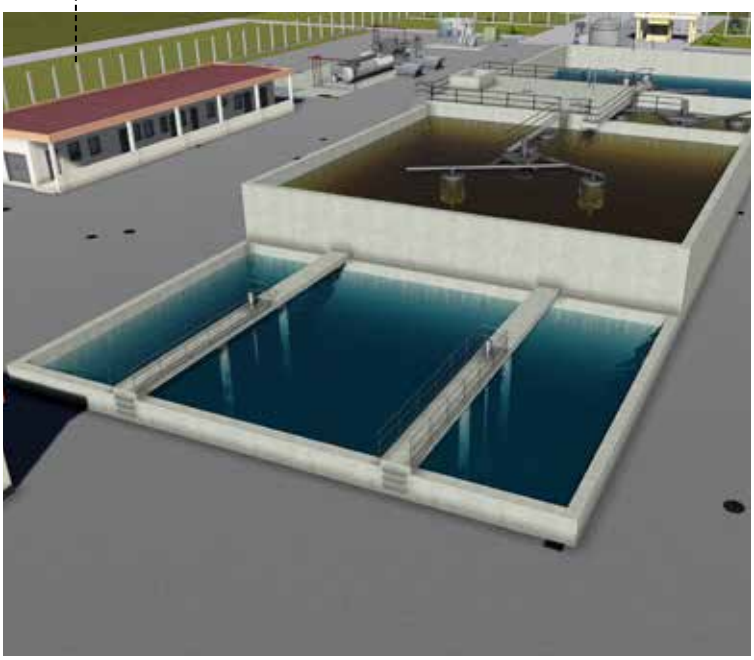
WWTP PROCESS DIAGRAM



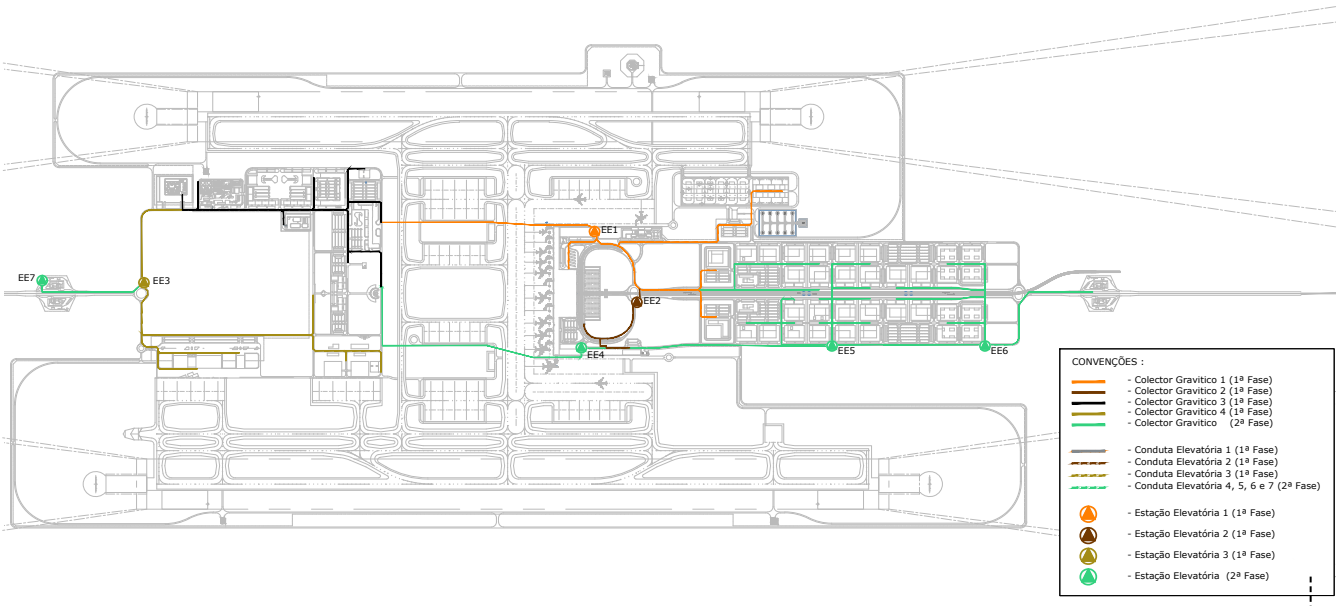


OVERVIEW OF THE WWTP

VIEW OF THE WWTP



VIEW OF THE WWTP



WASTEWATER NETWORK PLAN

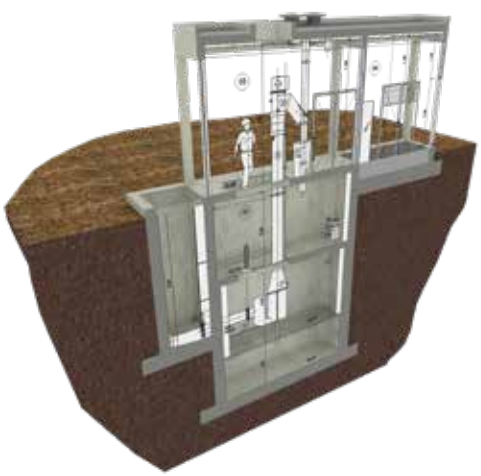
The airport's wastewater network was designed to service the entire airport complex, including all infrastructures required for its efficient functioning.

The materials used in the network's eduction pipes were HDPE, for diameters below or equal to 355 mm, and ductile cast iron, for diameters above 355 mm. PVC was used for drains.

Three lift stations were considered in this design.

In some buildings, a siphonic drainage system was used on roofs, allowing for drainage using smaller downpipes, foregoing slopes on outlets, improving self-cleaning conditions, lowering the number of embedded drains and promoting a faster installation process.

PERSPECTIVES OF LIFT STATION CROSS-SECTIONS



VIEW OF THE CATERING BUILDING

The airport's catering building is expected to supply 23 000 daily meals. In order to minimise inconveniences due to possible malfunctions and to provide proper treatment to each type of sewerage, the wastewater network was divided into three sectors.

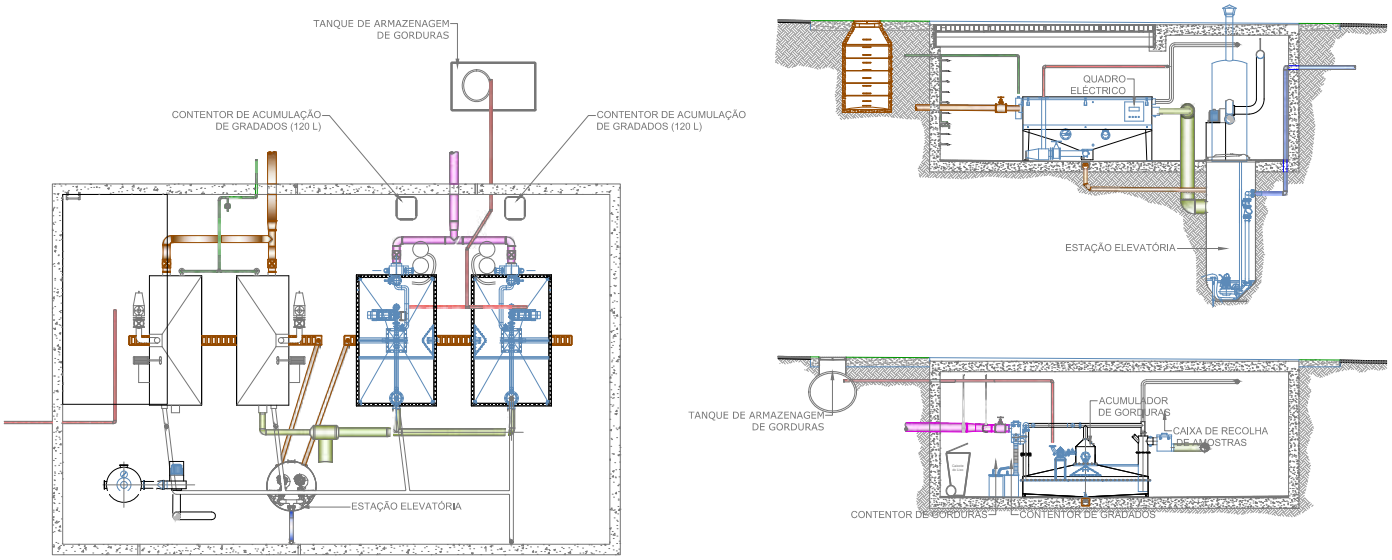
The total flow rate of the system for treatment of oil- and starch-tainted waste is of 1628 l/min.

The first sector integrates a network for oil-tainted waste that comes from the kitchen equipment, bar and cafeteria, and two fat separators for effluent treatment.

The second sector comprises a network for waste from the potato peeling machines and two starch separators for effluent treatment.

The third sector includes the wastewater network that collects the waste from sanitary facilities. After its respective treatment in this building, the sewerage is routed to the airport's wastewater treatment plant.

NETWORK FOR THE TREATMENT OF OIL-TAINTED SEWERAGE



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2007-2010

Location
Bengo, Angola

Client
Presidente da República/ Gabinete de Reconstrução Nacional

Estimated Cost
3 billion EUR

Stage
Detailed Design

Area
1980 ha

The New International Airport of Angola (NAIA), to be constructed in the vicinity of the city of Viana, approximately 40 km from Luanda, aims to provide an iconic, modern and innovative infrastructure, equipped with the latest technologies and aeronautical equipment, to the city of Luanda, the surrounding municipalities and, ultimately, the whole of Angola, mirroring the country's international development.

The NAIA occupies an area of approximately 1324 ha and contains a set of two parallel runways, 2200 m apart, allowing for mixed independent operations to be conducted in conditions of low visibility and low-hanging clouds.

The airside area had to conform to the strictest technical standards, namely in terms of the structures that are based there, their organisation and layout. These criteria are regulated internationally by ICAO (International Civil Aviation Organization), in specific documents and published regulations and guidelines.

MAIN ACCESS AVENUE

MASTER PLAN

PASSENGER TERMINAL

The design includes the following road infrastructures:

- Runways:
  Western runway, 3200 m long, with a 60 m wide typical cross-section that includes 7.50 m of runway edges, suitable for code E aircrafts;
  Eastern runway, 4200 m long, with a 75 m wide typical cross-section that includes 7.50 m of runway edges, suitable for code F aircrafts.

- Taxiways: this network of circulation paths was designed in conformity with the runways, namely, in terms of typical cross-section; there is a total of 27 taxiways in the layout, with a total of approximately 28 981 m.

- Airport aprons, for the parking of aircraft: designed to accommodate various classes of aircrafts, the layout includes 13 aprons, with a total area of 522 281 m^2.

- Other roads: aside from the runways and taxiways, a road network was designed to support the airside of the terminal, with typical cross-sections adapted to the needs of the airport operations and to the terrain, with a total length of 42 350 m.

The landside of the NAIA encompasses two distinct areas. The first, on the southwest corner, is the “services area”, where all services and operational equipment are located. The second is the “main avenue”, which marks the entrance to the NAIA complex. Part of the north access road, it is connected through an interchange with the Luanda–Cacuaco–Viana–Cabolombo motorway.

PASSENGER TERMINAL

VIEW OF THE LANDSIDE

This motorway serves as the main access road to the airport from the surrounding urban conglomerates. It significantly improves the connection from the new airport to Luanda, but also to the municipalities of Cacuaco, Viana, Samba and Kilamba Kiaxi, where approximately five million inhabitants, a third of the country's population, live.

- Services area: a road network was designed that included roundabouts, intersections and car parks, in a total length of 11 996 m.

- Main avenue: the proposed network was 19 376 m long and, among others, included the following segments:

  Main avenue proper, 2441 m long and with a 81 m wide cross-section that includes 8 m of railway tracks, 17 m of green spaces, 13 m of footways, 5 m of car parking and 3 m of road edges;
  Airport viaduct, 1213 m long and with a 31.75 m wide cross-section that includes 2.25 m of median strip, 9.50 m of footways and 0.50 m of road edges.

This design examined not only construction works, namely, earthworks, drainage, paving, traffic signalling and safety equipment, but also the design of the light signalling system and runway management.

EAST RUNWAY

PRESIDENTIAL TERMINAL

RAILWAY ACCESS TO THE NEW INTERNATIONAL AIRPORT OF ANGOLA

2009

Location
Bengo, Angola

Client
Casa Militar do Presidente da República/Gabinete de Reconstrução Nacional

Estimated Cost
18 million EUR

Stage
Base Design

Length
3.2 km

The best way to meet the mobility and accessibility requirements generated by the construction of the New International Airport of Angola (NAIA) was to provide a high quality and high capacity link to the public transportation network, something which could only be achieved by the creation of a dedicated channel for transports.

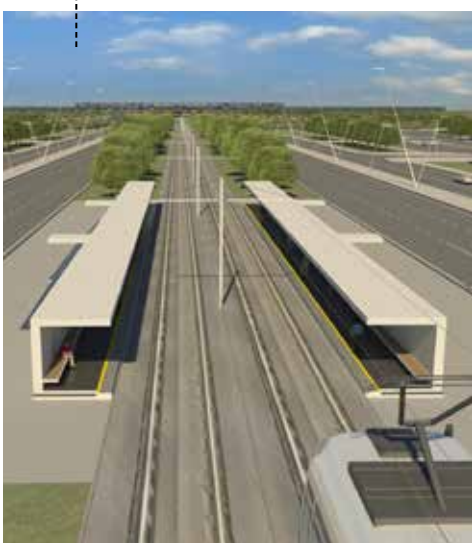
The light rail was considered to be the means of transportation best suited to the context. The details of its implantation were developed in-depth.

The proposed layout extends over a length of 3.2 km, from the airport main station (an underground station with a direct link to the passenger terminal) to the edge of the master plan.

The projected vertical alignment had to conform to the location of the station in the first kilometre and was designed to allow for future layout expansions, via tunnel, to the south-east.

TUNNEL ENTRANCE

DAYLIGHT VIEW



NIGHTTIME VIEW