DOCUMENTO Nº 1. MEMÓRIA DESCRITIVA E JUSTIFICATIVA

TÍTULO DO TRABALHO: PROJETO DE EXECUÇÃO
REABILITAÇÃO E MELHORIA DA ESTRADA NACIONAL "EN1-SL-01-ESPARGOS-SANTA MARIA"

TÍTULO DO DOCUMENTO: Memória

CLIENTE: **ESTRADAS DE CABO VERDE**

PROJETISTA: **SISTEMA**

Sociedad de Ingenieria, Servicios del Território y Medio Ambiente, S.A.

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1. THE DESCRIPTIVE MEMORY

EXECUTION PROJECT

REHABILITATION AND IMPROVEMENT OF THE NATIONAL ROAD "EN1-SL-01- ESPARGOS-SANTA MARIA"

TABLE OF CONTENTS

TABLE OF CONTENTS

EXECUTION PROJECT FOR REHABILITATION AND IMPROVEMENT OF THE NATIONAL ROAD "EN1-SL01-ESPARGOS-SANTA MARIA"

TABLE OF CONTENTS

1. INTRODUCTION

1.1. FRAMEWORK

Under procedure No. C-SL-02/2020, Estradas de Cabo Verde awards, by determination of the Board of Directors on 27 October through note ECV2020/222, the contract proposed by **SISTEMA INGENIERIA**, which has the objective of rehabilitating and improvement of the national roads "EN1-SL-01-Espargos-Santa Maria" and "EN3-SL-01-Avenida Dos Hotéis" it is drawn up this document which corresponds to the Descriptive and Justification of the Execution **Project of the National Road EN1-SL -01 – Espargos – Santa Maria**

The elaboration of the project parts is ruled by the legal and technical clauses of the Terms of Reference and Special Conditions, based on sizing standards, measurement criteria, price conditions and technical specifications mentioned below:

- The contract and the documents that form part of it.
- Technical Prescriptions for Road Works on Cabo Verde Roads.
- NIE 2 Standard Project "Road Terminology", Cabo Verde Roads.
- Project of Standard NIE 3 "Service Levels of Operational Capacity", Cabo Verde Roads.
- Project of Standard NIE 4 "Geometric characteristics and design parameters", Cabo Verde Roads.
- Project of Standard NIE 5 "Conditions of access to national roads", Cabo Verde Roads.
- Project Standard NIE 6 "Classification of pathologies in road network assets", Cabo Verde Roads.
- Project of Standard NIE 7 Standard "TYPE OF ROAD CONSTRUCTION INTERVENTIONS", Cabo Verde Roads.

- Project for Standard NIE 8 “system of budget items for road works”, Cabo Verde Roads.
- Layout Regulation – Autonomous Road Board – Portugal, 1994;
- Tracing Standard – Revision – INIR, IP 2010;
- MACOPAV – Road Pavement Conception Manual for the Network, National Bus Station, July 95;
- Guidelines for the Design of Pavements – Dimensioning Criteria;
- Sizing of Pavements for Low Traffic Roads;
- SATCC Pavement Guide (Southern Africa Transport and Communications Commission);

- Experimental Centre for Construction and Public Works (CEBTP, 1984);
- Manual of Superficial Drainage in Roads of Communication of the Institute of Roads of Portugal (IEP, 2001);
- Sheet of general technical requirements for highway and bridge works;
- Highway Instruction Standard 3.1-IC. traced;
- Highway Instruction Standard 8.1-IC.
- Highway Instruction Standard 8.1-IC. Road marks;
- Highway Instruction 5.2-I.C. Surface Drainage;
- Recommendations for the design and construction of underground drainage in road works.

Making a brief geographical description of the area where the project is being developed, it is located on the island of Sal, belonging to the Barlavento group of the archipelago of Cabo Verde, with a population of approximately 33,347 inhabitants, according to the National Institute of Statistics of Cabo Verde(Preliminary Results of the V General Population and Housing Census 2021) and an area of 219.8 km2. The national road **"EN1-SL-01-Espargos-Santa Maria"** constitutes the main transport infrastructure of the island, connecting the two most important cities (Santa Maria and Espargos) in addition to being the access road to the airport and the Murdeira and Algodoeiro ZDTI. The national road object of the referred study is still a strong artery in the development of tourist activities on the island and in the development of the national economy.

According to the National Institute of Statistics (2016), the island of Sal contributes with around 14.7% of the national GDP, mostly derived from tourism, and it has 46.2% of the beds of hotel establishments available in Cabo Verde.

It should be noted that the aforementioned road has already been built and that the present project seeks to rehabilitate and restore the original conditions of use.

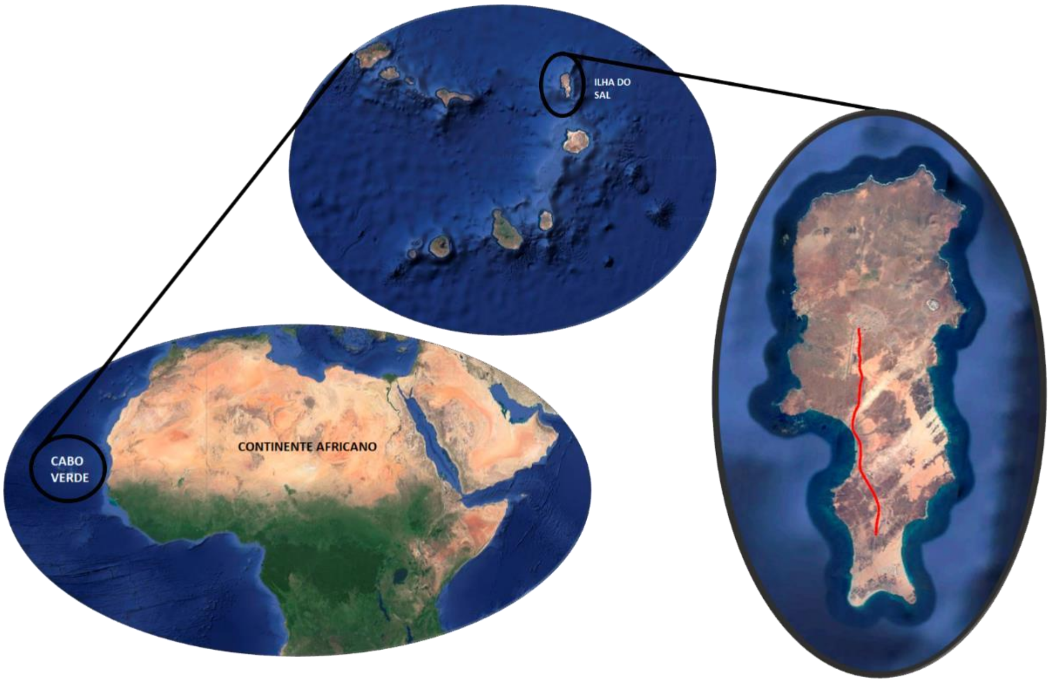

Figure 1 - Project Road identification

1.2. OBJECTIVE

The rehabilitation of the road in question is part of funding from the Government of Cabo Verde with the aim of improving the island's infrastructure and boosting the national economy. The national road EN1-SL-01 (Administrative classification in the PRN) with fast-track characteristics, constitutes a strategic investment in a true structuring route in terms of road transport on the island, guaranteeing the accessibility/mobility of the population to the main urban centres of the island, as well as to the airport, port and some ZDTI.

In this sense, the specific objectives of the present project are listed, which constitute the study of current conditions to propose rehabilitation solutions:

- Analysis of the current structural state of the existing pavement;
- Defining pavement rehabilitation and improvement solutions;
- Define improvement solutions for the road layout;
- Define improvement solutions in the drainage system;
- Analyse the need for expansion and/or incorporation of new road elements;
- Define corrective and environmental measures of environmental impact (AIA);
- Defining solutions to improve signalling and road safety.

In this context, this document was prepared, covering the Execution Project phase, which aims to define and detail the solutions presented and approved in the base project.

2. BACKGROUND

2.1. PROJECT BASE

2.1.1. BRIEF DESCRIPTION OF THE ASSET

EN1-SL-01: Main Road on the island of Sal, which is classified as a Class 1 National Road. The route (of the intervention area of this project) has a length of just over 14 km, with a profile type of four lanes of 3.5 meters with (two lanes in each carriageway in the opposite direction), interior inner berms measuring 0.5 meters and outer berms measuring 1.0 meters, a central separator of variable width and with five connecting nodes at roundabout level.

The current state of the asset is degraded, having already reached the end of its useful life and presenting several pathologies in its pavement structure.

2.1.2. RELATIONSHIP WITH OTHER TERRITORIAL MANAGEMENT INSTRUMENTS AND GEOMETRIC CRITERIA ADOPTED IN THE PROJECT.

The intervention area is covered by the following territorial management instruments:

- Spatial Planning Scheme – Sal Island, approved by Council of Ministers Resolution No. 3/2014, of 6 January.
- National Territory Planning Directive (DNOT), approved by Law n. º 28/VIII/2013, of April 10th.
- Sal Island Municipal Master Plan, ratified by Ordinance No. 1/2009, of January 20th.
- Installment plans such as the Detailed Territorial Plan for the Murdeira Village Resort, currently under public consultation.

Extract: Source: EROT from the island of Sal. Subsection III. Transport infrastructure. Articles 51 and 52. Quoting some extracts, the above-mentioned management instrument demarcates the EN1-SL-01 road as a primary transport infrastructure, being delimited in the proposed document for interventions with possible implications for the existing route, namely, road infrastructure proposals of new implementation as the new variant on the EN1-SL-01 road section passing through Murdeira, the delimitation of the ring road around the airport and the logistics area (Cluster of Heaven) and the layout of a new road that connects the island along the coast (tourist use) in addition to suggesting the creation of a basic network of bicycle lanes, removed from motor vehicle traffic. In road infrastructures of the primary system, level crossings with other infrastructures of any kind will be avoided, except in duly justified situations. Pedestrian crossings should be uneven, and intersections with other road infrastructure will require the execution of uneven sections. The geometric section of general roads must include, at least, pavement and berms, both interior and exterior, and a central divider, if the lanes are separate. The dimensioning of each of the elements that make up the platform will be carried out in accordance with the regulations in force for this purpose.

Chapter V, Access and circulation of SECTION I |Road network| Article 26.º | Road accesses of the Detailed Land Use Plan of the Murdeira Village Resort establish interferences with:

1. The main road on Sal Island (EN-SL-01) ensures access to the PODMVR intervention area, in accordance with the route and access node to the buildable areas, namely:
    a) Node to the north of the intervention area;
    b) Node in the center of the intervention area (existing);
    c) Node to the south of the intervention area.
2. Access to Murdeira Village Resort may be subject to access control.

Absorbed criteria: Taking into account the divergences of the contractual premises with the indications of the EROT, the designer, in case of a breach, will consider the mandatory contractual clauses to be indications to the contrary by the Administration and provided that they do not deviate too much from the assumptions that served as the basis for the tender and, therefore, the intersections at different levels for the EN1-SL-01 road, the studies for the implementation of the new variant on the section of the road EN1-SL-01 passing through Murdeira, for the bypass of the airport and zone logistics (Cluster of Heaven) and interconnection with the layout of a new road that connects the island along the coast (tourist use), but the designer graciously absorbed the proposal to include the creation of bicycle corridors that will form part of the basic network of bike roads/lanes proposed in the EROT. It still remains to be absorbed, creation of conditions in the existing infrastructure, introduction of detours in places where a stop can be placed, in the maximum safety conditions taking into account the circulation of public transport.

2.1.3. TECHNICAL ADVICE

- **TRACED IN PLANT AND LONGITUDINAL**

The layout in plant and the longitudinal mostly comply with what is expected for the road on which it fits as a 1st Class expressway road.

The constraints observed in terms of the longitudinal layout consist of the flat orography of the island, which provides slopes of less than 0.5% (minimum stipulated by standard).

Another constraint identified is the loss of visibility due to situations resulting from the incompatibility of the plant layout and the longitudinal layout, as shown in the following figure.

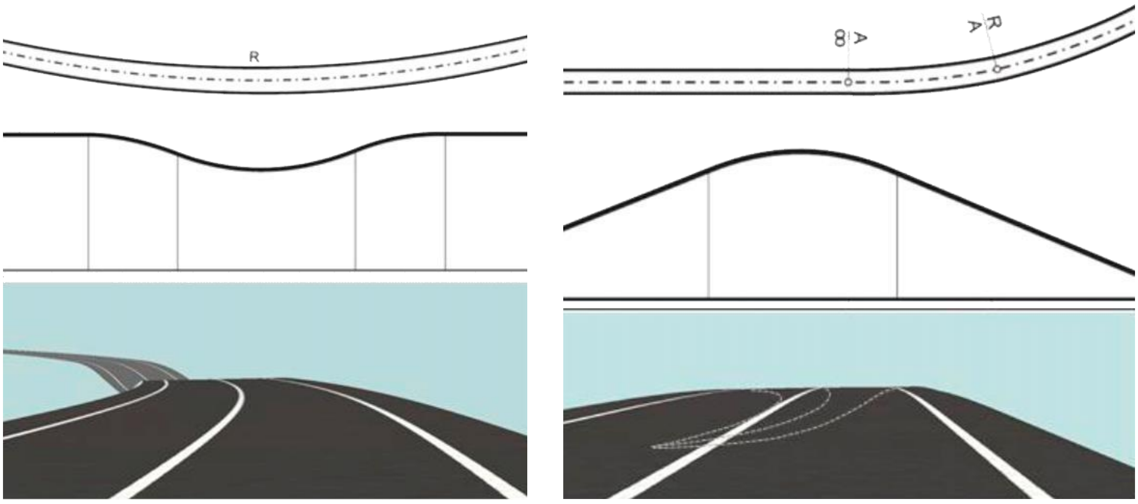

Figure 2 – Loss of Visibility due to Tracing Incompatibility

- **DRAINAGE**

As for the elements that make up the drainage system, they are quite degraded, compromising the structure of the pavement in the long term. The designer understands that the existing hydraulic passages no longer have a structure capable of withstanding another 20 years (project life). Therefore, some will have to be completely replaced and others will be rehabilitated. The existing ditches are all on land and are quite degraded, requiring maintenance work such as desilting.

It was observed that the road maintenance works over the years were far below what was necessary, which compromises the proper functioning of the drainage. Problems such as silting up of ditches and entry of PHs were seen very frequently. The PHs executed with concrete elements were greatly affected by atmospheric agents, such as the aggressive attacks of chlorides found in the sea air and sea water, erosion caused by runoff, leaving the aggregates very exposed and even causing localized disruption of the structure. This very severe degradation, also caused by the lack of maintenance, the environmental exposure class and the use of a low concrete class, leads the designer to look for other solutions that do not include the use of concrete.

With regard to the longitudinal drainage, it was solved by means of ditches that drain the water collected on the platform and discharge it at a point coinciding with a PH through a chamber-type device. Their state of conservation is quite deteriorated and overrun with vegetation largely due to the failure to carry out the maintenance work required for this type of drainage devices.

- **PAVEMENT**

The pavement of the EN1-SL-01 – Espargos – Santa Maria has several pathologies caused mainly due to its pavement structure. With the visual inspection, it was observed a structure of the pavement constituted by a thickness of approximately 5 cm of bituminous concrete over a layer of natural aggregate of extensive granulometry.

The designer points out as the cause of the degradation of the structure of the pavement its wear layer of 5 cm in bituminous concrete, the use of aggregates with a Dmax of 75 mm and mainly the end of its useful life.

In sizing a flexible pavement, the base and sub-base layer are responsible for absorbing traffic actions and the wear layer has the function of waterproofing the floor and resisting the abrasive force of traffic and erosive agents. A 5 cm layer is the minimum accepted by norm and should be applied to lower expression roads with little traffic and reduced speed (as in these cases the abrasive force of traffic is low). On high -speed and large truck roads the thickness should be higher because the abrasive force locking a heavy vehicle at high speed is very strong.

As mentioned in the previous paragraph, visual inspection demonstrated that the sections approaching a roundabout, a stretch with loss of visibility or other accesses tend to be the most pathologies and more worn sections. This is due to the braking force of the high -speed cars by transmitting an abrasive force on the pavement that wears the small layer of bituminous concrete quickly facilitating the access of erosive agents to the underlying layers causing the evolution of cracks developing various pathologies.

The Natural Tout-Venant base layer has a 75 mm DMáx, and a 37.5 mm Dmax is recommended.

In addition to the sections near the roundabouts, it was identified that from PK 4+500 to PK 7+800 due to the proximity of the rasant to the water level the floor had a degradation greater than in other sections. This is due to the loss of fine and loss of pavement bed load capacity when there is increased water level. Thus, a greater attention will be given to these sections.

- **PATHOLOGIES**

For the evaluation of the pathologies, it was considered the one specified in the Portuguese Paving Manual (from CEPSA), Vademécum de Pavimentación (Spanish) and the NIE 6 project “Classification of Pathologies in the Road Network 'assets” of Cabo Verde Roads.

That said, the structural evaluation made to the EN1-SL-01 National Road was based on visual inspection and tests presenting the observed pathologies and possible causes. It should be noted that the pathologies presented in this section find in various sections of the road.

Crocodile skin

Possible causes

Fatigal fissure of the wear layer; Deficiency of load capacity or thickness of the pavement; Evolution of wide mesh fitch.

Longitudinal slit on the road axis

Possible causes

Poor execution of the construction joint of the upper layer; Slot in the base layer;

Possible causes

Fatigue due to traffic actions; Differential settlement with the berm; Reflection of slits or construction joints of the lower layers; Rodeira Deficiency (with Crocodile Skin) Possible causes finishing longitudinal joint (if any)

Wide mesh

Possible causes

Deficiency of thickness or fatigue of the layers; Deficiency of pavement load capacity; Poor quality of some of the pavement layers

Slot in the base layer;

Localized deformation

Possible causes

Degradation of the lower layers; Localized deficiency or local contamination; Channeling rupture; Lack of drainage due to the absence or rupture of the drainage

Mistura betuminosa com resistência à deformação permanente insuficiente em combinação com tráfego pesado e tem camad

Ninh

Possible causes

Possible causes

Poor adhesion to the bottom layer; Insufficient wear layer thickness or stability

Lack of adhesiveness between aggregate and binder; Binder aged and very hard; Deficient dosage of binder; Lack of wear layer compaction;

Possible causes

Superficial breakdown

Possible causes

Evolution of other degradations, with disaggregation and removal of materials produced by traffic; imperfections locations

Binder aging; constructive deficiencies (segregation, poor formulation, overheating of the mixture, etc); Decomposition of aggregates

- **USER SAFETY.**

A road is safe when the road complies with the layout regulations and the pavement provides the user with a safe running surface, on which, at all times, good adhesion of the tire with the pavement is achieved. To assess this last aspect, it is necessary to carry out visual inspections and tests to measure the longitudinal and transverse coefficient of friction. From the visual inspection carried out, many nests, peeling and detachment of aggregate were observed in almost the entire extension. Under these conditions, it is possible to state that the tire-pavement friction is compromised.

Comfort was measured by running the complete road course in all lanes at the design speed by a light vehicle. During the course, the vibrations induced by the pavement to the vehicle were evaluated, as well as the need to avoid nests and naked areas. It was concluded that comfort was greatly impaired by the degradation of the pavement and the presence of nests of significant depth has endangered the lives of users and accelerated the damage to vehicles.

To complete the functional analysis, the opinion of frequent users was heard: they feel comfortable and safe when traveling on the road, so everyone has the same idea that comfort has dropped a lot, which has affected safety, mainly due to frequent nests and bumps on the road. As it is a two-lane road in each direction and most of the time operates with service level A or B (according to the road service level classification of the "Rural Highways Geometric Project Manual"), light vehicle operators are constantly to make detours so as not to affect the vehicle passing over a nest or naked. Another concern raised by users is the presence of animals on the road causing accidents, mainly at night and in stretches with little visibility distance.

It should also be noted that the conditions and features mentioned above make it even more compromised at night, as the entire route is developed without public lighting, which makes it difficult to identify holes, animals and other obstacles in time. The aforementioned lack of lighting is also highly contested by tourist promoters and taxi drivers, claiming the feeling of insecurity that is transmitted to visitors who arrive at a strange destination and are faced with the reality of traveling 14km in the presence of a stranger and on a road with poor lighting and signaling, mainly horizontal. Investing in highway lighting is extremely important because it allows for more efficient security and enables citizens to visualize danger in advance.

3. CARTOGRAPHY AND TOPOGRAPHY

In case of rehabilitation and improvements to an existing road, topographic and cartographic surveys are of great importance not only in surveying the route, but in identifying areas with more pathologies and damage to the pavement, checking slopes and the system of drainage as a whole, expansion zones, technical networks, services affected, among other elements. The methodology applied was to proceed with the previous definition, on an existing cartography, scale 1/10,000 and 1/5,000 of an axis suitable for the corridor and fitted with the support bases placed on the ground. After checking the compliance of the layout parameters for the defined axis, it was implanted on the ground, starting from the aforementioned support bases. Subsequently, a topographical survey was carried out, in an extension of 20 meters on each side of the corridor, as already mentioned.

In this sense, it was based on the following documents.

- Cartography of Sal Island (2010) at scale 1/5.000 and 1/10.000 – to check the island's conditions 10 years ago;
- Topographic survey (updated) with GPS of the entire road layout and the 20 meters on each side tied to the Geographical Coordinates Reference System: Ellipsoid GRS 1980 (Geodetic Reference System); Equatorial axis (a) = 6.378.137.0000 meters; Polar axis (b) = 6.356.752.3141 meter; Inverse of flattening (1/f) = 298.257222101. This survey was carried out by an experienced surveyor with knowledge of the island and instructed to survey with greater precision all the areas of greatest damage and depreciation.
- Updated cartographic survey using an unmanned vehicle (Drone) at an average height of 60 m, in the UTM coordinate system and cm precision, due to the use of an RTK GPS attached to the Drone.

In Annex **1.B.1 CARTOGRAPHY, TOPOGRAPHY AND DEPLOYMENT,** the base points and geodetic landmarks of the island are presented.

4. CLIMATOLOGY AND HYDROLOGY

4.1. FRAMEWORK

Cabo Verde is an archipelago of volcanic origin, located in the Atlantic Ocean, between 15 and 17 degrees north latitude, west of the Sahel zone, a savannah area located between the Sahara desert and tropical Africa, with a climate that could be defined as Dry-tropical 500 km off the west coast of Africa, opposite Senegal, and approximately 1600 km from the Canary Islands. Geologically it belongs to the group of islands, integrated in the Macaronesia region, together with the Azores, Madeira and the Canary Islands.

The climate of the archipelago is tropical dry, moderated by the action of the Atlantic wind, characterized by low precipitation and its irregularity. The time of year when precipitation "the rainy season" usually occurs is between the months of July and October, when the weather sometimes becomes uncomfortable due to high temperatures and humidity.

In the other season between December and June, when the trade winds are frequent, only the areas with altitudes above 600 meters tend to receive rain on a regular basis. The northeastern slopes of the high mountains often receive some rainfall while the southwestern slopes do not receive them due to the "pluviometric shadow". The rain normally, when it falls, it does so with great intensity, and half of the year's rain usually falls in a single storm. Islands with rugged and mountainous topography such as Santo Antão, São Nicolau, Santiago, Fogo and Brava ultimately benefit from the highest rainfall. The temperature is practically uniform throughout the year, with daily averages varying between 21.3 degrees Celsius in February, in the coolest month, and 27.2 degrees Celsius in September, in the hottest month, with an annual average of 26 degrees Celsius.

4.2. DRAINAGE FLOWS

In Annex **1.B.2 CLIMATOLOGY, HYDROLOGY AND DRAINAGE**, the indices considered in the calculation of basins and flows are presented and justified.

The construction of roads induces changes in the natural drainage network, causing changes in the established flow system. In this sense, this chapter has been prepared, the entire justification content of which is found in Annex **1.B.2 CLIMATOLOGY, HYDROLOGY AND DRAINAGE** in order to present the flows obtained in summary form.

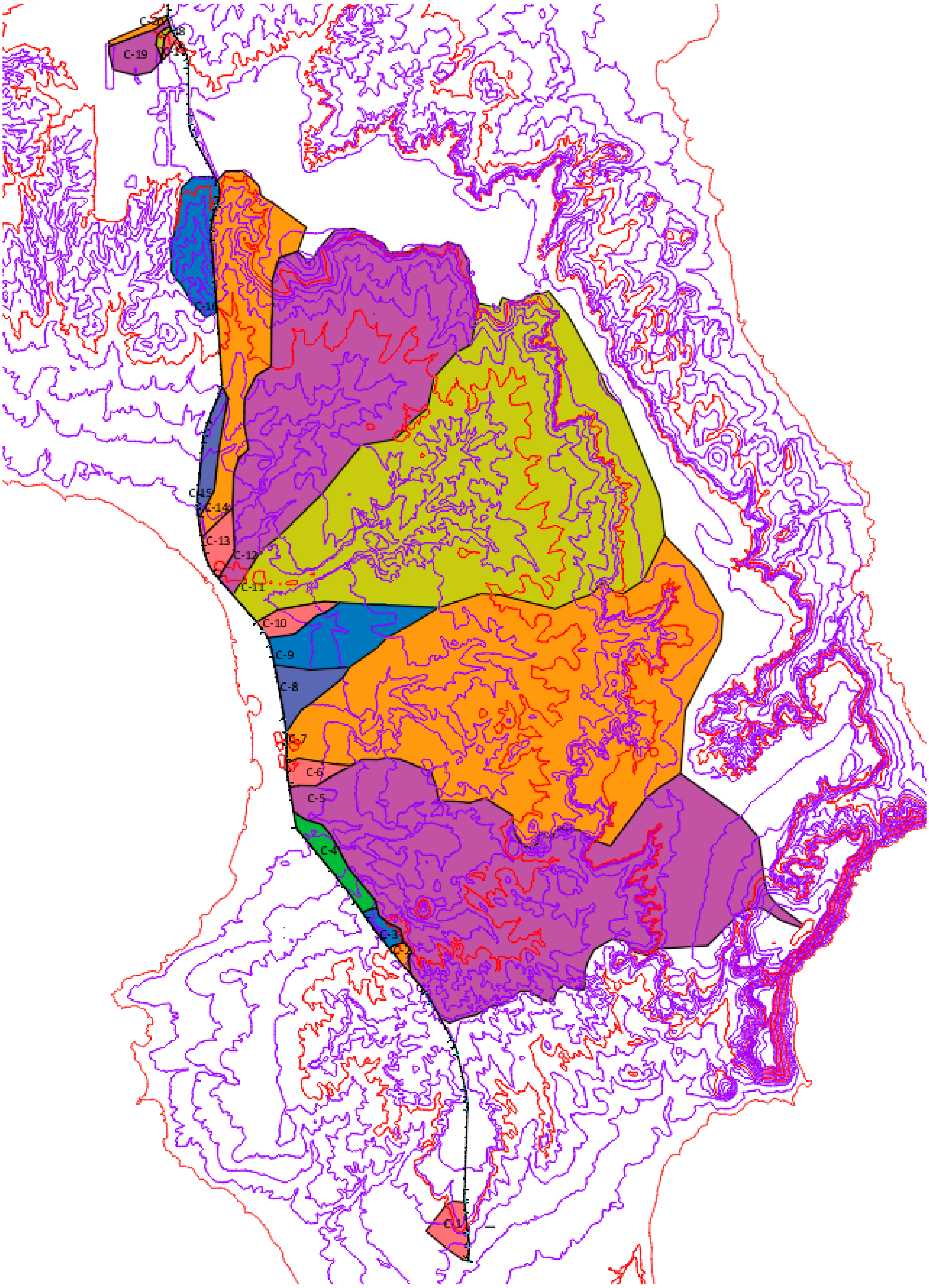

Figure 3 – Identified river basins

Name	Area (m^2)	Rainfall average	Coefficient Flow	Concentration time	Rainfall intensity	Rail I (m^3/s)	Drag coefficient	Rail I final m^3/s)	Return time (years)
C-01	122.364	100 mm	0,37	0,38	72,52 mm/h	0,92	1,20	**1,10**	500
C-02	29.920	100 mm	0,37	0,34	75,86 mm/h	0,23	1,20	**0,28**	500
C-03	65.982	100 mm	0,37	0,35	75,84 mm/h	0,52	1,20	**0,62**	500
C-04	6.144.212	100 mm	0,35	3,16	21,32 mm/h	15,55	1,20	**18.66**	500
C-05	497.009,54	100 mm	0,37	0,66	58,16 mm/h	3,05	1,20	**3.67**	500
C-06	108.963	100 mm	0,37	0,33	80,31 mm/h	0,90	1,20	**1,08**	500
C-07	7.004.998	100 mm	0,35	2,26	25,31 mm/h	19,84	1,20	**23,81**	500
C-08	212.118	100 mm	0,37	0,37	78,34 mm/h	1,72	1,20	**2,06**	500
C-09	601.010	100 mm	0,37	0,89	50,73 mm/h	3,28	1,20	**3,93**	500
C-10	136.224	100 mm	0,37	0,40	76,82 mm/h	1,09	1,20	**1,30**	500
C-11	7.461.867	100 mm	0,35	2,11	26,84 mm/h	22,15	1,20	**26,58**	500
C-12	4.384.783	100 mm	0,35	1,86	30,21 mm/h	14,63	1,20	**17,55**	500
C-13	1.622.338	100 mm	0,36	1,74	33,45 mm/h	6,11	1,20	**7,34**	500
C-14	456.309	100 mm	0,37	0,82	55,88 mm/h	2,73	1,20	**3,27**	500
C-15	20.784	100 mm	0,37	0,30	90,458 mm/h	0,19	1,20	**0,23**	500
C-16	17.010	100 mm	0,37	0,30	91,20 mm/h	0,16	1,20	**0,19**	500
C-17	167.014	100 mm	0,37	0,34	87,22 mm/h	1,51	1,20	**1,81**	500

C-18	14.597	100 mm	0,37	0,30	93,399 mm/h	0,14	1,20	**0,17**	500

Table. 1 - Calculation tails

5. DRAINAGE

5.1. GENERAL CONSIDERATIONS

In the following epigraphs, projected devices and drainage structures are presented, divided into two sections, the first for the longitudinal drainage system and the second part concerns the transverse drainage devices.

It is important to emphasize that, in the case of small flow flows, one opts for discharge in the nearest main basin.

5.2. Longitudinal drainage

With regard to the devices adopted for longitudinal drainage of the platform, it was considered a triangular concrete, 0.35 meters deep and a total width of 2.80 m, a coated stone rooting ditt with triangular section concrete, 0.35 meters deep and a total width of 2.80 m and a ditch of earth in the triangular section median, 0.50 meters deep and a total width of 3.00 meters.

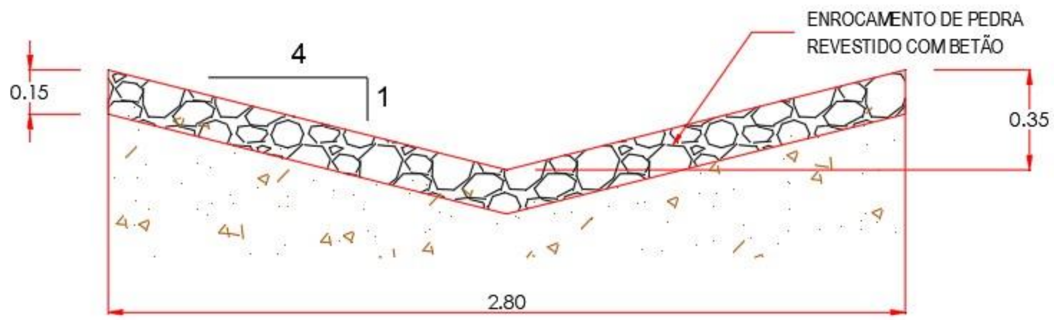

Figure 4 - Guard Vallet

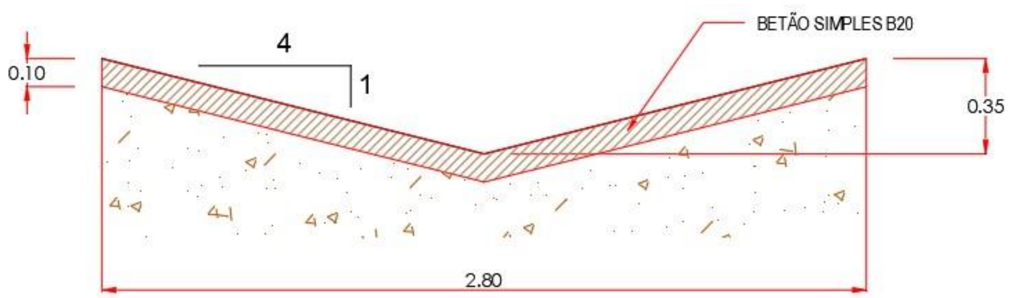

Figure 5 - Road Vallet

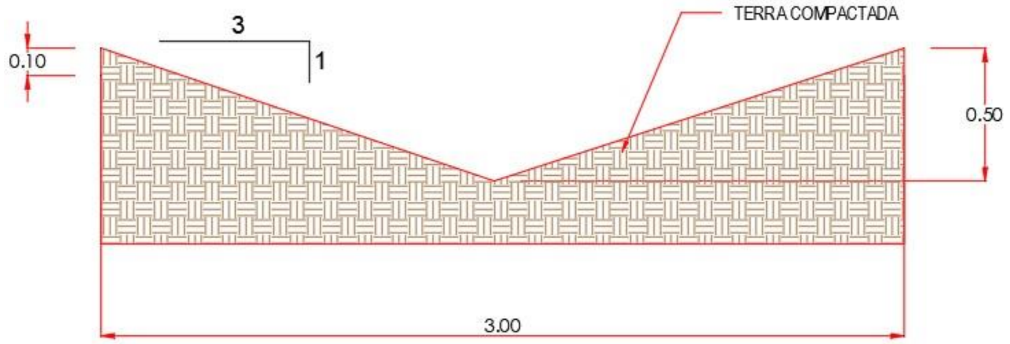

Figure 6 - Median Vallet

The calculations and justifications are presented in Annex **1.B.2 Climatology, Hydrology and Drainage.**

The waters of the ditches are collected by drainage boxes and then channelled out of the platform in corrugated tubes DN300 mm or in transverse drainage elements (hydraulic passages). The construction process for the corrugated DN300 tubes follows the same as those of the cross - sectional drainage in corrugated tube.

5.3. Transverse drainage

It was adopted for transverse drainage, Hydraulic Passages (PH) in 1000 mm PN8 corrugated tube and double PH in reinforced concrete and cyclopic concrete with 2 x 1 meter section.

The construction process for corrugated tube hydraulic passages should follow the following steps:

- Opening of the ditch with stable slopes, width of the base equal to the tube diameter plus 50 cm. The depth of the ditch must be 15 cm lower than the dimension of the lower tube generatrix;
- Performing a 15 cm bed of regular and compacted sand in which it will ensure the tubing slope;
- Placing the pipe and landfill with noble material in layers not exceeding 15 cm and compacted carefully so as not to damage the pipe. This step should continue to the upper generation of the tube and should be slightly apparent;
- Landfill on the pipe with selected material and a suitable landfill from excavation or loan. Compacting should be done with light equipment on both sides of the pipe and without compressing the central zone corresponding to tube projection.

Landfills over hydraulic passages must always be made of non-cohesive, sieved material, free of silt and clay.

Whenever the upper generatrix of the pipeline is at a depth of less than 1 meter from the level of the road or more than 6 meters, it must be soaked with a 20 cm layer of concrete c 20/25.

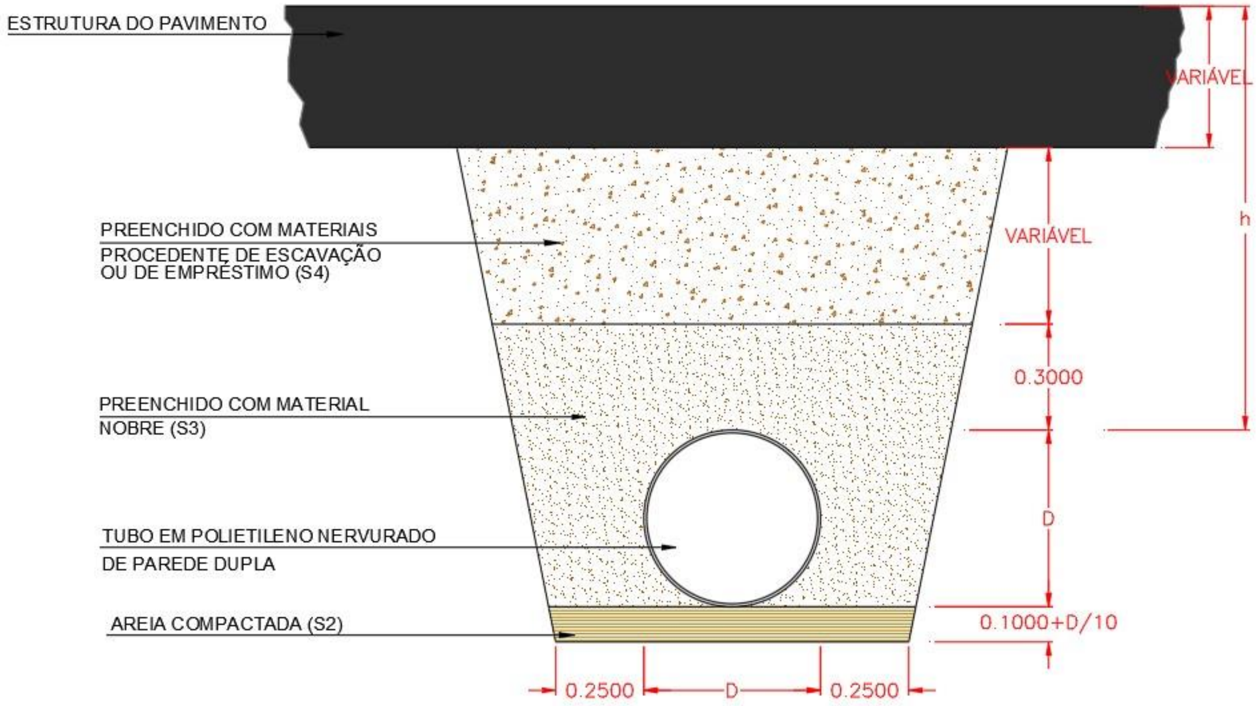

Figure 7 - Execution of corrugated pipes on site

The details of calculation of the flows and the justification of the adopted section are presented in **Annex 1.B.2 CLIMATOLOGY, HYDROLOGY AND DRAINAGE**. The location of the PH as well as its extension are shown in the drawings, namely 2.F.3 DETAILS DRAINAGE.

5.3.1. JUSTIFICATION OF THE SOLUTION

The island of Sal has a very aggressive environment for concrete, as observed in the existing drainage elements. Based on this observation, the designer looked for modern solutions with greater durability at a competitive cost. From this market study, the drainage system in corrugated pipe was identified, consisting of a composite of polypropylene copolymer (PP), common name for the copolymer of ethylene and propylene, which combines the superior shock resistance of polyethylene with the better rigidity of polypropylene and provides the following advantages:

- Safety:

Low specific gravity; Easy and safe to handle and install in the trench.

- Durability - life expectancy of 50 years:
  - Excellent chemical and corrosion resistance (see ISO/TR 10358 standard); Excellent resistance to abrasion and the propagation of cracks; Resistance to high temperatures (Vicat temperature greater than 150 °C for pipes and fittings);
  - Excellent impact resistance; The tubes and accessories with structural integrity which makes them flexible and their unions tolerate soil movements;
  - Low probability of failure compared to traditional materials.
- Project:
  - Less pressure drops than with other materials, due to its smooth circular interior surface, which does not allow incrustations;
  - High drainage capacity and higher circulation speed; All parts of the system are made of the same material, including tubes, perforated tubes, accessories and branch boxes;
  - Excellent superficial finishing and dimensional stability;
- Handling and installation:
  - High circumferential stiffness - stiffness class SN8; Superior assembly performance; High impact resistance even at low temperature; Low specific weight - easy handling and installation; In tubes and accessories, the connection system by means of an elastomer ring (lip oring) positioned on the profile, prevents its displacement during installation;
- Environmentally friendly solution:
  - Does not contain additives based on heavy metals or those not recommended by legislation;
  - Fully recyclable; Its production and processing are non-polluting;
  - The gases from its decomposition are not toxic; Union by elastomer ring (lip oring), which guarantees 100% watertightness, eliminating the possibility of infiltrations into the interior of the conduit and leaks and consequently soil contamination.
- Time and money savings. Low specific weight per meter of tube, accessory or box component;
  - Easy to handle and install; Competitive price.

5.3.2. GEOMETRIC CHARACTERISTICS

d_n	Diâm. exterior médio série DN (mm)	Diâm. exterior médio série OD (mm)	Diâmetro interior médio do tubo (mm) SN8	Espessura mínima e_1 (mm)	Espessura mínima total $e_1 + e_2$ (mm)
125	125,0 - 126,2	124,3 - 125,4	107,6	1,0	1,1
160	160,0 - 161,5	159,1 - 160,5	139,7	1,0	1,2
200	200,0 - 201,8	198,8 - 200,6	176,9	1,1	1,4
250	250,0 - 252,3	248,5 - 250,8	221,6	1,4	1,7
315	315,0 - 317,9	313,2 - 316,0	274,1	1,6	1,9
400	400,0 - 403,6	397,6 - 401,2	349,8	2,0	2,3
500	500,0 - 504,5	497,0 - 501,5	442,3	2,8	2,8
630	630,0 - 635,7	626,3 - 631,9	548,1	3,3	3,3
800	800,0 - 807,2	795,2 - 802,4	698,3	4,1	4,1
1000	1000,0 – 1004,0	994,0 - 1003,0	857,6	5,0	5,0

Table. 2 – Values of the dimensions of the tubes and male terminal of the accessories

d_n	Comprimento da boca L (mm)	Comprimento útil da boca L_1 ($A_{mín}$) (mm)	Diâmetro exterior médio da boca D_e (mm)	Diâmetro interior médio da boca D_i (mm)	Espessura mínima da boca e_4 (mm)
125	92	55	128	128,0	1,65
160	109	65	177	161,5	1,80
200	129	78	217	201,3	2,10
250	136	83	273	252,2	2,55
315	199	112	336	317,9	2,85
400	219	126	425	405,0	3,45
500	266	176	530	504,5	4,20
630	360	194	676	635,0	4,95
800	415	240	836	803,6	6,15
1000	350	300	1031	1010,3	8,10

Table. 3- Values of the dimensions of the mouth of tubes and accessories

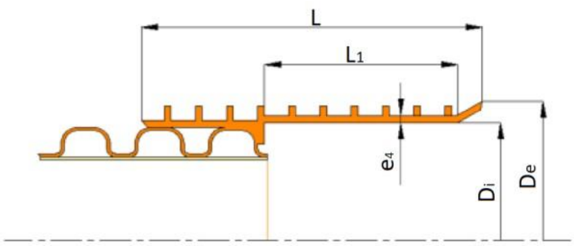

Figure 8 - Drawing of the mouth of tubes and accessories

5.3.1. PHYSICAL AND MECHANICAL CHARACTERISTICS OF THE TUBES

Característica	Requisitos	Parâmetros de ensaio		Norma
		Parâmetro	Valor	
Ensaio de estufa	Sem delaminações, fissuras e bolhas durante o ensaio	Temperatura Tempo de ensaio $e_S \leq 8$ mm $e_S > 8$ mm	150 ± 2 °C 30 min 60 min	ISO 12091
Rigidez circunferencial	≥ SN relevante em kN/m²	De acordo com a EN ISO 9969		EN ISO 9969
Resistência ao impacto de tubos - método do relógio	TIR ≤ 10 %	Temperatura Tipo de percutor Massa do percutor: $110 < d_{em,min} \leq 125$ $125 < d_{em,min} \leq 160$ $160 < d_{em,min} \leq 200$ $200 < d_{em,min} \leq 250$ $250 < d_{em,min} \leq 315$ $315 < d_{em,min}$ Altura de queda	0 ± 1 °C d90 0,8 kg 1,0 kg 1,6 kg 2,0 kg 2,5 kg 3,2 kg 2,00 m	EN 744
Flexibilidade anelar	Sem diminuição da força medida, fissuras, delaminações ou rupturas e deformação permanente na estrutura perfilada.	Deflexão Comprimento do provete Posição do provete	30 % do d_{em} ou 20 % do d_{em} ≥ 5 anéis 0 ° / 45 ° / 90 °	EN ISO 13968
Ensaio de fluência	≤ 4 com extrapolação a 2 anos	De acordo com a EN ISO 9967		EN ISO 9967

Table. 4- Physical and Mechanical Characteristics of TUBES

6. TRACED GEOMETRY

6.1. GENERAL CONSIDERATIONS

A **study of the layout geometry** for the projected road was carried out and all the parameters of the Project layout were established, the elements adopted are verified with reference to the project specifications established in the Cabo VerdeStandards “NIE”, the “Trace Standard of JAE-Portugal” and the Project Manager's guidelines based on the analysis carried out on the Base Project presented.

Next, the study of the geometric characteristics that characterize the projected road axis is discussed, checking its adequacy to the applicable standard, taking into account the constraints inherent in the design of a flat road, the constraints derived from the surroundings, as well as the difficult orography of the terrain where the projected route is developed. Applied standards:

- NIE 1 Standard Project “Road Terminology”, Cabo Verde Roads.

- Draft Standard NIE 2 “Service Levels of Operational Capacity”, Cabo Verde Roads.
- NIE 3 Standard Project “Geometric characteristics and design parameters”, Cabo Verde Roads.
- Layout Regulation – Autonomous Road Board – Portugal, 1994.
- Layout Standard – Revision – INIR, IP 2010.

The design of Standard NIE 3 “Geometric characteristics and design parameters”, applies to National Roads classified in the “National Road Plan” of Cape Verde, with the exception of stretches of national road that constitute urban crossings delimited by start and stop signs. end of location.

6.2. BASE SPEED AND TRAFFIC SPEED

In the construction of new roads or when carrying out improvement works, the base speed or design speed must be defined.

The automatic traffic counts carried out in Cabo Verdemake it possible to establish effective speeds (Traffic Speed). It is concluded that the relationship between Base Speed and Traffic Speed is indicated in Table 5.1.

For the purposes of applying the NIE 4 Standard, in its article 4, for the different base speeds, the values in the attached table result:

TYPICAL BASE SPEED AND TRAFFIC SPEED OF THE CV ROAD NETWORK						
Base speed	80	70	60	50	40	30
Traffic speed	100	90	80	60	50	40

Table. 5- Base Speed and Traffic Speed

The design parameters were established trying to adjust to the geometric characteristics for a **Base Speed (Vb) of 80 km/h.**

The adopted base speed is not valid for the entire route, due to the existence of roundabouts. Therefore, the 50 meters before and after the roundabouts are slow traffic (Vb 40km/h) and the 300 meters before the roundabouts the speed is limited to 70 km/h.

The following epigraphs present a summary of the most significant parameters of the layout in plan and in longitudinal profile, adopted in the projected road.

6.3. TECHNICAL PARAMETERS

For the purposes of applying **Standard NIE 4, in its article 5**, in the following headings, the essential elements to be defined in plan and in longitudinal profile, in the preparation of road projects, are defined.

6.3.1. TRACED ON PLANT

The essential elements of visibility distances and radius in plan that allow to define basic rules of geometric sizing, are those established in road projects, associated with base speeds and traffic speeds.

In case of the projected road, as already mentioned, the definition of the geometric elements is conditioned to its class and base speed, with the absolute Minimum Radius adopted being 240 meters (according to **NIE 4 Standard**).

From 20 curved stretches, only one has a radius smaller than the absolute minimum (radius of 200 meters in PK 14+015), however, this curve is within the limit of 50 meters before the roundabouts, that is, the base speed for this section is 40 km/h and not 80 km/h, therefore, the said section complies with the minimum requirements stipulated by NIE 4 Standard.

In **Annex 1.B.4. TRACED** is displayed all sections in curves and their radius.

6.3.2. TRACED IN LONGITUDINAL PROFILE

MINIMUM RADIUS OF VERTICAL CONCORDANCES

The essential elements of minimum radius for convex and concave concordances to be considered are established in road projects associated with base speed and traffic speed.

The absolute minimum radius of the concave and convex concordance curves are 3500 m and 5000 m, respectively. The minimum developments of the concave and convex concordance curves are 120 m and 120 m respectively (According to **NIE 4 Standard**).

As for the vertical agreement, all established in the project respect the minimum stipulated by NIE 4 Standard.

TRAINING SLOPES

The essential elements of maximum desirable slopes to consider in road designs are associated with base speeds and traffic speeds.

In case of the projected grazing, the Maximum Inclination limit value was established according to the NIE 4 Standard of 6% and a minimum of 0.5% due to water flow issues.

The maximum obtained with the projected grazing was 5.6% and the minimum was 0.5%.

6.4. TYPE CROSS PROFILES

For the purposes of applying **Standard NIE 4**, in its article 6, in road construction or improvement projects, the transversal profiles indicated in the following table must be observed.

CROSS PROFILES FOR THE ROAD NETWORK OF CABO VERDE		
Road class	**Carriageway (m)**	**Berm (m)**
1st class	7	1,0 a 2,5*
2nd Class	5,0 a 6,0	0,5 a 1
3rd class	5	0,0 a 0,5
Country road	4	0,0 a 0,5

*Upper limit to be used exceptionally

Table. 6– Cross Profiles Road Network

The elements and dimensions of the Type Cross Profiles adopted for the current section of the road are collected in the attached table.

TRANSVERSAL PROFILE ADOPTED ON THE PROJECTED TRACK					
Vb Design Criteria (Km/H)	**Carriageway (m)**	**Berms interior (m)**	**Berms exterior (m)**	**Concordances (m)**	**Class**
80	**7,00**	**1,00**	**1,50**	**1,00**	**1st Class**

Table. 7– Transversal Profile Adopted

In Drawn Part **2.B.3** the various existing standard profiles are presented.

6.5. TRANSVERSE INCLINATION

The basic objective of the transverse slope of the platform is to facilitate the evacuation of surface water, and to minimize its passage over the carriageway.

For its implementation, the following criteria were adopted, corresponding to dual carriageway roads:

- The carriageway and berms have the same transverse inclination, of 2.0% for each side of the carriageway from the implantation axis (the central separator in an earth ditch), and the concordances have an inclination of 4, 0%;

- In superelevation, transverse slopes reach 8% and - 8%.

6.6. EARTHMOVING - SLOPES

The slopes adopted in the profiles in an Embankment situation are 3H:2V and in the Excavation profiles, 1H:3V.

6.7. INTERSECTIONS

Level intersections on the road are limited to roundabouts only, with the exception of access to the existing INMG. In that case, there must be an acceleration lane for cars entering EN-SL-01 and a deceleration lane for cars leaving EN-SL01. For cars heading towards Espargos – Santa Maria, continue to the nearest roundabout and reverse to exit the EN-SL-01 on the slow-down lane parallel to the road. To prevent disorderly cars and trucks from passing over the central divider to gain access to the access road to the INMG (currently common practice), a barrier will be placed between the two lanes.

Another existing access that deserves special attention is the access to the quarry and the CIMPOR power station at PK 1+300. In this case, due to the proximity to a roundabout, it is preferable to build a new road from the roundabout as shown in Figure 10 below. Likewise, access from EN1-SL-01 must be blocked with barriers and users of this access must be notified

In any case, a typical detail is specified for the acceleration and deceleration range if necessary during the execution of the Contract

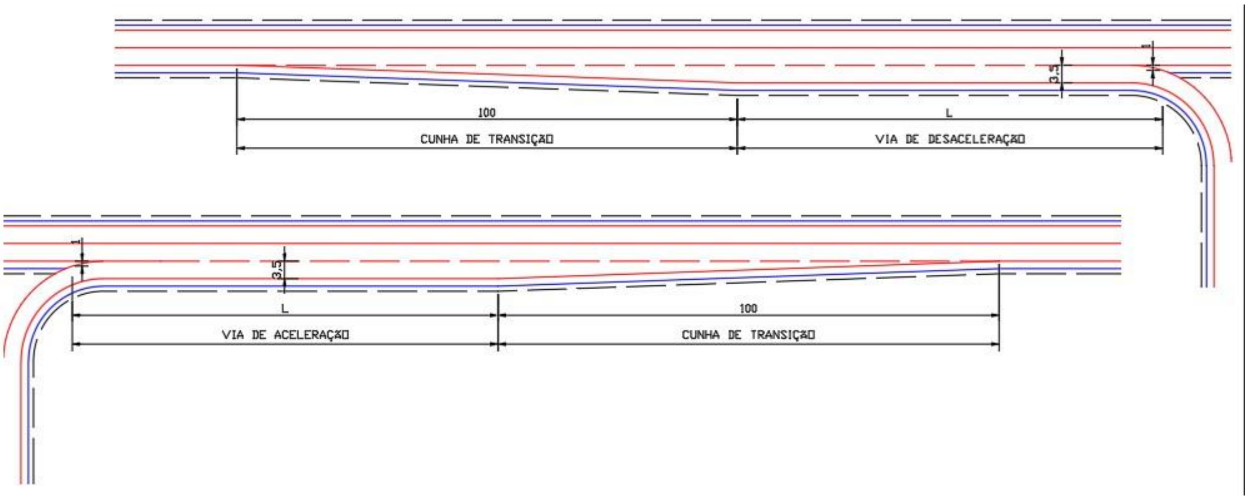

Figure 9 - Typical acceleration and deceleration range typology

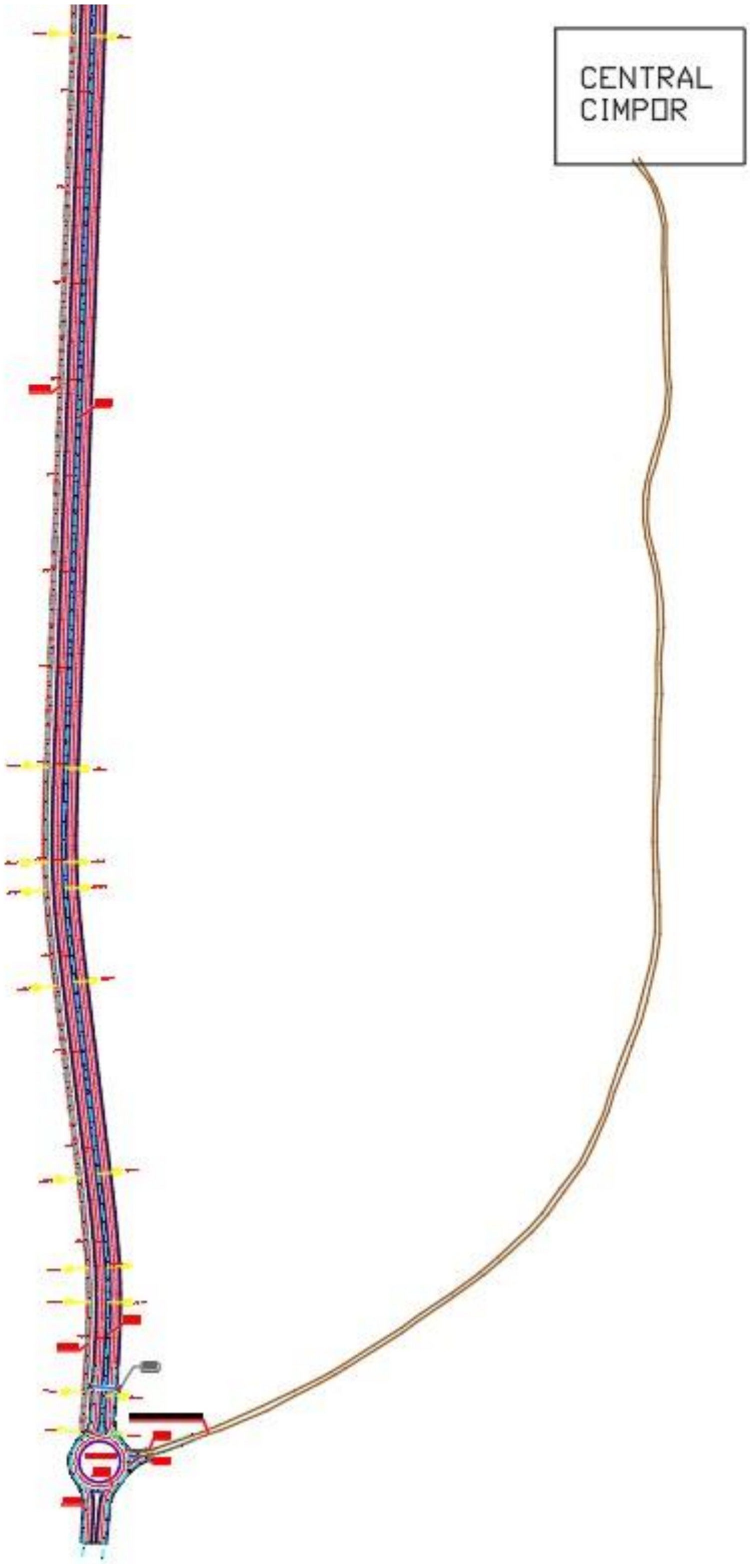

Figure 10 – Planned access from the roundabout to CIMPOR Central

6.8. VISIBILITY

A visibility study was prepared, which can be found in **Annex 1.B.4. TRACED**. The results of the study were as follows:

- PK 0+200 did not meet the desired minimum for a speed of 8km/h, however, this section is very close to roundabout 1, that is, traffic in this section is low (less than 80 km/h), so it can be said that the same complied with the minimum visibility.
- At PK 3+629,743 to PK 3+609,743 (20 meters) on the way back, it also did not fulfil the desired, but the problem presented is related to a small point where the light from the headlight collides with the road (the focal angle goes against grazing). This small non-compliance in a small extension (20 meters) was disregarded.

7. IMPLANTATION

Attachment **1.B.1 CARTOGRAPHY, TOPOGRAPHY AND IMPLEMENTATION** presents the list of Coordinate Points for Road Implementation, as well as the reference base points and the coordinate system used.

The listings were generated using the ISTRAM program from the study of the layout carried out both in plan and in profile.

8. PAVEMENT

In Annex **1.B.5. PAVEMENT** the justifications, the pavement calculation methodology and the traffic study are presented. Therefore, in this section, only the solutions adopted for each section of the road will be presented.

8.1. STRUCTURAL PAVEMENT SOLUTION OF THE ROAD TRACKS

For quality control and assurance purposes, the suggested pavement structure was analysed using Shell's BISAR 3.0 calculation program, in order to verify the stresses to which the pavement will be subject throughout its useful life.

The structural solution adopted consists of the following steps:

- Removal of the entire bituminous concrete layer;
- Removal of 40 cm of the existing natural tout-venant and store on the construction site for reuse;
- Carrying out all earthworks, adjusting the level of the project;
- Production of soil-cement in a plant using the natural tout-venant removed in the previous point and cement in a percentage such that the mixture reaches a deformability modulus equal to or greater than 2,000 MPa. For this activity, it will be necessary to sift the natural tout-venant, in such a way that it obtains a Dmax of 25 mm;
- Regularization and compaction of the pavement bed layer to a minimum of 98% of the proctor;
- Placement of a 15 cm layer of stored natural tout-venant, leveled and compacted to 98% of the proctor;
- Placement of 20 cm of soil-cement produced in the plant, smoothing and compacting 100% of the proctor;
- Supply and application of 5 cm of bituminous concrete AC 14 surf (BB) with a minimum modulus of 4,000 MPa determined in laboratory tests and in an experimental section.

It should be noted that the proposed materials must comply with the specifications of the project specifications and that of the Cabo Verde Roads.

In any case, the action of heavy vehicles expressed in terms of an equivalent number of passages of the standard axle of 130 kN with double wheels and 31.5 cm spacing and with a circular tire impression area with a diameter of approximately 21 cm was considered.

Therefore, the structure of the final pavement would be:

- 5 cm of Bituminous Concrete AC 14 surf (BB);
- 20 cm of soil-cement,
- 15 cm of natural tout-venant (material existing on the road)
- Pavement bed, minimum CBR 20%, maximum IP 10.

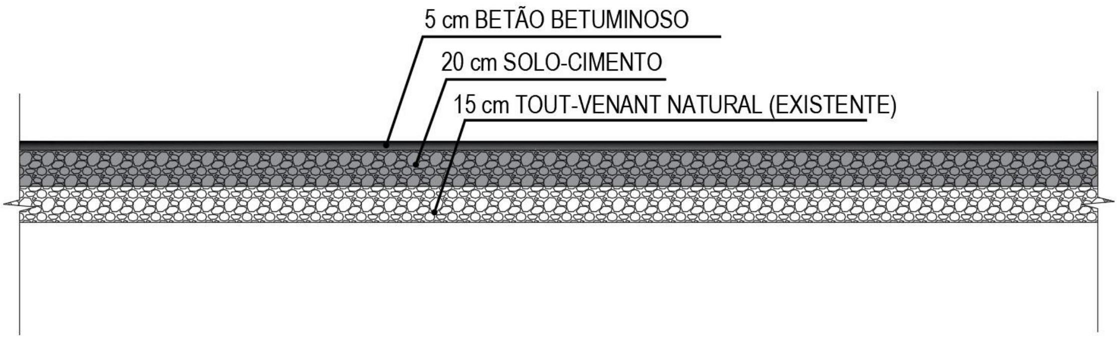

Figure 11 – Pavement Structure

In Annex **1.B.5 PAVEMENT** is presented the calculation justifications for a useful life of 20 years. By way of summary, the table below presents the results obtained and the respective damage caused to the pavement over the lifetime of the project.

PAVEMENT STRUCTURE				
Camadas	**Pavement bed**	**Sub-base in tout venant natural**	**Base in soil cement**	**Bituminous Concrete Coating**
Thickness	-	15 cm	20 cm	5 cm
AND (MPa)	100	150	2000	4000

CALCULATION BY BISAR 3.0			
N_{dim130}	ε_{Zadmi}	$N_{admi130}$	**Dano**
1.535.844	502,5 X 10^{-6}	1.646.439	**93,29 %**

Table. 8– Pavement damage in 20 years

8.2. SOLUTION FOR SPECIAL TRAINS

Some sections will have to have a thicker layer of bituminous concrete due to greater shearing forces arising from the braking of trucks and/or the altimetric proximity to the water table, causing loss of foundation capacity. These special sections consist of the 200 meters before each roundabout and a section from PK 4+500 to PK 7+800 in which they are closer to the water table. From the visual inspection of the terrain, these sections highlighted as special sections are the sections with the most damage, which justifies investing in a structure with greater resistance.

That said, in these sections the pavement structure will be the same, but with 8 cm of bituminous concrete. In the section between PK 4+500 and PK 7+800, a geotextile blanket will be placed involving the entire pavement structure (sub-base 15 cm of natural tout-venant and 20 cm of base layer in cement soil) as a form of to prevent the loss of fines and consequent loss of load capacity.

8.3. JUSTIFICATION OF THE PAVEMENT STRUCTURE

When defining the pavement structure, care was taken to find the solution with the best cost-benefit for Cabo Verde, that is, a solution which would provide 20 years of useful life at a lower investment and maintenance cost for the Roads of Cabo Verde. Therefore, one of the premises outlined was to reuse all the good material that was still in the existing road structure.

Based on this concept, the existing natural tout-venant of the base layer and sub-base layer of the existing pavement structure can also be reused through a prior treatment of granulometry and mixing with cement to further increase its load capacity in order to withstand the expected increase in traffic over the next 20 years.

This solution has a lower cost in terms of the supply of materials, since most of the material is already on site (the tout-venant of the existing base layer and sub-base). In addition to the already existing material, the Contractor has to mobilize a certain amount of ABGE of suitable granulometry to complement the total required amount of the work, as well as to correct the granulometry of the existing aggregate and cement. In addition, soil-cement provides a greater increase in load capacity and consequently a longer service life.

8.4. PAVED BERMS

The paved verges will be executed in such a way that there is no difference in level between the lane and the verge and will have the same paving structure as the carriageway.

8.5. B UNPAVED BERMS

The unpaved berms will be executed with material from excavations or borrowing with the characteristic of filling material protected by a layer of monocouche as described in this chapter. It must remain compressed and regularized. The monocouche should run as follows:

- A layer of bituminous emulsion on the previously levelled, compacted and slightly dampened base;
- A layer of crushed material of granulometry 4/6.3 with Los Angeles ≤ 20;

- Compaction without using vibration.

The total layer of the monocouche must be equal to the diameter of the largest aggregate used and the amount of bituminous emulsion must be sufficient to hold the aggregates. The minimum amount of bituminous emulsion to be used is 1.0 kg/m2, if the aggregate fails to adhere, the Inspection may request a reinforcement layer of bituminous emulsion of at least 0.5 kg/m2 on the crushed material

8.6. BICYCLE ROAD

The cycle path is a new structure, a new element incorporated into the road. As it is an element without heavy traffic, a minimum pavement structure was adopted in consultation with Estradas de Cabo Verde, which consists of a 20 cm base layer in ABGE and a 4 cm running layer in bituminous concrete. AC 14 surf.

9. HEALTH AND SAFETY PLAN

A Project **Health and Safety Plan** was drawn up with the aim of predicting the risks of accidents and professional illnesses, establishing the preventive measures to be taken during the assembly and execution of the Work. Therefore, its main function is to create a set of conditions for construction workers to carry out their duties in a safe, healthy and hygienic manner, complying with current legislation and labour laws in force.

In carrying out the PSS, the regulations in force on Occupational Safety, Health and Hygiene (SSHT) were taken into account, namely the following:

- **Decree-Law nº 55/99** – (Sets measures that guarantee workers' safety and health in the workplace).
- **Decree-Law No. 64/2010** – (Establishes the general rules for planning, organization and coordination to promote safety, hygiene and health at work on construction sites).
- **Legislative Decree nº 5/2007** - (Approves the Cape Verdean Labor Code).
- **Decree-Law no. 13/2012** – (Approves the statute of the General Labor Inspection)

The Health and Safety Plan is set out in Annex **1.B.9 Health and Safety Plan** and must be completed by the Contractor.

10. ENVIRONMENTAL IMPACT STUDY

An Environmental Impact Study of the Project was prepared in order to assess and quantify the risks and environmental impacts that will arise from the execution of the work, as well as the mitigation or compensation measures for these impacts. Therefore, the main objective is to establish measures to be addressed during and after the execution of the Contract to reduce and/or compensate for environmental impacts.

In carrying out the EIA, the regulations in force regarding the assessment of environmental impacts, municipal plans and regional schemes were taken into account, namely the following:

- Official Bulletin Resolution No. 3/2014;
- Decree-Law No. 29/2006;
- Regulatory Decree No. 7/2002;
- Regulatory Decree nº 7/94;
- Decree-Law No. 3/2003;
- Law nº 86/IV/93;
- Legislative Decree nº 14/97;
- Decree-Law No. 6/2003;
- Law No. 102/III/90;

The Environmental Impact Study is presented in Annex **1.B.8 Environmental Impact Study** and must be completed by the Contractor.

From the Environmental Impact Study carried out, it was concluded that the Contract has very little negative impact, since it is a rehabilitation of an already built road where there is no use of new areas of soil or new visual impacts, on the flora and in the fauna. Therefore, the Project was evaluated as **POSITIVE, HIGHLY SIGNIFICANT**, since it promotes great improvements in the economy and human population without increasing or creating new impacts on flora, fauna, landscape and land use.

11. SIGNALING

In **Annex 1.B.6 SIGNALS** and in the Drawn Parts, horizontal and vertical signs were designed, considered as the most convenient, in order to achieve the maximum degree of safety, efficiency and comfort in the circulation of vehicles, both in terms of signs for user orientation as well as with regard to metallic guards at those points where they are needed. The **proposed maximum circulation speed limitation,** due to the conditions imposed in the supervision of the project, is **80 km/h** for the entire road.

These elements are road markings, vertical signs, buoying and metal guards, the first two having the additional mission of informing road users, the third guiding the driver and the fourth protecting against possible accidents and preventing entry. of large animals on the road.

The following regulations were used as a basis for defining horizontal and vertical signaling:

- **Instruction 8.2-I.C. "Marcas Viales"** (1994), from the General Directorate of Highways;
- **Recommendations for the Intersections Project** (1968);
- **Recommendations for the Links Project** (1968);
- **Recommendations on Roundabouts** (1994);
- **Recommendations for the Design of Roundabouts on Suburban Highways** (1989) from the General Directorate of Transport of the Community of Madrid.
- **Circular Order 325/97 T** on "**Signaling, Beaconing and Protection of Highways in relation to their Constituent Materials**"
- **Instruction 8.1-I.C. "Vertical Signage"** (March 2014)
- **Vertical Traffic Signs. Volume I. Characteristics of the Signals**" (June 1992)
- **"Vertical Circulation Signals. Volume II. Catalog and Meaning of the Signals"** (June 1992).
- ***Circular Order 325/97 T** on **"Signaling, Beaconing and Protection of Highways in relation to their Constituent Materials"***
- **Circular Order 309/90 C and E on "Arista Landmarks"**
- "**Circular Order 35/2014 on Criteria for the Application of Metallic Security Barriers"**
- **"Instruction 8.3-I.C. "Signalization of Works"** (1989)
- **Fixed Works Signaling Example Manual"** (1997)

12. INTEGRAL PROJECT DOCUMENTS

DOCUMENT No. 1 - WRITTEN PIECES.

1. THE DESCRIPTIVE MEMORY

1.B. MEMORY ATTACHMENTS

1.B.1. CARTOGRAPHY, TOPOGRAPHY AND DEPLOYMENT
1.B.2. CLIMATOLOGY, HYDROLOGY AND DRAINAGE
1.B.3. GEOTECHNICS AND GEOLOGY
1.B.4. TRACED

1.B.5. PAVEMENT
1.B.6. SIGNALING
1.B.7. WORK PLAN
1.B.8. ENVIRONMENTAL IMPACT STUDY
1.B.9. HEALTH AND SAFETY PLAN

DOCUMENT No. 2 - DRAWN PARTS.

2.A. GENERAL CHARACTERIZATION
2.B. GEOMETRICAL PROJECT
1.B.1.LAYOUT ON ROAD PLANT
1.B.2. INTERSECTIONS PLAN TRAINING
1.B.3. GENERAL DETAILS
2.C. LONGITUDINAL PROFILE
2.D. CROSS PROFILE
2.E. EARTHMOVING
2.F. DRAINAGE PROJECT
2.F.1. HYDROGRAPHIC BASIN
2.F.2. GENERAL PLANT DRAINAGE
2.F.3. GENERAL DETAILS DRAINAGE
2.G. PROJECT SIGNALING
2.G.1. SIGNALING GENERAL PLAN
2.G.2. SIGNALING GENERAL PLANT

DOCUMENTO Nº 3 – CADERNO DE ENCARGOS.

3.A. GENERAL Tender Specifications for the Roads of Cabo Verde
3.B. SPECIFIC TENDER DOCUMENTS/SPECIFICATIONS

DOCUMENT Nº 4 – BUDGET

4.A. QUANTITIES MAP

4.B. BUDGET ESTIMATE

EXECUTION PROJECT FOR REHABILITATION AND IMPROVEMENT OF THE NATIONAL ROAD “EN1-SL01-ESPARGOS-SANTA MARIA”

Praia, Santiago Island, August 2022 SISTEMA,

S.A.

O coautor do Projeto	A autora do Projeto	O coautor do Projeto
Fdo.: Adérito J. V. Teixeira	Fdo.: Nedelia Morales Soler	Fdo.: Jean Jaques H. C. Furtado
Engenheiro Civil	Engenheira Civil	Engenheiro Civil
Membro OECV Nº 1088	Colegiado (membro) nº 18.805	Membro OECV Nº 1222

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