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REHABILITATION AND EXTENSION PROJECT

BEIRA CENTRAL WAREHOUSE

U.N.D.P / MISAU

DESCRIPTIVE AND JUSTIFICATIVE MEMORY

STRUCTURE

SEPTEMBER 2020

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INDEX

1. INTRODUCTION

The present specification refers to the Project of Structure for the Expansion and Rehabilitation of the Beira Intermediate Drug Deposit.

The Project includes the following buildings:

- Main Warehouse;
- Toxic and Flammable Warehouse;
- Administrative Block;
- Cold Area.

The structural plan was conceived in order to satisfy the imposed architectural requirements, and the compatibility of this specialty must always be checked in any possible alteration to the architectural project before its execution.

2. LEGISLATION AND REGULATION

During the conception of the project now presented, the following standards were respected:

- REBAP – Regulation of Reinforced and Pre-stressed Concrete Structures;
- RSA (Dynamic - Spectral Modal) – Design of Structures for Earthquake Resistance;
- EUROCODES 3 e 4 – Formed Steel Structures Project;
- EUROCODE 4 – Mixed Steel and Concrete Structures Project;
- Civil Engineering Technical Tables.

3. CHARACTERIZATION OF THE FOUNDATION SOIL

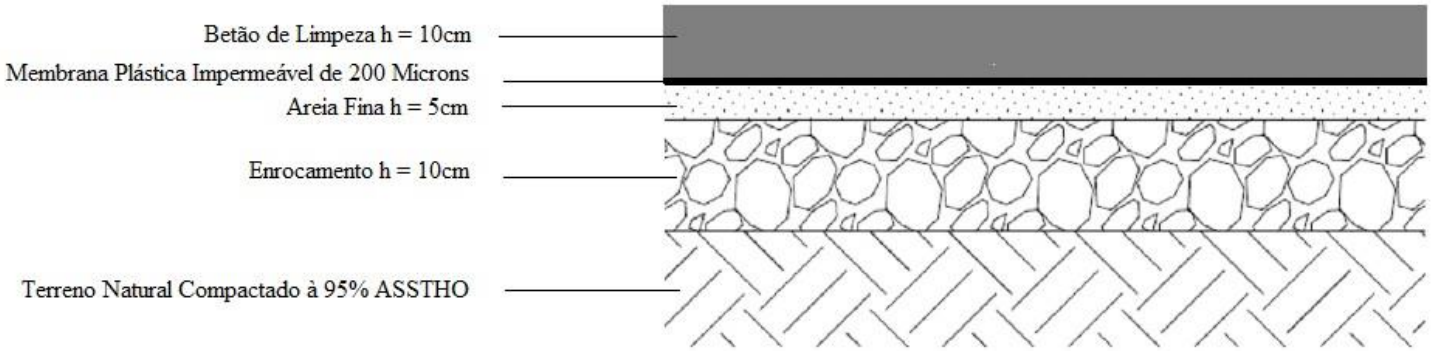
For the purpose of calculating foundations, an allowable soil tension of 150 kPa was considered.

4. FOUDATION AND PAVIMENT BASE

For the warehouse, direct foundations and foundation lintels were considered.

The foundation base will be laid on a 10cm cleaning concrete layer followed by a 5cm fine sand layer and a 10cm rockfill layer, below these, the natural soil previously compacted to 95% ASSTHO.

The foundation, as well as the floor slab, will be protected by a 200 micron waterproof plastic membrane.



5. ACTIONS

For the Main Warehouse were considered permanent actions, overloads, wind and earthquakes actions.

5.1. Permanent Actions

The following permanent charges are referring to the Main Warehouse:

- Reinforced concrete – 25,00 kN/m3 (automatically considered by the program);
- Double wall on the outer perimeter of the Main Warehouse – 16,00 kN/m;
- Roof in IBR plates 0.8 mm tick – 0,10 kN/m2;

- IPE 200 profiles – 22,40 kg/m (automatically considered by the program);
- IPE 450 profiles – 77,60 kg/m (automatically considered by the program);
- IPE 500 profiles – 80,70 kg/m (automatically considered by the program).

5.2. Overloads

The following overloads are refering to the Main Warehouse:

- Main warehouse floor – 7,50 kN/m2;
- Ordinary roof (IBR Plate) – 0,30 kN/m2;
- Forklifts (medicine warehouse) – 63,00 kN/wheel;
- Racks (medicine warehouse) – 27,50 kN/support.

5.3. Wind

In the stability calculation, the main structural elements were designed for cyclonic winds with a speed of around 200 Km/h.

5.4. Earthquake

The earthquake load was calculated using RSA with the following characteristics:

- Terrain C (Deep deposits of compact or moderately compact sand, pebble or hard clay with a thickness between several tens and many hundreds of meters);
- Type 1 earthquake;
- X and Y direction earthquake.

6. STRUCTURAL MATERIALS

6.1. Reinforced concrete

The project considers B25 class concrete for all structural elements, with the exception of the floor slab, in the forklift circulation area, which will be B40 class concrete.

Concrete Class	fck	γc
B25 (C20/25)	20MPa	1,50
B40 (C35/40)	35MPa	1,50

For covering, 50 mm is specified for foundations and buried elements, 40 mm for columns, beams and 30 mm for slabs/capitals.

6.2. Steel Rods

For all reinforced concrete elements, the use of steel bars was recommended:

Steel Class	fyk	γs
A500	500MPa	1,15

7. STRUCTURAL CALCULUS

To analyze and design the structures of the Main Warehouse, the CYPECAD 2016 calculation program was used, respecting the regulatory precepts.

7.1. Description of Structures

7.1.1. Main Warehouse

The warehouse will be displaced 2.3 m to the right, with a frontal, lateral and posterior extension with a total area of approximately 1,150 m^2.

In order to mitigate the costs and execution time of the work, we opted for a structure composed of reinforced concrete columns and beams. The warehouse foundation consists in isolated footing connected by foundation lintels. The global action of the wind load and earthquakes were considered.

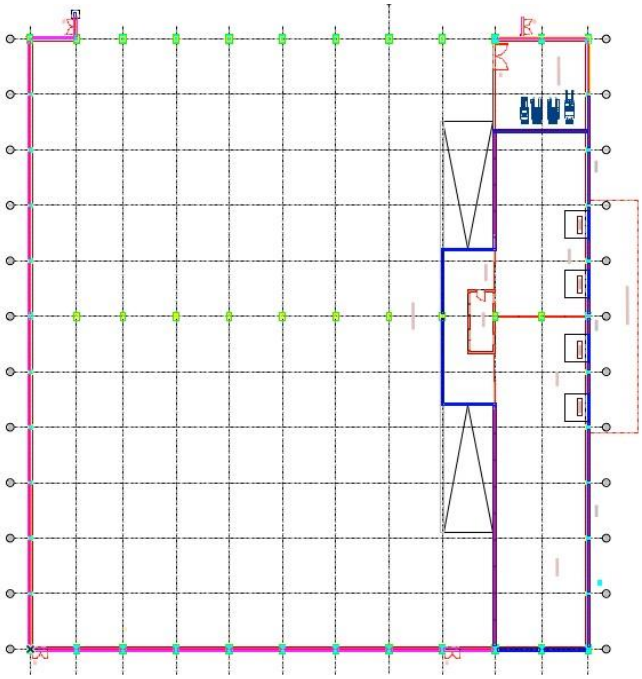
As it is a situation of rehabilitation/expansion, the existing pavement slab will serve as a lost formwork for a larger area of the warehouse, which will now have a base layer with greater load support.

The B40 concrete will give the slab a high load capacity and an enormous resistance to surface wear.

As a way to guarantee the peripheral locking of the pavement slab inside the warehouse, two types of retaining walls were considered, Type 1 with h = 0.40 m and Type 2 with h = 0.70 m from the level of the natural terrain. Both founded at 0.90 m deep and 0.25 m thick, as shown in the figure below:

Legenda

- Wall Type 1 h=0.40m
- Wall Type 2 h=0.70m



The pillars of Axis 6 will serve as supports for the locking beam (0.40x0.40m) of the floor slab, which will also serve as a transition between the floor slab and the access ramp that will lead to the corridor of the Administrative block.

The pavement was calculated to support the load of using a forklift type FL3 (63 kN) and the maximum load of the pallets (110 kN).

The loading and unloading areas will have Leveling Docks, which have the function of facilitating the process of loading and unloading goods, thus serving as a bridge between the vehicle floor and the warehouse floor, thus acting as a height compensating structure for the forklift /goods access.

For the front of the warehouse, in the reception area, a ramp with a -2% inclination was foreseen, in order to compensate for the unevenness between the floor of the trucks and the floor of the loading and unloading area.

7.1.2. Flammable warehouse

The building of the flammable warehouse will not undergo structural interventions, with only a replacement of the roof sheets for those similar to those of the main warehouse, without disturbing the roof structure and porches.

7.1.3. Administrative block

In the Administrative Block, intervention at a structural level will be light. In terms of roof coverage, the replacement of fiber cement sheets with metal sheets similar to those of the warehouse is planned.

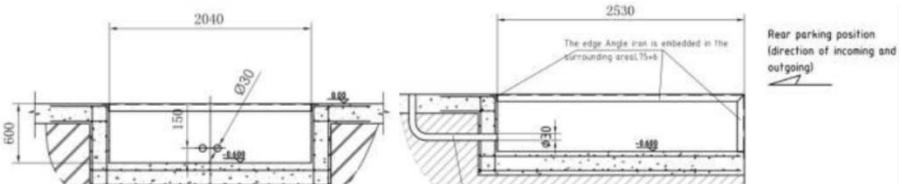
7.1.4. Cold Area

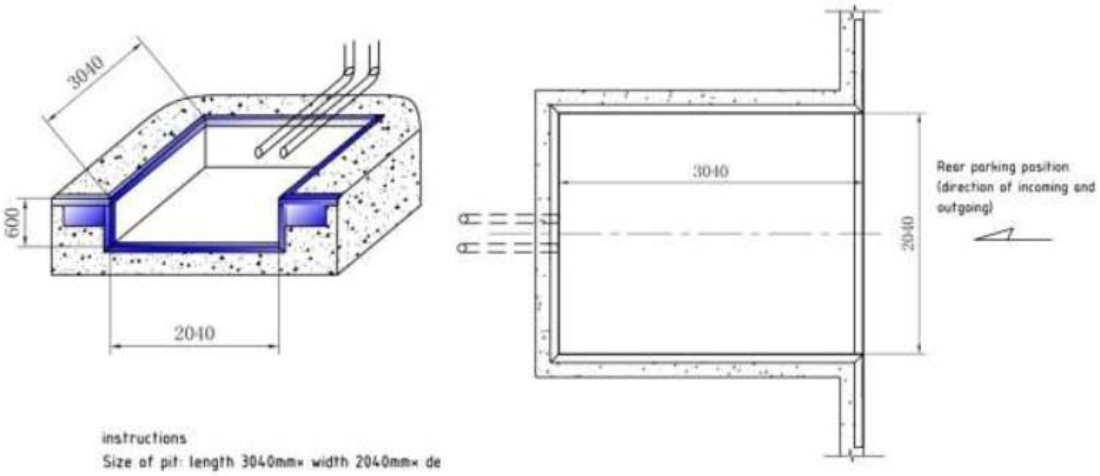
The cold area will not undergo structural interventions.

7.2. Dock Leveler

The hydraulic dock leveler is the special auxiliary equipment used for loading and unloading of goods. Its height adjustment function can be adjusted with the different heights of lorries. With its transport vehicles like dorks can move into the wagon box directly to carry out loading and unloading operations, and only one person operation can easily fulfill rapid loading of goods. The equipment helps the enterprise to reduce a great amount of labor force and double the work efficiency, speed up the rate of goods flow, so as to achieve greater economic results. It is an indispensable device for enterprise to realize rate, civilized production with high efficiency.

1. The platform and the lip are driven hydraulically, convenient and reliable in operation.
2. Adopt the full long shaft articulation with high strength and good reliability, ensuring that under the condition of heavy load; they will not be worn out deformed even used all the year round.
3. Apply imported sealing ring, to ensure the hydraulic system with super sealing function.
4. The hydraulic cylinder adopts the foreign advanced full-module-type hydraulic station, which has operation reliability and long lifespan.
5. The platform is of high strength U-shaped beam design, which guarantees that it will not deform under high load and longtime operation.
6. The surface board of the platform adopts the anti-slip riffled plated with good anti-slip property so that the fork will not slip when driving on the platform.
7. Both sides of the platform are fitted with anti-seizure safety guard board to prevent tiptoes from being accidently injured when stretching into the platform.
8. The vehicle ramp has a safety support rod that enables the platform to stay opened, allowing personal to get inside the lever to do maintenance work conveniently.





1. The two built-in tubes are for lying of the driving power line and control power line respectively

2. The diameter of the tubes should be greater than 25mm; the runs of the built-in tubes depend on the location of the driving power junction box and the location of fixing the vehicle ramp operation button.

3. The height of the platform depends on the height of orries which load and unload goods regularly, usually being at about 1,400mm.

4. The pit dimension allowance should be smaller than 5mm, the flat surface is of a foursquare rectangular with upright pit walls and a near and smooth pit floor.

Model	Rated Load (T)	Table Size (m)	Lip Width (m)	Guardrail Height (m)	Travel route		Motor Power	Pit size		
					Up incline	Down incline		L	W	H
DCQ15-0.7	15	3*2	0.4	0.59	0.4	0.3	1.5	3.04	2.04	0.6

1. Table, lapping board: table with non-slip pattern board, thickness of 8mm, lapping board thickness of 20mm.
2. Table support: 100*80*6mm rectangular tube.
3. Bottom frame: 12# channel steel, 10# Angle steel.
4. Shaft pin, box: 45#steel modulation backfire treatment.
5. Hydraulic oil cylinder: professional oil cylinder manufacturers supporting supply (jingjiang benyi),with inside diameter ofφ63mm*1 PCS andφ50mm*1 PCS.
6. Hydraulic power unit: adopt Italian heep, 1.5KW,380V.
7. Hydraulic oil pipe, Adopts double deck steel wire gauze A type burked rubber oil tube.
8. The paint: Suzhou Canglang.
9. Electrical components: schneider, Siemens.
10. Sealing element： Adopts Japanese VALQUA sealing element.
11. Collision block: 2PCS.

	Leveling Dock
Type	DCQ-15T-0.7M
Dimension mm	3040x2040
Dock opening	600
Capacity	15 Tons
Quantity	2
Shock Absorbers	Yes

8. TECHNICAL SPECIFICATIONS

8.1. Concrete Structures

8.1.2. Cement

I. The cements to be used must satisfy the requirements of the legislation, standardization and applicable regulations, namely the one that establishes the Cement Quality Mark. The following documents are in effect:

- Portuguese Standards NP ENV 206 (1993);
- Portuguese Standards NP 2064 (1991) with Amendment 1 of 1993;
- Portuguese Standards NP 2065 (1983);

II. The cement should be preferably national, of recent manufacture and packaged in order to be well protected against moisture. Under the current legislation, the cement to be used must have the Quality Mark.

III. The cement must be supplied in bulk or, exceptionally, in bags. The cement supplied in bulk must be stored in moisture-tight silos and equipped with thermometers. When supplied in bags, it will not be allowed to be stored in the open, and must be kept with all the care indicated in clause 9.1.2.1. of Portuguese Standard NP ENV 206.

IV. For each shipment, the Contractor shall provide the Inspection with a delivery note indicating the quantity, the shipment number, the name of the manufacturer, the grinding date and the number and date of the factory test certificate for the same shipment.

V. The Contractor shall ensure that deliveries are made as often as required by the work plan, in order to ensure the freshness and sufficiency of the material.

VI. If the Inspection has doubts about the state of conservation of the cement, in warehouse or in the lots supplied, it may require the collection of samples for testing.

VII. Any cement that presents with traces of moisture, hardened, with granules, or that is poorly conditioned or stored will be rejected. When in bags, anyone who is contained in open bags or with signs of violation will be rejected. The storage time will not exceed 90 days. The rejected cement must be identified and removed from the construction site.

VIII. Mixing cement from different sources is not permitted.

IX. Cement, for a quality of concrete, and for the same element of work, must be from the same source, which must be proven by certificates of origin.

X. The cement to be used, according to a specific composition of the concrete, cannot have characteristics of significantly lower quality than those of the cement batch that served as the basis for the establishment of that composition. If another rule is not agreed, the result of the tests to determine the mechanical resistance to compression at 28 days on the normal screedfinishing cannot be less than 5 MPa below the average of the values attributed to that batch.

XI. Portland cement to be used in concrete and screedfinishing will be of resistance class 32.5 (CE 32.5).

XII. As an alternative to Portland CE Cement 32.5, other cements may be proposed by the Contractor that lead to better durability conditions for concrete and screedfinishing, namely 60/80 blast furnace cement or pozzolanic cement.

XIII. The mixing of additions to cement works should only be allowed in exceptional cases, duly justified and when the Cement Industry does not currently produce certified cements with equivalent characteristics.

XIV. Without prejudice to the provisions of the previous point, the addition of additions in the kneading phase can only be allowed when the cement is of type I and has the objective of obtaining the adequate durability for the concrete, satisfying the Specifications and Standards in force.

XV. The mixing of additions must be subject to the provisions of Specification E378 - Concrete.

Guide for using Hydraulic Binders. The use of any addition that is not covered by the following Standards or Specifications is prohibited: NP 4220, NP EN450, LNEC E375, LNEC E376 and LNEC E377.

8.1.3. Inerts

I. The aggregates for hydraulic binder concrete must satisfy the requirements of the screedfinishing and Concrete Standard. Characteristics and Compliance Verification. Failing these, they must meet the requirements of recommendations R.73.21 and R. 73.23 of the "Européen du Béton Committee (C.E.B.)".

II. The Contractor shall submit to the Inspection approval the plan for obtaining aggregates, washing and selection of aggregates, provenance, transport and storage, in order to verify the guarantee of their production and supply with the convenient and constant characteristics, in the required quantities and dimensions. The origins of aggregates must not be changed without prior authorization.

III. The Inspection will always retain a collection of samples of the approved aggregates to serve as a standard throughout the execution of the work.

IV. The sand to be used in the manufacture of concrete and screedfinishing must, in particular, satisfy the following conditions:

- Be properly cleaned or washed, and circulated, if necessary in the opinion of the Inspection;
- Do not contain harmful amounts of clay and organic substances or other impurities;
- Have angular grain rough to the touch;
- Be hard, preferably siliceous or quartz.

V. In the manufacture of screedfinishings for irregular stone masonry, medium grained sand should be preferred; for screedfinishings to be used for laying stonework, brick masonry and plaster or trim, fine-grained sand should be used; for reinforced concrete it must be composed of fine, medium and coarse grains, in approximately equal parts and always so that its granulometric composition is the most convenient for the compactness of the concrete.

VI. Coarse-grained sand is considered to be passed through a 5mm sieve, removed on a 2mm sieve; medium grain sand which, when passed through the 2mm sieve, is removed in the 0.5mm sieve; fine-grained sand which, passing through the 0.5 mm sieve, is removed in the 0.07 mm sieve.

VII. The coarse inert must preferably come from crushed stone or angular pebble and must, in particular, meet the following conditions:

- Present mechanical resistance, shape and chemical composition suitable for the manufacture of the concrete for which they are intended;
- Do not contain, in harmful quantities, clay films or any other coating that isolates them from the binder, excessively fine particles and soft particles;
- It must always be washed, and with special care if it is cobble;
- The individual elements of thick inert should preferably be isometric, and the portion of flat or elongated particles should not exceed 20% of the total weight; a particle is considered flat when d / b <0.5 and elongated when L / b> 1.5, being b the width, d the thickness and L the length of the particle;
- The maximum dimension of coarse inert should not exceed 1/4 of the smallest dimension of the piece to be cast, 1.3 times the thickness of the reinforcement covering or exceed 3/4 of the distance between bars, cables or sheaths.

VIII. The particle size of the aggregates must comply with the guidelines established in Portuguese Standard NP ENV 206 (1993). Its determination will constitute a mandatory test when it is necessary to study the composition of the concrete. The aggregates should also have a fineness module that does not deviate more than 0.20 from the fineness module of the aggregates that served as the basis for the establishment of the said composition.

IX. The Contractor will submit for inspection to the Inspection the plan of inert tests that it proposes to carry out and the justification in the case of the exemption of some tests recommended in the LNEC E373 specification to verify the characteristics of the inert.

X. The Inspection may order to carry out the tests deemed necessary. The referred tests will be carried out according to the normative documents specified in Portuguese Standard NP ENV 206 (1993). Inert materials whose tests do not guarantee the required durability for concrete will be rejected.

XI. While storing the aggregates, they must be stacked in order to avoid the segregation of the elements. The stacks must consist of layers of substantially uniform thickness and in the order of 1 meter. Each layer must be complete before starting the next, and a layer should not be allowed to be stacked irregularly on the layer immediately

below. Inert materials that have been segregated or mixed with other foreign material must not be used.

8.1.4. Water

I. The water to be used in the manufacture of concrete and screedfinishing must meet the conditions prescribed in Portuguese Norm NP ENV 206 (1993) and in the LNEC E372 Specification.

- Mixing water for concrete. Characteristics and Compliance Verification.

II. The water to be used on the construction site, both for making concrete and screedfinishing and for curing concrete must, in general, be sweet, clean and free of foreign matter in solution or suspension.

III. The water from the distribution network to the public or that has already been approved in other works does not need any study, as long as it complies with the requirements of the point.

IV. The inspection can be assured at the beginning of the work and periodically, during the execution of the water quality work. The Contractor must proceed with the collection and packaging of the samples and will bear all charges with the determinations and analyzes to be carried out in an official laboratory.

V. It cannot be used water that, used in other works, has produced efflorescence or disturbances in the process of setting and hardening the concrete and screedfinishing manufactured with them. It is forbidden to use sea or brackish water from wells for mixing or curing concrete. The mixing water must be free of chlorides.

8.1.5. Adjuvants for Concrete and Screedfinishing

I. Adjuvants to be used in the manufacture of concrete must meet the requirements of Portuguese Standard NP ENV 206 (1993) and LNEC E374 Specification.

II. Adjuvants may be used in screedfinishings and concrete, as plasticizers, air introducers, or both, or even setting retarders and accelerators, provided they are approved by the Inspection. The adjuvants to be used in concrete and screedfinishing have the objective, namely to increase durability, reduce shrinkage and increase

workability without resorting to increasing the water / cement ratio, which should not exceed that specified in the project.

III. In sealing areas, high-strength screedfinishings should be used, which must be submitted to Inspection for approval. These screedfinishings will be pre-dosed and supplied ready to apply.

IV. The Contractor must always submit to the Supervisory Board the use of an adjuvant, and for that purpose must present a certificate of origin, specification of the manufacture, composition, guarantee certificate, storage conditions and sensitivity of screedfinishings and concrete to the dosage of adjuvants.

V. The use of a given adjuvant presupposes the approval of the Inspection, which may, in addition to the aforementioned elements, have the necessary tests carried out to verify that the adjuvant produces, in screedfinishings or concrete, the desired effect. The number and nature of the tests to be carried out both on the adjuvants and on the concrete manufactured with them will be those indicated in the LNEC E374 Specification and carried out according to the standards referred to therein. Samples of the concrete used must be kept. It must also be verified that the adjuvant does not produce any reaction with the reinforcement.

VI. Whenever using adjuvants, the Contractor undertakes to observe the application prescriptions set by the manufacturer, particularly with regard to dosage.

VII. Mixtures of adjuvants of different brands, although of the same nature, will not be allowed. When the possibility of using various types of adjuvants is posed, a compatibility study must be carried out in advance in order to verify the final result.

VIII. The use of adjuvants containing chlorides should be avoided. If this is not the case, the Contractor must show that the chloride content in the concrete will be, at most, that indicated in clause 5.5 of the Portuguese Standard NP ENV 206 (1993) for simple, reinforced and pre-stressed concrete.

IX. The use of adjuvants in relation to which there is no experience of application in works of the type to which these Technical Conditions refer, obliges the Contractor to promote, on his own account, the performance of tests that prove their efficiency and safety.

X. The total amount of adjuvants, when used, must respect the limits indicated in clause 5.8 of Portuguese Standard NP ENV 206 (1993).

8.1.6. Epoxi Resin and Hardener

I. The use of epoxy resin is foreseen in the repair of concrete defects or possibly when bonding elements to be bonded.
II. The tensile strength of the compound must not be less than 50 Kgf / cm^2.
III. Certificates of product quality assurance, issued by their manufacturers, and documentation proving that the products used are suitable for the intended use must be submitted to the Inspection.

8.1.7. Bonding materials between concrete of different ages

I. The selection of materials to be used in the connection between concrete and screedfinishing of different ages must take into account that one must try to ensure the perfect bonding between the existing and the new concrete. It must be ensured that the materials to be applied can ensure a resistance of the connection joint compatible with the traction to be installed there.
II. The resistance of the connection must guarantee a resistant traction force of at least 2MPa in the pull-off test, to be carried out at 28 days.
III. The materials to be used must be proposed by the Contractor for Inspection accompanied by samples and the respective specifications of manufacture and behavior and the existing guarantee certificates.

8.1.8. General Conditions and Classification

I. Regarding the composition, manufacture and placement of concrete and other complementary operations, the rules established by Portuguese Standard NP ENV 206 (1993) approved by Decree-Law No. 330/95 of 14 December, according to the applicable LNEC specifications and the Regulation of Reinforced and Pre-stressed Concrete Structures approved by Decree-Law No. 349-C / 83 on 30 July.
II. The concrete to be used will be, as specified in the project, of the following types, class and qualities:

- Type I - Concrete of class C35 / 45, exposure class ECP1 with minimum dosage of 360 Kg / m3 of concrete and maximum A / C ratio of 0.45, to be used in general;
- Type II - Concrete of class C16 / 20 to be used to regularize the foundation base (cleaning concrete).

8.1.9. Concrete Composition

I. The composition of the concrete must be expressed through the following elements:

- Type, class and quality of the concrete;
- Nature and dosage of the binder;
- Identification, characteristics, granulometry and maximum dimension of the aggregates and quantities to be used by each aggregate category;
- Water / binder ratio, referred to dry aggregates;
- Nature and dosage of adjuvants, when used.

II. The study of the composition of the concrete must be submitted by the Contractor for approval by the Inspection, at least 30 days in advance in relation to the concreting date of the first element of the work to which this concrete is applied.

III. The Contractor undertakes to have the necessary tests carried out in the same laboratory responsible for the study of the characteristics and composition of the concrete. In particular, it must determine, in addition to its compressive strength, the instantaneous and long-term elastic modulus, shrinkage, creep for various stress levels, consistency, porosity and permeability.

IV. The Contractor will deliver to the Inspection samples of the same aggregates used in the studies of the concrete to be able to prove the maintenance of its characteristics.

V. The Contractor undertakes to instruct the laboratory that carries out the preliminary studies of the concrete to control its manufacture, mainly in view of accidental corrections to be made as a result of variations in humidity, granulometry and other causes.

VI. The cement used will also be tested systematically in the same laboratory, according to a plan to be established, rejecting all those that do not have the regulatory characteristics or that do not allow obtaining the required concrete for the work. The

origin of the cements cannot be changed during the execution of the contract, except with the approval of the Inspection. In exceptional cases, and of manifest impossibility, studies will be carried out in the official laboratory in charge of using the same element, having approximately the same alkalinity, thus ensuring that there is no fear of corrosion phenomena in the reinforcement.

VII. In the composition of the concrete, the Contractor may use, from his own account and subject to the provisions of Portuguese Standard NP ENV 206 - art. 5.8, adjuvants whose need is justified, mainly plasticizers and setting accelerators, in order to improve workability with the lowest possible water-cement ratio. The Contractor shall submit the adjuvant he intends to use to the Supervisory Board for approval, and the use of adjuvants based on chlorides or containing any corrosive elements is now prohibited.

VIII. All charges for the study and control of concrete characteristics, whether specifically mentioned or not, are the exclusive responsibility and responsibility of the Contractor and are considered included in the respective unit prices.

IX. In the concrete parts where the elements are in permanent contact, or may be in prolonged contact with water, waterproofing will be added that the Inspection approves, with the dosage that the manufacturer prescribes. The effectiveness of the proposed waterproofing can be confirmed through laboratory tests that the Inspection requires.

X. The study of the composition of the concrete is in all cases mandatory.

XI. Whenever the Inspection considers it, additional tests will be carried out in an official laboratory, on behalf of the Contractor.

8.1.10. Concrete Manufacturing

Manufacturing facilities

I. The manufacture of concrete must be carried out respecting the composition approved by the inspection and which is stated in the manufacturing bulletin

II. The concrete will be manufactured by mechanical means, using a central concrete installation mounted on the construction site or ready-mixed concrete, obeying the materials that make up its composition to the conditions indicated above, in accordance with the legal provisions in force, and with due regard to the requirements of Portuguese Standard NP.

III. Portuguese referred to in its National Annex. The Contractor must propose the concrete manufacturing facilities for approval, which must have sufficient capacity to comply with the established work program.

IV. All equipment must be maintained in an appropriate state and be free of hardened concrete deposits. Any deficient equipment or with adherent concrete will not be approved by the Inspection until it is properly repaired, replaced or cleaned. The Inspection may require the Contractor that no work period is started without prior notice, in order to be able to check the condition of the equipment.

V. Inert materials and cement will be metered by weight for all concrete.

VI. Concrete mixers must have water meters and scales properly checked so that the quantities of water and materials introduced in each mix are exactly those that the official laboratory has indicated in the approved study.

VII. When cement is used in bags, the quantities of aggregates for each kneading must be exactly sufficient for an exact number of bags filled with cement and no kneading that requires part of the bags will be allowed.

VIII. All bulk cement must be weighed in a device containing a tank and a graduated hopper. This tremendous must be properly sealed and ventilated to prevent the entry of dust during the operation. The discharge pipe must not be suspended from the tremendous and must be arranged so that cement is not retained or escapes from it.

IX. The concrete installation must include receptacles, tremendous and separate scales for fine aggregates and for each dimension of coarse aggregates.

X. The proportion of inert moisture, especially sand, must be checked several times a day using equipment that allows for an almost instantaneous determination of moisture. The amount of moisture determined in this way must be considered for correcting the volume of water in the mixer.

XI. The Contractor shall check and calibrate all weight / measurement devices at least twice a day, once before the start of morning operations and once before beginning afternoon operations.

The scales must be inspected and sealed at least once a month or more frequently if the Inspection considers it necessary to ensure their continuous accuracy.

Kneading execution

I. The mixing of the concrete must be carried out mechanically and the mixing volume will not exceed the nominal capacity of the concrete mixer specified by the manufacturer.

II. The materials for the manufacture of concrete will be introduced into the mixer in the following order: thick and medium aggregates, cement, sand and water, so that the final mixture is homogeneous and does not give rise to segregation when unloading. The manufacture of dry mixtures will not be allowed, with a view to the further addition of water.

III. The working time of the concrete mixers in each mix must be adapted according to the type of work to be carried out, and, in principle, should not be more than triple the amount necessary for the dry mix to appear uniform if another one does not show up. More convenient, depending on the special characteristics of the concrete mixer.

IV. The normal consistency of the molded concrete masses, to be checked by means of an Abrams cone or the mobile platform, must be checked at the exit of the plant and at the application site (as much as possible that of the wet earth). The amount of water required will be determined in the previous tests in order to achieve workability compatible with the desired resistance, with the dimensional characteristics of the elements to be molded and with the adopted vibration processes, safeguarding the limit of the water / cement ratio indicated in the project.

V. The amount of water must be frequently corrected, according to the humidity variations of the aggregates, so that the water / cement ratio is that recommended in concrete quality studies, and cannot exceed the maximum value indicated in the project. The humidity of the aggregates should be periodically determined, either with the entry of new batches of aggregates, or whenever the change in atmospheric conditions justifies it, so that the aforementioned corrections can be carried out in a timely manner and with the greatest rigor.

VI. The distance between the locations of the manufacturing and concrete installation sites will be as short as possible, and the means of transport and routes to be used, as well as the times foreseen for transportation, must be submitted to the Inspection. The transport of the concrete, to the different application areas, must be done by processes that do not lead to the segregation of the aggregates.

VII. If the ambient temperature is such that there is a risk that the temperature of the concrete at the time of placement is below 5º C or above 345ºC, the contractor must take appropriate measures, duly justified with the current standards.

8.1.11. Concrete and demolding

I. The concreting must obey the norms established in the Regulation of Reinforced and Pre-stressed Concrete Structures, in the Portuguese Norm NP ENV 206, artº 10 (1993) and in the LNEC Specifications and Portuguese Norms referred in its National Annex, and also taking into account what is indicated in this Specifications and in the Project.

II. Concrete will be used right after its manufactured, only with the delays inherent to the operation of the facilities. It will not be tolerated that the period between the manufacture of the concrete and the end of its vibration, exceeds half an hour in hot weather and an hour in cold weather, and these tolerances should be reduced if circumstances require.

III. Compaction will be done exclusively by mechanical means (surface vibration, mold vibration and pervibration). The characteristics of the vibrators, will be previously submitted for inspection by the Inspection, and the vibrators for pervibration must be of high frequency (9 000 to 20 000 cycles / min).

IV. The vibration will be done in a uniform way, until the mixing water reflects on the surface, and for the concrete to be homogeneous.

V. After concreting and vibration, the concrete will be protected against water losses through evaporation and against extreme temperatures, according to clause 10.6 of Portuguese Standard NP ENV 206 (1993). To avoid moisture losses, the exposed surfaces must be protected by the means that the Contractor intends to propose and the Inspection approves. These means include the use of waterproof screens and liquid compounds for the formation of membranes, also impermeable.

VI. The curing of the concrete must begin immediately after concreting and must be maintained for the necessary period with a minimum of 12 days. The curing period depends on the concrete composition, temperature and humidity conditions.

VII. If the temperature at the construction site is below zero degrees centigrade, or if it is expected to happen in the next five days, concreting will not be allowed. For

temperatures between zero and + 5ºC (five), concreting will only be carried out if the Inspection allows it, as long as they are scrupulously local to the work, is higher than + 35ºC (thirty-five), concreting will not be allowed except with the express authorization of the Inspection and with the strict compliance with the conditions of Art. 5.10 of the aforementioned Portuguese Standard.

VIII. In order to comply with the stipulations of the previous clause, the Contractor undertakes to have a thermometer duly calibrated at the shipyard and must record the temperatures on the days of the concreting operations as well as on the following five days.

IX. Each building element should be cast in a continuous manner, that is, without intervals longer than the hours of rest, entirely dependent on the follow-up of the different construction phases, always seeking to reduce the contraction efforts between aged concrete layers many different.

X. The concreting joints will only take place at the points where the Inspection allows it in accordance with the concreting plan to be prepared by the Contractor and to be approved by the Inspection. Before starting a concreting, the concrete surfaces will be properly treated in accordance with the instructions of the Inspection, admitting, in principle, the following treatment: small indentation boxes and inert protrusions will be left on the interruption surface; if the concrete is caught in the joints, the surfaces will be washed with air and water and the "cream" will be removed which is disaggregated in order to obtain a good adhesion surface, with the use of metal brushes being absolutely prohibited in the treatment concreting surfaces.

XI. All reinforcement in the section area where the concrete joint is located must have continuity through it.

XII. In joints where overlapping elements to be executed later should be superimposed, 2 to 5 hours must be spent, the areas to be occupied by these upper elements must be cleaned, treating these areas in a manner similar to that indicated above.

XIII. On the visible faces of the elevating elements (pillars, walls, etc.), joints will only be allowed in sections coinciding with the formwork joints. Runoff or cross-section differences will not be tolerated, so the formwork joints must be properly sealed and the formwork carefully pressed against the already concreted parts.

XIV. The concrete joints of the slabs will be washed with a jet of water, removing any stones that are known to be loose.

XV. For concreting joints, the use of "glue" or “screedfinishing" appropriate to the base of "epoxy" resins will be mandatory, however, the Inspection may dispense with this work if this is not absolutely necessary.

XVI. If the concreting interruption leads to a poorly oriented joint, the concrete will be demolished to the required extent, in order to achieve a properly oriented joint; but before concreting is resumed, and if the previous concrete has already started to set, the joint surface must be carefully treated and cleaned so that it does not become inert with the possibility of detachment. The surface treated in this way should be wetted so that the concrete is properly moistened, and the concreting will not start again while the water runs or accumulates.

XVII. All edges of the concrete surfaces will be chamfered at 45º, with 1.5 cm in width the triangular section resulting from the chamfer, whether it corresponds to a filling or to a cut of the chamfered part, except in the areas where the project itself already includes a square larger dimensions.

XVIII. After obtaining the agreement of the Inspection, the demoulding of the bottoms of the structural elements can only be carried out when the concrete has a resistance of at least 2/3 of the characteristic value and never before 3 days after the last placement of the concrete.

XIX. In the case of using prestressing, demoulding will never be done before 3 days after the last prestressing, injecting the colloidal screedfinishing and sealing the moorings.

XX. Demoulding and dismembering operations should be carried out in such a way that no inconvenient efforts, shocks or strong vibrations are caused.

XXI. Concreting will not be carried out during periods of heavy rain.

8.1.12. Control of the mechanical characteristics of concrete

I. During the concreting tests will be carried out to control the mechanical characteristics of the concrete, which will be carried out on a minimum of six cubes for each kneading or for each 20m3 of concrete if the kneading exceeds this value, or for each concreted element of a single time if that element does not use more than one kneading; in the

case of continuous concreting, cubes for control testing should be manufactured at least three times a week.

II. The cubes will be made of the concrete of the mixtures intended to be applied on site and designated by the Inspection.

III. The cubes can only be manufactured in the presence of the Inspection. The cubes will be executed, transported, cured and preserved in accordance with LNEC Specification E255 - 1971 and with the Inspection instructions, in metallic molds with well-performed faces.

IV. A compiler record of all cube tests for all concrete must be organized in order to verify compliance with the established characteristics at any time.

V. All cubes will be numbered in the normal sequence of whole numbers, starting at 1, regardless of the type of concrete tested.

VI. Not only will the order number be engraved on the cube, but also the class, the part of the work to which it relates and the date of manufacture.

VII. The compiler register must contain the following elements:

- Cube number;
- Date of manufacture;
- Test date;
- Age;
- Type, class and quality;
- Dosage;
- Amount of mixing water;
- Place of use of the concrete from which the mass for the cube manufacture was removed;
- Resistance obtained in the test;
- Average resistance of the three cubes that make up the test set;
- Resistance equivalent to 28 days of hardening, according to the resistance curve that is stipulated by the official laboratory that carried out the study, taking into account the approved composition for the concrete or, in the absence of this curve, according to the hardening coefficients indicated in art. REBAP;
- Cube weigth;
- Observations.

VIII. The conservation of the cubes during hardening will obey what is determined by the Inspection, according to the existing climatic conditions.

IX. Whenever cubes are manufactured, for each series of six 6 (six) - or 3 (three) in the case of the concrete class not less than C20 / 25-, a "test entry" will be filled in by the resident inspection, which will include the number of cubes, the date of manufacture, the cement brand, the dosage, the granulometry, the mixing water, the method of manufacture and other indications that are considered convenient. The Contractor will receive a duplicate of the "test entry".

X. The cubes will be transported to the test laboratory, properly packaged and so that they do not deteriorate.

XI. Based on the "test entry", and after the Inspection has set the date on which the cubes are to be tested, a Inspection letter will be delivered to the Contractor, which will accompany the cubes on delivery to the laboratory that will carry out the tests. respective tests. For this purpose, the Contractor undertakes to take the necessary precautions so that the date set for the test is observed and that the results of these are communicated immediately and directly to the Inspection.

XII. The acceptance control will be carried out for each type of structural element separately, according to the following criteria:

- Number of samples inferior than 6.

XIII. Each acceptance control will be represented by three samples.

XIV. Since R1, R2 and R3 are the resistance of the last three samples, the average of the resistance of the cubes of each sample, and Rmin being the smallest of all, the control is considered positive, leading to the acceptance of the concrete, when both conditions are verified :

Rm > (fck + 5) MPa

Rmin > (fck - 1) MPa

On what:

Rm = (R1 + R2 + R3) / 3

- Number of samples equal to or greater than 6.

XV. Since R1, R2, Rn, the resistance of the last n consecutive samples, averages of the resistance of the specimens of each sample, and Rmin being the smallest of all, the control is considered positive, leading to the acceptance of the concrete, when both are verified the conditions:

Rm > fck + **l**s

Rmin > fck - k

On what:

s - is the standard deviation of the resistances of the sample set.

l e k - are the values indicated in the following Table according to the number n of samples in the set.

n	**l**	**k**
6	1,87	3
7	1,77	3
8	1,72	3
9	1,67	3
10	1,62	4
11	1,58	4
12	1,55	4
13	1,52	4
14	1,50	4
15	1,48	4

XVI. In consistency tests, carried out with the ABRAMS cone, it is allowed, for pumped concrete, consistencies up to 15 cm and for the remaining consistencies up to 5 cm.

XVII. Tests on cubes will be systematically conducted to determine the compressive strength at 1, 3, 7, 28, 90 and 120 days in order to be able to plan and properly control the various work sequences (application of prestress, advance of the crimps and the molds, load inputs, etc.).

XVIII. The specimens that the Inspection determines will be made to determine the elasticity modules of concrete with different ages, and to quantify the real shrinkage and creep parameters, values that are essential for the correct execution.

Control of the durability characteristics of concrete

I. The control of the durability and adhesion characteristics of the concrete may involve the following tests on the concrete actually applied:

- Permeability tests, on test pieces in the laboratory;
- Porosity tests;
- Retraction tests.

If they are to be carried out, these tests will be defined by the Inspection, both with regard to the test methodologies and in relation to the acceptance rules.

Concrete Rejection

I. In the event that the Inspection determines the immediate rejection of concrete that does not meet the stipulations, either with regard to strength or with regard to durability characteristics, the agreement referred to in clause 11 of Portuguese Standard NP ENV 206 (1993) may, in its judgment, be established under the following conditions:

- On behalf of the Contractor, non-destructive tests or normal tests on test pieces collected in areas that do not appreciably affect the resistance capacity of the parts will be carried out; if the results obtained are unquestionably satisfactory, in the judgment of the Inspection, the part of the work to which they relate will be accepted.

- If the results of these tests show, like the control tests, concrete characteristics below those required, two cases will be considered:
  - If the characteristics reached (in particular those of resistance to efforts) are above 85% of those required, load and behavior tests will be carried out, on behalf of the Contractor who, if they give satisfactory results in the opinion of the Inspection, will

    determine the acceptance of the part of the work in doubt, without any other penalty or the Contractor will suffer a penalty corresponding to a 10% reduction in the value of the unit price to be applied to the quantity of work in question.
  - If the characteristics determined are less than 85% of those required, the Contractor will be required to demolish and rebuild the defective parts, at his own expense.

Load tests

When there is a situation corresponding to that defined in b1) of point 7.1, or the execution has not been carried out within the established or normally accepted tolerances, the Inspection may require the Contractor to carry out load tests.

I. The charges for carrying out load tests are the Contractor's account, and are not entitled to receive any compensation.

II. The recommended conditions for load tests, the duration of the tests, the successive loading and unloading cycles and the measurements to be carried out will be the subject of a detailed program which will be established according to the Inspection and approved by the Designer.

III. The overloads to be applied should not exceed the characteristic overloads adopted in the Project.

IV. In tests with mobile loads, the speed of the load should be as much as possible, the speed predicted for the exploration.

V. The test will be considered satisfactory, in the tested element, when the following two conditions are met:

- The measured arrows do not exceed the values calculated based on the results obtained for the concrete's elasticity modules;

- The residual arrows are small enough, taking into account the duration of application of the load, so that the behavior can be considered elastic. This condition must be fulfilled, either after the first load, or the following ones, if any.

8.1.13. Regulatory provisions

Portuguese Standards

I. NP 87 Consistency of Concrete. Lowering test

II. NP 414 Consistency of Concrete. Scattering test

III. NP 1384 Concrete. Determination of density of fresh concrete

IV. NP 1385 Concrete. Determination of the compression of fresh concrete

V. NP 1386 Concrete. Determination of the air content of fresh concrete. Pneumatic process

VI. NP 1387 Concrete. Determination of setting times

Specifications LNEC

I. E 226 Concrete. Compression test

II. E 227 Concrete. Bending test

III. E 228 Concrete. Determination of workability

8.2. Steel for reinforced concrete reinforcement

8.2.1. Technical features

I. Reinforced concrete reinforcement steel will be in round bar with the diameters indicated in the project and in class A500NR, also using the round bar of class A400 (in hooks for welding and in anchor bolts) and the use of electrowelded meshes from class A500ER,

having as minimum characteristics to satisfy the requirements of REBAP or Official Homologation Documents.

II. Steel must have a homogeneous fine-grained texture, not brittle and free of zinc plating, painting, tar, clay, oil, grease, loose rust and excessive scales, cement grout or other materials that impair its adhesion to the concrete, strictly obeying the requirements of the Regulation of Reinforced and Pre-stressed Concrete Structures. When this happens, the reinforcement must be energetically passed through the wire brush and checked by the inspection.

III. The tolerance of the diameters of the rods must satisfy that specified in standard NP-332, including the ribbed steel rods where the tolerance will be measured between the nominal diameter and the effective diameter.

IV. The reinforcements must have indelible marks that allow their easy identification on site.

8.2.2. Reception tests

I. The tests to be carried out will be of traction on proportional long and folding specimens, carried out in accordance with the Portuguese Standards in force, respectively NP-105 and NP-173.

II. The reception tests will be carried out, taking six samples of each diameter and type, for each steel match entered in the shipyard, or at least once a month, three samples for tensile tests and the others for bending tests.

III. All charges for the control of the steel characteristics, especially mentioned or not mentioned in this Specifications, are the exclusive account of the Contractor and are considered included in the respective unit prices.

IV. The collection of the samples to be tested will be done according to the following table, considering two main cases:

- The reinforcements have already been tested at the factory and are accompanied by the corresponding test certificates, so it will be possible to accurately identify the batch to which they correspond;
- It is not possible to present the results of tests carried out at the factory.

CASE	N.º UNITS OF EACH PART OF DELIVERY	N.º OF SAMPLES IN RELATION TO WEIGHT	
		£ 10 t	>**10t**
	INDEPENDENT OF N.º	2*	**3***
2	£ 10	2	-
	11 - 100	2	8

* refers to the Nº of samples per batch.

"Delivery part" means here steel rods of a single class, with the same diameter, supplied by the same supplier and at the same time, however, it may be admitted that the transport is subdivided by several transport units and even carried out with some time interval, provided that its identical origin is proven.

8.2.3. Armor transport and storage

I. The transport and storage of the reinforcements must be carried out in accordance with article 154.1 of the R.E.B.A.P.

II. In the case of prefabricated reinforcement, care must be taken, in particular, to maintain its shape and the relative positions of the bars that make it up.

III. The joint use of steels of different types requires that precautions be taken in the work to avoid errors resulting from incorrect identification of the steels.

8.2.4. Execution of Armors

Cutting and Folding Rods

I. The cutting of bars must be done exclusively by mechanical means.

II. The bending of the bars must be done cold by mechanical means at constant speed, with the aid of mandrels, in order to ensure a constant radius of curvature in the folded area.

III. For diameters greater than 25 mm, the folding can be done hot, but in this case the cooling must be slow due to the action of air and sheltered from rain or bad weather.

IV. The bending of ribbed steel bars will be carried out in accordance with the provisions of art. 79 of REBAP.

V. Torch heating is not permitted to facilitate the folding operation. In case the ambient temperature is low (below 5º C), special precautions must be taken when bending bars, such as reducing the bending speed, increasing the radii of curvature.

VI. It is only allowed to unfold the bars, in special cases where this is indispensable (waiting bars for example) and provided that, obviously, the operation does not damage the bars.

Amendment of Bars

I. The amendments of bars will be allowed where indicated in the drawings, or in accordance with articles 84 and 85 of REBAP upon approval of the Inspection, amendments of bars of less than 3m in length are not allowed.

II. In case it is intended to make amendments to bars by welding, the aptitude of the steels to be welded and the welding technique to be employed must be proved, by presenting a favorable opinion from an official laboratory. In any case, the welding must guarantee a resistant capacity superior to 90% of the capacity of the bars that it joins, the welding in folding zones is not allowed, nor as a connection between crossed reinforcements.

III. Torch welding will not be used.

IV. The welders to be used must be properly qualified. The Work Owner or his representative reserves the right to demand proof of qualification from the welders. It is also reserved the right to the Work Owner or his representative to refuse the welder who showed insufficient quality in the first welds he made on the job.

V. The sequence of the welds to be carried out and the electrodes to be used must be subject to prior written approval by the Project Owner or his representative. The specifications of the welding processes must also be previously presented to the Project Owner or his representative.

VI. The surfaces to be welded must be dry and well cleaned, immediately before welding, eliminating slag, rust, oil, etc. The electrodes must also be dry.

VII. The supplier must proceed with the cutting of the slags when the weld beads are obtained by more than one passage.

VIII. The welds will be controlled by visual inspection with evaluation of the weld beads' gauges and their perfection in terms of geometry and finish. Welds can be controlled by penetrating liquids in order to detect cracks.

IX. If the Inspection so decides, tensile tests can be carried out on test pieces subject to the same welding process as the one performed "in situ".

Armor Assembly

I. The reinforcements will be assembled according to the project and according to the provisions of the applicable regulations, namely as regards curvatures, hooks, mooring lengths and overlapping splices as well as with regard to the distances between bars and reinforcement coverings.

II. The bars will be conveniently connected by annealed wire bandages with a diameter of 1.5 to 2 mm or by spot welding. The ends of the wire bandages should be folded in such a way that, when placed on site, they do not cross the reinforcement covering layer.

III. In the case of using welds using connection points of steels of a different quality than A235 steel, mandatory tests will be carried out in order to verify that the welding does not affect the mechanical properties of the reinforcement.

Prefabricated Ordinary Armors

I. The Contractor may supply the work with ordinary prefabricated reinforcements in rigid assemblies. In such a case, the Inspection should be provided with the facilities necessary

to verify the characteristics of the bars used and the techniques for carrying out the assemblies.

Armor Placement

I. The reinforcements will be placed strictly as the drawings indicate and should be tied effectively so that they do not move during the various stages of construction execution.

II. The positioning of ordinary reinforcement must be such that the useful height of the "d" elements meets the following tolerances:

- For d < or = 20cm d = + 0.075 d
- For 20 < d > 40 d = + (0.05 d + 0.5 cm)
- For d > ou = 40cm d = + 2.5cm
- Regarding the gap between bars in the direction of the element width, the tolerance is + 6mm.

III. The positioners to be used must be conveniently surrounded by the concrete, they must not harm the concreting nor should they contribute to the weakening of the part, either directly or facilitating the action of the environment.

IV. In addition, they must be made of inert material in relation to the concrete and steel of the reinforcement, and small prefabricated blocks with the smallest possible size, made of screedfinishing, micro-concrete or plastic can be used to keep the reinforcement away from the molds and to guarantee the reinforcement coverings prescribed in the project, the use of crushed stones is not allowed for this purpose. If concrete or screedfinishing wedges are used, it must be ensured that they have permeability characteristics identical to the concrete used in the same element and be suitable for the type of finish required for the surfaces of the parts.

V. The covering will be as indicated in the drawings and in accordance with E-378. The covering tolerance is ± 0.5cm.

VI. It will not be allowed to place reinforcement on fresh concrete layers or the use of metallic supports that reach the concrete surface.

VII. The placement of electrowelded meshes will have to be carried out with the utmost attention and the respective fixation must be achieved through devices previously approved by the Inspection.

VIII. The submerged concrete reinforcement will be fixed with special care that the situation requires before the concreting begins.

Armature Check

I. The concrete cannot be spread over the reinforcement before the Inspection approves its placement and assembly.

II. During the execution of concreting, deformation and displacement of the reinforcement should be avoided as much as possible.

8.3. Metal structure

I. According to the dimensioning performed, it was decided to support the roof with double laminated steel profiles (IPE) in a 100mm separation coffin, joined by rails spaced at 500mm, and IBR plates 0.8 mm thick with two 12º waters. of inclination. The Nave's coverage was calculated to withstand an overload of 0.3 kN / m2.

II. The profiles will be based on reinforced concrete pillars with 1.21 m2 anchors in plan and 1.2 m high, since the contact area of the pillars is not sufficient to support the metal structure.

8.3.1. General considerations

I. The profiles to be used will be steel grades Fe360 (S235), Fe430 (S275) or Fe510 (S355), specified in R.E.A.E. and / or Eurocode 3 and these must be provided with a quality certificate.

II. The profiles and plates to be used in the structures will be made of construction steel, starting from new material and worked according to the best technique.

III. The metallic structures to be supplied and to be assembled, will comprise the metallic elements (profiles, plates, etc.) and the connecting organs (screws, nuts, washers, plates, welding electrodes, etc.).

IV. Manufacturing tolerances must be in accordance with ECCS European recommendations.

V. The contractor will be responsible for any damage caused to materials during transport, from the workshop to the assembly site.

VI. In omitted cases, the supplier must comply with standards and / or codes that refer to this type of construction, including REAE (regulation of steel structures for buildings), Eurocode 3 (Pre-European standard ENV 1993-1- 1), SIA 161 (Construction Metállique) among others, in which case it must inform the developer or his representative of the technical standards or codes adopted.

VII. As long as the quality of the steel meets the same conditions and the Inspection approves it, the profiles can be replaced by equivalent profiles, but only in the elements that do not jeopardize the architecture project.

VIII. The steels to be used in the metallic structure must have a compact and homogeneous texture and have no inclusions, cracks or other defects harmful to their use. If the raw material purchased by the supplier eventually shows any defect, its application will only be allowed if the correction is carried out by processes that guarantee the initial characteristics of the material and perfect functioning of the parts for which they are intended.

IX. The supplier shall be obliged to inform the Inspection the type of defect found, as well as the specification for its recovery. Only after written agreement of the Inspection that the supplier can initiate the repair process or, if necessary, the replacement of the defective part.

X. The mechanical characteristics of the steels must respect the project specifications according to R.E.A.E. The steel in screws and welds must correspond to that specified in the project and meet the conditions prescribed in R.E.A.E. The resistance classes specified for the screws must comply with DIN 267.

XI. Stamped washers must meet DIN 125 - Form A and wedge washers meet DIN 434 and 435 (1967).

XII. Screw steel must comply with the conditions of article 10 of R.E.A.E. or Eurocode 3.

XIII. The welding filler metal will comply with the conditions expressed in article 11º of R.E.A.E.

8.3.1.1. Execution Conditions

Preparation of plates and profiles

I. All sheets and profiles to be used in the construction must be perfectly performed and aligned, which means that they should not have arrows, due to curvatures, greater than 1/1500.

II. The Inspection may reject all sheets and profiles that do not meet these conditions.

III. The performance and alignment operations must be carried out with the press, the hammer or with the aid of a roller machine.

Cutting, drilling and grinding of sheets and profiles

I. The cutting of the sheets and profiles can be done by scissors, saw or oxyfuel. In the first two cases, the parts may be rough, as long as the cut does not show tears, material shortages or burrs. In the latter case, this process will only be accepted as long as an automatic oxyfuel machine is used, which guarantees that the cut is regular, however it is necessary to repair all irregularities that occur.

II. The drilling of the sheets or profiles must under no circumstances be carried out using a torch. In current cases, this drilling can be done by drilling or punching directly, in the definitive diameter, as long as the boring of the hole is not required. If, however, for special connection reasons, boring holes are required, they must be opened with a

diameter less than 3 mm from the definitive one, by any of the previously indicated processes or by using drilling devices or drills, making them then the hole widening to the final dimension with the aid of a mandrel.

III. The cuts made by oxyfuel, and particularly those to which weld beads are to be applied, should be properly cleaned and stroked.

Assembly

I. The contractor must present an assembly plan as well as the means to be used. These must be approved by the inspection.

II. The parts to be connected in the assembly must be marked, carefully positioned, for which it will be necessary to consider the placement of positioning devices that keep the parts in the correct positions, without introducing secondary efforts.

III. All elements of the structure must be stripped and painted before assembly; The areas of the welds will be touched up with appropriate anti-corrosion paint, the same being done for all areas damaged during assembly.

IV. Mounting tolerances, such as manufacturing, should be in accordance with ECCS European recommendations.

8.3.1.2. Connections

I. All connections must be made without making any major effort on the parts.

II. The execution of the various connections must obey the rules intentionally accepted for this type of connections, namely the ECCS recommendations for metallic construction and compatible with the regulatory provisions of R.E.A.E.

III. Any change to the type of connection envisaged must comply with the design criteria used in the project and must, in any case, be submitted for inspection approval.

IV. All paints that have been damaged during the connections must be touched up against corrosion.

V. In works considered to be of greater importance or whenever the contractor considers it convenient, the contractor may be required to carry out tests, carried out in official laboratories, of the type of connection made.

VI. All connections will be approved by the inspection.

Bolted connections, connectors and anchors

I. The screw connections must have characteristics that comply with the conditions prescribed in articles 22 and 23 of the R.E.A.E. The screw arrangements must comply with that indicated in article 25 of R.E.A.E., 1986.
II. After tightening, the threaded part of the screws should protrude from the nuts of a length corresponding to at least one loop, with a maximum of 60% of the screw diameter.
III. The anchor bolts must have the minimum characteristics indicated in the drawings.
IV. In the case of the use of pre-stressed bolted connections, the screws used must not have a strength class lower than 8.8. In these connections there can be no sliding between screws.

Welded connections

General

I. The welders to be used must be properly qualified. The contractor or his representative is entitled to demand proof of qualification from the welders and to refuse the welder who revealed insufficient quality in the first welds he made on the job.
II. Necessary precautions must be taken to avoid excessive deformation of the parts to be welded or harmful effects to thermal vibrations. For this purpose, a careful criterion should be established for the sequence of welds to be carried out on each part, informing the inspection.
III. Welding work must be carried out in the absence of rain, wind or snow, and must be interrupted if the temperature drops below + 5 ° C, unless special provisions are taken to ensure the good quality of the cords made in these conditions.
IV. The sequence of the welds to be carried out and the electrodes to be used must be subject to prior written approval by the Project Owner or his representative. The specifications of the welding processes must also be previously presented to the Project Owner or his representative, where welding parameters, chamfer preparations, etc. are defined, among others.
V. The surfaces to be welded must be dry and well cleaned, immediately before welding, eliminating slag, rust, oil, etc. The electrodes must also be dry.

VI. The supplier must proceed with the cutting of the slags when the weld beads are obtained by more than one passage.

VII. In butt weld beads and whenever this is constructively possible, the root will be ground and the respective bead made.

VIII. The thickness of all the corner strands will be the maximum as defined in the Regulation of Steel Structures for Buildings.

IX. When the thickness of the cords is indicated in the drawings, the indications contained therein must be observed.

X. The welds must be free of harmful defects and with adequate dimensions and contours.

Weld verification

I. The welds will be controlled by visual inspection with evaluation of the weld bead gauges and their perfection in terms of geometry and finish.

II. Welds can be controlled by penetrating liquids in order to detect cracks.

III. If the Inspection so wishes, the welds may be radiographed.

8.3.2. Protection of Metal Structures

I. The profiles must be protected against corrosion by stripping and painting with primer and three layers of anticorrosive paint.

II. The building's interior profiles will also be protected with a thick coating that ensures a fire resistance greater than or equal to EF30. Protection against corrosion and protection against fire can be made from the same material. The protection system must be proposed by the Contractor, and the proposal must be accompanied by manufacturing certificates that must include results of qualification tests in an official laboratory.

III. The pickling will be carried out with SA 2½ grade steel shot in the workshop.

IV. The paints to be applied in the different layers must have different colors or shades.

V. The primer to be adapted should be a 40 micron epoxy zinc primer, with the exception of the areas in the vicinity of the edges to be welded.

VI. In the welded areas and in its vicinity, a special thick primer based on modified epoxy resin and aluminum will be applied on site immediately after welding and brushing with a hard wire brush.

VII. The paint layer to be applied over the epoxy primer (undercoat) should be 75 microns, based on acrylic resins and chlorinated rubber.

VIII. The next layers of paint to be applied on the undercoat will be 35 microns thick, with placement to be defined by the Inspection, it will also be based on acrylic resins and chlorinated rubber.

IX. The paints must comply with the general requirements established in the applicable Portuguese standards. The Inspection may require the necessary tests before approval.

X. The application of the paint will be done by specialized broaching painters, carefully following what is advised by the manufacturer's technicians.

XI. Painting at the work site will be carried out only after the elements are perfectly seated and carefully cleaned, and cannot be carried out in rainy weather or on wet surfaces.

XII. The layers of paint should perfectly cover the surfaces and present a uniform thickness, not allowing the application of a layer over another one that has already been made, only after verifying that it is completely dry.

8.3.3. Metal Sheets

General considerations

I. The materials to be used in the plates must be in accordance with that specified in R.E.A.E. and / or Eurocode 3 and these must be provided with a quality certificate.

II. The plates must resist the actions and requests that will be submitted according to the conditions defined in the R.S.A. (Safety regulations and actions for building structures and bridges).

III. The plates to be used in the structures will be made of construction steel, starting from new material and worked according to the best technique.

IV. Manufacturing tolerances must be in accordance with ECCS European recommendations.

V. Storage will be done so that the plates are covered, thus being protected from water in order to avoid condensation.

VI. The transport and placement of materials will be done so that there is no damage to the parts. The contractor will be responsible for any damage caused to materials during transport, from the workshop to the assembly site.

VII. In omitted cases, the supplier must be governed by standards and / or codes that refer to this type of construction, including REAE (regulation of steel structures for buildings), Eurocode 3 (Pre-European standard ENV 1993-1- 1), SIA 161 (Construction Metállique) among others, in which case it must inform the developer or his representative of the technical standards or codes adopted.

VIII. All personnel to be used must be properly qualified. The contractor or his representative is entitled to demand proof of qualification.

8.3.3.1. Execution Conditions

Preparation

I. All plates to be used must not have a maximum arrow of l / 1000 before assembly (l is the longest length of the plate to be used).

II. Before mounting the plates, according to the assembly plan.

III. All plates will be inspected by the inspection, which may reject all plates that do not meet the required conditions.

Execution

I. The assembly must be in accordance with the assembly plan previously defined by the contractor and duly advised by the manufacturer and must subsequently be approved by the inspection.

II. The assembly will be done according to the drawings and will have the tolerances in accordance with the European recommendations of the ECCS.

III. In the assembly, anchors and other mechanisms should be installed to limit deformations.

IV. The contractor must ensure that the materials are arranged, so that under no circumstances are areas of the plate overloaded with loads greater than those dimensioned.

V. If the project provides for collaborative slabs (mixed slabs), the assembly of these will be proposed by the contractor and approved by the inspection, so that there are no efforts in the structure that were not foreseen in the execution project.