CONSULMAR

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CONSULMAR

HYDRAULIC DETAILED DESIGN PROJECT DESCRIPTION

1. INTRODUCTION

1.1. General Information

The present specification describes the hydraulic networks of the Central Warehouse of Medicines of Beira.

This Specification includes the following hydraulic networks:

- Drinking water supply network;
- Water supply network by hole;
- Rainwater reuse network;
- Firefighting network;
- Domestic wastewater drainage network;
- Rainwater drainage network.

The hydraulic systems proposed in this project comply with the regulation of the water supply and drainage systems for wastewater and rainwater (RSPHARAR) in force in the country, as well as technical norms followed in similar projects.

1.2. Project overview

The Central Warehouse of Medicines of Beira will have a capacity of 5,259 pallets after its expansion, surrounded by a heavy vehicle circulation area and support services.

The support areas will be composed of:

- Guardhouse;
- Transformation Station;
- Generator Group;
- Support area for external collaborators (showers for drivers);

- Pressure tower with buried water tank and other high; and,
- Toxic and Flammable Products Warehouse.

According to the architecture project, the estimated maximum number of employees for the warehouse is 40 people, an amount considered in the design of hydraulic systems.

The buildings for the support of external collaborators, of Toxic and Flammable Products and Guardhouse, have bathrooms, kitchens / pantries, etc., which will need to be supplied with drinking water, for the sink sinks, washbasins and showers, and with rainwater for urinals and cisterns.

It is important to mention that only urinals, cisterns and irrigation or washing mouths will be supplied, either by drinking water or by alternating rainwater.

2. DRINKING WATER SUPPLY NETWORK AND STORMWATER REUSE

2.1. Networks general description

The networks of drinking water and rainwater reuse are completely independent.

Because the water supply in many parts of the country is intermittent and with big pressure oscillation, it opted for an indirect drinking water supply system with water storage obtained from the public network or from the water well, in lower reservoir of the pressure tower with a capacity of 78 m³ of water.

From the lower reservoir the water will be pumped through a compact system consisting of two alternating- flow vertical multicellular centrifugal pumps, GRUNDFOS Hydro Multi-E 2 CRE 3-5 (for a flow rate, Q = 4 m 3/ h and total height of Elevation, H = 20 m) for a high reservoir in reinforced concrete, with a capacity of 10 m³ and a height, up to the base of the same, of 13 m.

The connecting pipe of the water lift pumps to the upper reservoir, the connection with the lower reservoir and the connection between pumps, until leaving the pump tower housing will be in Galvanized Iron with a diameter of 2 ".

The water distribution to the water supply system of the Pharmaceutical Intermediate Warehouse will be from the upper reservoir, descending by a galvanized Iron pipe with 4 " in diameter connected to PP-R PN12 pipe at ground level, whose diameters are indicated in drawings Specialty.

At the entrance of each compartment and housing to be supplied with water from the pressure tower, a isolating valve (cut) is provided to allow its isolation in the event of maintenance.

It is planned to supply hot water through electric heaters to the kitchens/ scullery with a capacity of 80 liters.

If the water hole is considered as the source of water for the potable water supply system, the quality of the water should be assessed in order to decide the type of treatment to be submitted, in order to make it drinkable.

According to Decree-Law x of 2005 of Mozambique, "Rainwater that falls on the roofs of public buildings" should be used.

Therefore, Rainwater collected in the coverage of the Drug Store, shall be stored in one of the lower reservoirs of the pressure tower, which shall have a capacity of 55 m^3 of rainwater, for later use in the water supply to the toilet basins, urinals and watering nozzles and washings indicated in designed.

This system of reuse of rainwater will have a compact pressurizing system consisting of two alternating-flow vertical multicellular centrifugal pumps, GRUNDFOS Hydro Multi-E 2 CRE 10-3 (for a flow rate, $Q = 20$ m^3/h and total height of elevation, $H = 25$ m) that will directly feed the consumption points covered by the rainwater reuse network.

2.2. Materials

The connection to the water supply hole will be in 50 mm diameter HDPE PN10 piping with a mechanical float of the same diameter as that of the pipe, the inlet of the lower reservoir of the pressure tower (see drawing). It is planned to place a water meter on the connection line to the public network, including sectioning valves upstream and downstream, installed inside a cabinet near the fence.

In the general and internal networks of water distribution to the buildings of the Main Warehouse and to the irrigating taps will be used the pipe in Rim Polypropylene of class 12 (PP-R PN12), with accessories of connection of the same material or another compatible, properly approved . For these materials, in the areas where the piping is in view, the spacing between the clamps should comply with the recommendations of the manufacturer and shall not exceed 80 cm for pipes with diameters up to 40 mm and 150 cm for pipes with diameters greater than 40 mm.

All fittings, valves and taps shall be compatible with the piping material and service pressure of the water distribution network and shall not compromise the potability of the water supply network. These must be of high quality, whose application will be preceded by the approval of the inspection and / or the owner of the work.

2.3. Calculation

For the sizing of the general distribution network, as well as of the buildings (internal and external), the regulatory instantaneous flows for each type of appliance were taken into account. In the possession of these instantaneous flows, it is accumulated and according to the desired level of comfort (for this project, it was considered an average comfort), associated with the coefficients of simultaneity, the calculation flow for each section is found. Then, for each section and depending on the roughness of the material considered, the sizing of the pipe diameters is done.

This design is intended to guarantee an efficient hydraulic performance of the system, respecting the minimum (0,5 m / s) and maximum (2 m / s) speeds established in the regulations in force in the country and, at the hydraulically Flow rate and minimum pressure (of about 5 mca) required. In the present project, Cype Software was used in the Building Installations module for design purposes.

2.4. Tests

The verification of system compliance deployed with the project and with the technical specifications should be done with the pipes and accessories in sight. Before you plug any pipe section, it must be inspected and approved.

The tightness test shall be conducted with the pipes, joints and accessories in sight, conveniently locked and the plugged ends and devoid of use of devices.

The process of execution of the test should follow the described below:

a) Connection of the pump test with pressure gauge located as close as possible to the point of smallest elevation of the section to be tested;

b) Filling the pipes by pump, in order to release any air contained in them and ensure a pressure equal to one and half times the maximum service with a minimum of 900 kPa (9 bar);

c) The pressure gauge reading, which should not accuse reduction for at least fifteen minutes;

d) Emptying of the test section.

Once constructed, the system is tested as a whole, must be for it to proceed to the filling taking special care in which it is done slowly and gradually in order to avoid ruptures in the pipeline and in order to check the hydraulic behavior of the system.

Before putting the system into service, it must be disinfected.

After completion of the network and already put to use devices, cleaning and disinfection of the entire system with a chlorine-based solution will be made.

3. FIRE FIGHTING NETWORK

3.1. Network Overview

It is an independent fire-fighting network of the armed / wet type, constituted by armed fire hydrants arranged in the perimeter of the Main Warehouse each covering a radius of action of 30 m.

In the case of firefighting, water will be pumped from the lower water tank of the pressure tower of 78 m³ of useful capacity to the hydrants by means of galvanized steel pipes of different diameters.

3.2. Network Layout and Installation

The installation of the fire network must be made according to the design parts of the project and other aspects related to the equipment manufacturers, general technical specifications of Civil Engineering and according to the suggestions of the inspection.

The piping will be installed buried and in the ceiling, fixed by clamps with adequate spacing.

The fire hydrants were positioned in places easily accessible and visible in particular in the corridors near the access stairs, each covering a radius of action of 30 m (length of the hoses).

3.3. Materials Nature

The pipes and all accessories that make up the fire network must be in galvanized iron (FG).

The choice of these materials is due to the fact that they are materials with availability in the national market and the use of ungrounded plastic piping for firefighting is not appropriate.

3.4. Network accessory elements

3.4.1. Valves

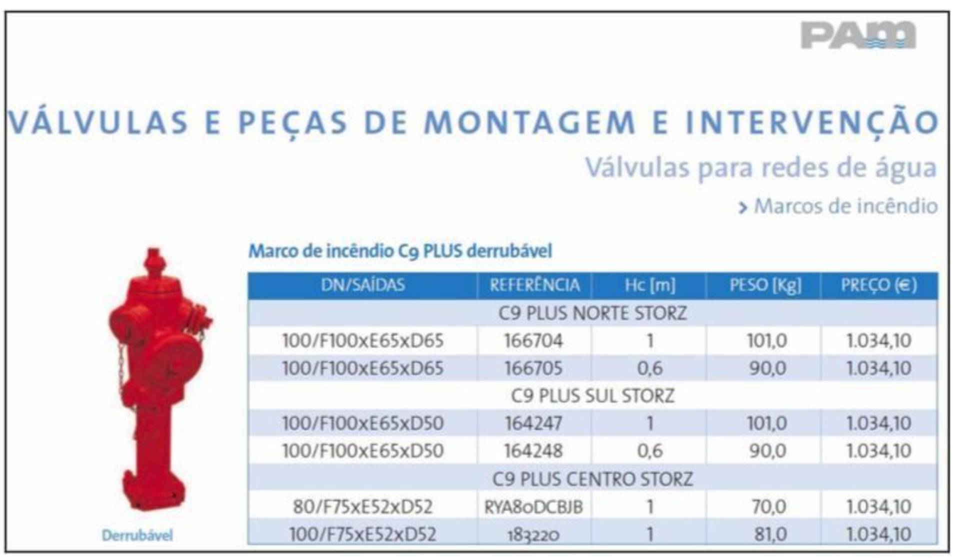
Gate valves will be installed on the suction pipe of the pump, immediately upstream and downstream of the fire pump and upstream of the fire hydrant and other strategic points in the fire network.

The valves will be made of galvanized iron or other material that meets the necessary conditions of use as long as previously approved by the inspection.

Easy access for maintenance and handling of the valves shall be ensured. In the yard they should be installed in valve boxes, equipped with all the accessories to handle them from the top according to the design drawings.

3.4.2. Hydrants

In the outer courtyard of the Main Warehouse, removable column hydrants should be installed in ductile cast iron with nominal 100 mm diameter and three exits (100x65x50mm) with red color.


PAM

VÁLVULAS E PEÇAS DE MONTAGEM E INTERVENÇÃO

Válvulas para redes de água

› Marcos de incêndio

Marco de incêndio C9 PLUS derrubável

DN/SAÍDAS	REFERÊNCIA	Hc [m]	PESO [Kg]	PREÇO (€)
C9 PLUS NORTE STORZ				
100/F100xE65xD65	166704	1	101,0	1.034,10
100/F100xE65xD65	166705	0,6	90,0	1.034,10
C9 PLUS SUL STORZ				
100/F100xE65xD50	164247	1	101,0	1.034,10
100/F100xE65xD50	164248	0,6	90,0	1.034,10
C9 PLUS CENTRO STORZ				
80/F75xE52xD52	RYA80DCBJB	1	70,0	1.034,10
100/F75xE52xD52	183220	1	81,0	1.034,10

Derrubável

Figure 1 - Image column hydrants to put in courtyard

In the perimeter yard of the Main Warehouse will be installed fire hydrants equipped with all necessary accessories for firefighting.

3.5. Basis elements for calculating the network

3.5.1. Classification of the Building in Relation with the Risk Group

According to the National Fire Protection Association, NFPA 13 (see table 1) the building in question is classified as Ordinary Group 3.

Risk class	Building Type
Light	Apartments, churches, clubs, schools, hospitals, offices, museums, etc.
Ordinary - Group 1	Garages, bakeries, boiler houses, factories electrical components, car parks, laundries, theaters, service areas in restaurants, etc.
Ordinary - Group 2	Factories for: low-risk chemicals, machinery, textiles, cigarettes, paints.
Ordinary - Group 3	Paper factories, refineries, tire factories, warehouses flammable products, etc.
Severe - Group 1	Fuel areas, paint and thinner factory, vulcanizations, etc.
Severe - Group 2	Gas, sprays, polyurethanes packaging factory etc.

Table 1 – Classification of buildings in relation to the risk group according to NFPA 13

3.5.2. Number of fire hydrants in simultaneous operation

It has been assumed that two fire hydrants of the column hydrant will work simultaneously.

3.5.3. Water demand for firefighting

The amount of water required for firefighting was determined by the number of fire hydrants in simultaneous operation for 120 min (2 hours) corresponding to a volume of water of about 43.2 m³.

3.6. Hydraulic design

3.6.1. Distribution network

The hydraulic dimensioning of the fire network composed of armed fire hydrants was carried out according to the following elements:

a) Flow rates;
b) Speeds between 0.5 m/s and 2.0 m/s;
c) Roughness of material;
d) Minimum pressure in the fire hydrants: 250 kPa;
e) Minimum diameters of extensions: 50 mm (2”);
f) Hydraulically most unfavorable positioning hydrants.

3.6.2. Pumping Station (Reservoir and Pumps)

A volume of the fire reservoir of 78 m³ was established. This value is higher than that needed to combat 2 fire hydrants for 2 hours taking into account that the same tank is used for water supply.

The pumping station is the heart of the system and will consist of 2 pumps, one electric pump and the other a Jockey pump.

The pumps must have direct drive and automatic start. There should be the possibility of manual starting. When switched on, pumps must run continuously up to a manual stop command.

A general signaling panel with control buttons, pilot light test, indicating the operating status and alarm, and voltage and current displays must be provided.

Automatic priming equipment will be provided to ensure that the pumps are running water at all times, eliminating the air inside the pump and the suction piping.

Any pressure drop in the system causing the pump to start automatically shall produce a visual and audible alarm signal at the appropriate location of the facility.

A valve system shall be provided which allows the automatic start-up of pumps to be tested periodically for maintenance purposes.

The pressure gauges to be installed in the piping system shall indicate the relevant pressures in the system.

The water pumps will be installed inside a pump house built for this purpose, this shelter being resistant to fire. The pump housing shall be accessible from the outside and shall be as small as possible in order to discourage its use for other purposes.

The electric pump has been calculated in order to ensure the minimum flow necessary for the operation of the fire pumps simultaneously and with adequate and established minimum pressures. The characteristics of the electric pumps can be seen in the hydraulic project catalogs.

3.7. Simulation of the network with CYPECAD, version 2016

After manual calculation, the network was simulated with cypecad, version 2016.

3.8. Verification, testing and disinfection

Verification of the conformity of the system with the approved design and with the legal provisions in force shall be made with the pipes and their accessories in view as described in section 2.4.

4. SEWAGE NETWORK

4.1. General Design

The fundamental objective of designing and designing this network is to collect the sewage from the sanitary appliances of the building and evacuate them to the final point of discharge (without endangering the health of users of the site) also located in the same enclosure. The drainage of these sewage will be done in a separative manner, which means that the white water will be directed directly to the infiltration drain and the black water from the toilet discharges will be sent to septic tanks and, after undergoing pretreatment, Will be directed to the infiltration drain.

The conduction of the water both to the drain as well as to the septic tanks will be by uPVC pipes interspersed by visiting boxes. The visiting boxes shall be masonry of cement blocks and sand, with internal dimensions of at least 50x50 cm2, with a minimum depth of 40 cm and shall be spaced not more than 15 m (according to the drawings). All inspection boxes, in addition to being siphoned, will carry hydraulic covers in concrete, suitable for sanitation systems. In the case of black water tanks, these shall be insulated by filling between anchors with a mass or other insulating material that does not allow the gases to flow out of them.

The septic tanks provided for in the project have the following capabilities:

Building	Pit Capacity
Guardhouse	25 people
Outdoor toilets	
Toxic Warehouse and Flammable	3 people
Main Warehouse	25 people

Table 2 – Capacity of the septic tank receiving black water from the building(s)

The piping layout, as well as its gauges, are indicated in the drawings attached to this memory.

4.2. Materials

The piping material to be applied in the sewage drainage project will be uPVC PN6, from Marley, DPI or MACNEIL, or from another manufacturer being of the best quality and previously approved by the inspection, of the following type:

- Tubing approved to comply with SABS 967 - to be used in-wall or in fixed sight with clamps;
- Piping approved as complying with SABS 791 or 1601 - to be used in the ground.

4.3. Calculation

For the dimensioning of both the discharge lines as well as the collectors, the regulatory flow rates for each type of appliance were taken into account. In the possession of the flows, it is accumulated and then, for each section, the design flow is defined taking into account the simultaneity of the discharges.

Thus, due to the roughness of the material considered and the range of variation of the inclination of the pipes, the sizing of the pipes is done considering a half-section flow for the branches and manifolds.

In the present project, for the purpose of sizing, Cype Software was used in the Building Installations module.

4.4. Tests

It will be obligatory to carry out sealing tests and efficiency, in order to ensure the proper functioning of the sewerage network.

All installed pipe will be subjected to water testing as specified in the Regulation of Building Systems Water Distribution and Wastewater Drainage, before closing grooves or trenches.

They will not be allowed to test the covered tube leaving only the view of the joints since it is not possible to assess this way the conditions of the pipeline. The results of the tests must be recorded in modules created for this purpose.

5. WATER DRAINAGE AND STORMWATER STORAGE

5.1. General conception

With regard to drainage of rainwater, the projected system is designed to collect rainwater falling to the level of the Drug Depot roof, through rectangular gutters and its conduction up to the level of the floor, in inspection boxes, by circular drop tubes. Most of these waters will be conducted by uPVC PN6 pipes of diameters 160 and 200 mm, as shown in the attached drawings, connected to inspection boxes to a lower reservoir of the pressure tower with a capacity of 55 m^3 of water.

At Guardhouse, Maintenance and waste treatment buildings, the rainwater will be discharged directly into the sidewalk by fall piping.

5.2. Materials

Drop tubes and gutters to be applied shall be galvanized sheet metal. The gutters shall be quadrangular of 150 mm and 150 mm of section (according to the drawings), with thickness of 0,6 mm and the drop tubes shall be circular of 50 mm and 125 mm of diameter (according to the drawn pieces), with a Thickness of 0.5 mm. Both the gutters as well as the drop tubes and all their accessories will be galvanized to Z275 (Galvanizing with 275 g / m2 of zinc).

In the areas of roofs in slabs, where rainwater collection was anticipated, they will be used for the collection of rainwater, ACO PASSAVANT, according to the drawings and catalog of the manufacturer.

It is also planned to place ACO PASSAVANT drains on the warehouse's internal floors for the collection of water resulting from the washing of the same.

The collectors will be in uPVC PN6, similar to those specified for sewage drainage.

5.3. Basic elements for dimensioning

5.3.1. Intensity, duration and frequency

The period of return considered in the hydraulic design of a rainwater drainage system was 5 years. For a rainfall duration of 5 minutes, we will have a precipitation intensity of 400.65 mm / h (1.5 x 267.1 mm / h).

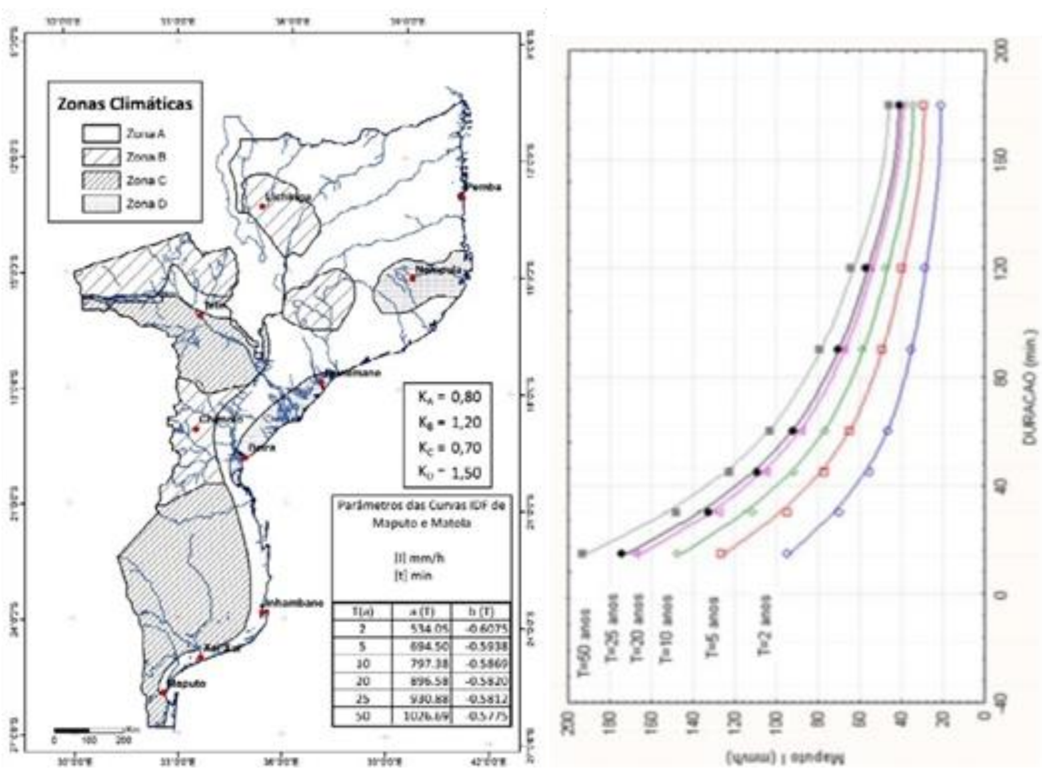


Figure 2 - IDF curves for Mozambique

a= 694,50

b = -0,5938

5.3.2. Coefficient of flow

A coefficient of leakage equal to 1 was adopted for the coverages.

5.3.3. Flow rates

The flow rates for the discharge of rainwater were based on the areas to be drained in horizontal projection, flow coefficient and precipitation and is done by the rational formula:

$$Q = C.I.A$$

On what:

Q - Calculation flow (l/min);

C - Coefficient of flow, which depends on the nature and slope of the terrain;

I - Precipitation intensity (l/min*m²), Depending on the return period and the duration of precipitation;

A - Area to be drained, measured in horizontal projection (m²).

5.4. Hydraulic dimensioning

5.4.1. Discharge branch line

5.4.1.1. Minimum diameter

The minimum nominal diameter of rainwater discharge lines is 50 mm.

5.4.1.2. Sequence of Sections

The section of the discharge branch cannot decrease in the direction of flow.

5.4.1.3. Hydraulic sizing

In the hydraulic dimensioning of the rainwater discharge lines, attention was paid to:

a) The calculation flows;

b) Slopes, which should not be less than 5 mm/m;

c) The roughness of the material.

The rainwater discharge lines were sized to flow to the full section.

Table 3 - Sizing of discharge lines

DN (mm)	*Diâmetro interior (mm)*	*Caudais (l/min)*			
		Inclinação			
		1%	*2%*	*3%*	*4%*
40	36,4	32	45	55	63
50	45,6	60	84	103	119
75	70,6	191	270	331	382
90	85,6	319	452	553	639
110	105,1	552	781	956	1104
125	119,5	777	1100	1347	1555

Os caudais das canalizações foram calculados de forma a que o escoamento se processe a secção cheia, através da fórmula de Manning-Strickler e considerando que o material da tubagem possui uma rugosidade $K = 120\ m^{1/3}.\ s^{-1}$

5.4.2. Gutters

In gutters hydraulic design must be taken into account:

a) The calculation flows;
b) The slope;
c) The roughness of the material;
d) The height of the liquid sheet, which shall not exceed 0,1 of the cross-sectional height.

The gutters will be in galvanized iron with quadrangular section.

5.4.3. Downpipes

The flow rates for falling rainwater pipes shall be the sum of the calculation flows of the gutters and discharge branches which discharge them.

5.4.3.1. Minimum diameter

The nominal diameter of domestic or rainwater falling pipes shall not be less than the largest of the diameters of the branches connected thereto, with a minimum of 50 mm.

5.4.3.2. Hydraulic dimensioning

In the hydraulic dimensioning of the rainwater dropping pipes, attention should be given to:

a) The calculation flows referred to in the previous article;
b) The height of water above the drop tube, is the load on the column.
c)

Caracte-rísticas	Diâmetro d (mm)	Comprimento mínimo dos tubos de queda l (m)	Caudais Q_c (l/min)									
			Altura da lâmina líquida h (mm)									
			10	20	30	40	50	60	70	80	90	100
$l \geq 0{,}04$ d, de entrada com aresta viva	50	2	21	69	143	244	374					
	75	3	31	96	192	320	480	673	903			
	100	4	40	123	241	395	585	812	1078	1383	1729	
	125	5	50	150	290	471	691	951	1253	1593	1984	2416
	150	6	59	176	340	546	796	1090	1428	1810	2239	2715
$l \geq 0{,}04$ d, de entrada cónica	50	2	27	84	170	286	432					
	75	3	39	118	233	382	567	788	1048			
	100	4	51	152	296	479	702	966	1271	1619	2011	
	125	5	63	187	358	575	837	1143	1494	1892	2336	2829
	150	6	75	221	421	672	971	1320	1718	2165	2662	3210
$l < 0{,}04$ d	50	2	26	37	45	52	58	64	69	74	78	83
	75	3	59	83	102	117	131	144	155	166	176	186
	100	4	104	148	181	209	233	256	276	295	313	330
	125	5	163	231	282	326	365	399	431	461	489	516
	150	6	235	332	407	470	525	575	621	664	704	743

Table 4 - Sizing of downpipes

5.4.4. Building Collectors

The calculation flow rates for rainwater collectors shall be the sum of the flow rates for the calculation of falling pipes and discharge branches directly connected to them and, where appropriate, groundwater.

5.4.4.1. Minimum diameter

The nominal diameter of the building manifolds shall not be less than the largest of the diameters of the pipes connected thereto, with a minimum of 100 mm.

5.4.4.2. Sequence of Sections

The manifold section cannot decrease in the direction of flow.

5.4.4.3. Hydraulic sizing

In the hydraulic design of rainwater collectors, attention should be paid to:

a) The calculation flows;
b) The inclination, which must be between 10 mm and 40 mm / m, can be lowered to 5 mm/m;
c) The roughness of the material.
d)

Rainwater collectors must be designed for full section flow.

Diâmetro d (mm)	Caudais Q_c (l/min)				Anotações
	Inclinação i				
	1%	2%	3%	4%	
110	559	790	968	1118	O diâmetro mínimo dos colectores prediais não deve ser inferior ao maior das distâncias das canalizações a eles ligados; com um mínimo de 100 mm. A inclinação dos colectores deve estar compreendida entre 10 e 40 mm/m
125	777	1099	1345	1554	
140	1051	1487	1821	2103	
160	1052	2124	2601	3004	
200	2725	3854	4720	5451	
250	5136	7009	8584	9913	
315	9182	12.986	15.904	18.365	

Table 5 - Sizing of building collectors

5.5. Accessories

5.5.1. Drains

They will be placed in the places on the concrete gutters on top of the drop tubes.

They must have a working area equal to or greater than 1.5 times the cross-sectional area of those tubes.

The drains can be made of cast iron, brass or other materials that meet the necessary conditions of use.

5.6. Simulation of the network with CYPECAD, version 2016

After the manual calculation, the network was simulated with the cypecad, cersão 2016.

5.7. Tests

It is mandatory to carry out watertightness tests, in order to ensure the proper functioning of rainwater drainage networks.

5.7.1. Sealing tests

For leakage tests on indoor rainwater systems, the following shall apply:

a) The systems are filled with water by the upper extremities, the remaining ones being sealed, and there shall be no lowering of the water level for at least 15 minutes;
b) In these tests, air or smoke may also be used, under pressure conditions equivalent to those of the previous paragraph.

6. SYNTHESIS

For the drawings, diameters, equipment and details of execution, all the indications provided by this document, as well as the Drawings, quantity map and catalogs must be followed.

In all the execution, the applicable technical implementing rules will be respected, and all the materials to be applied must have quality certificate, and must be submitted to prior approval by the inspection in the case of sanitary parts and their accessories.

In any omission or not specified in this document, all existing laws and regulations, as well as other inspection indications, shall be respected.

7. ANNEXES

7.1. Annex 1 – Catalogs