# VOLUME 3

# Technical specifications

**1.** **General**

**1.1. General considerations**

On the technical viewpoint and before any execution,

The Contractor in charge of the implementation of the works in the present project, should take knowledge of all the specific parts of the work specified in the tender document that form in all a homogeneous and complete work. This implies that all works and supplies must be completed in a perfect manner.

In a way to avoid other contentions the contractor shall inform the engineer, in a separate note to his/her Bid, all mistakes, omission or contradiction sighted in the document during studies. In case of omissions in the description of certain works, the contractor shall in all cases execute all necessary works to the perfect completion after consultation meeting with client reached an agreement on necessary works to be executed.

**1.2. The unit prices of the Contractor**

Prices for the replacement of damaged materials and/or equipment must always include the dismantling and the evacuation of materials and /or the equipment including the repair of the works damaged during the dismantling of work and other surroundings.

The descriptive bills of quantities in the technical clauses do not alone make up contractual statements.

The contractor should be conscious and verify all quantities during the time of Bid preparation. If he finds out that some quantities indicated in the descriptive and quantitative clauses are improper or missing, the contractor shall correct them in a separate note joined to his/her Bid and shall not in any way ask for any price modifications.

**1.3. During works execution**

The contractor shall signal out all expenses, materials and other equipment or plans and diagrams that he judges necessary for the perfect execution of the works. These documents shall be submitted to the client for approval who replies in 5 days following the receipt of the requests.

All details of supplies leading to the performance of principle plans must be submitted inevitably for approval before the beginning of works execution.

The contractor shall not ask for any prolongation or compensation in terms of time for any modification he will have been asked to do.

The Supplied materials either Locals or Exported should respect the ISO standard or Rwanda Standard Board (RSB)

**1.3.1. Security**

The Contractor must always know the working environment and should adhere to the existing laws, should always adhere to the conditions of the security and police. The contractor shall always be liable to any losses caused by any site incident and shall always be responsible for the entire security of the site throughout construction works and before final project handover.

**1.3.2. Water and electricity**

The contractor shall be responsible for all the water and electricity consumption at the site.

**1.3.3. Access to the Site**

The utilization of the existing routes by trucks and by other equipment should not cause any nuisances to the environment (dusts, noises, ruts etc.). All deterioration of surface caused to the adjacent works shall be repaired at the expense of the contractor.

**1.3.4. Implantation of works**

All the Works and parts of works implantations will be done by the contractor and at his expenses. Before commencement of works execution or implantation, the contractor shall begin by a sub – implantation in order to verify the leveling of the land and inform the client of any possible inaccuracy. The representative of the client should first verify the implantation before works execution commences. A statement to the implantation shall be pronounced and given to the contractor. Before all beginning of works, the enterprise must precise in the presence of the client, the timeline of works based on data provided by the client: benchmark, origin of each intervention zone. He will be responsible for all accidents that may occur on the site and should always endeavor to prevent them.

**1.3.5. Utilization of materials**

Materials to be used should be in conformity with the norms and laws in Rwanda and should conform to the present tender document. The conditions stipulated here shall always be considered as the minimum required for the implementation of the works.

**1.3.6. Environment Protection**

The contractor must respect the norms and prescriptions in relation to environment protection. On this note he is supposed to remove all garbage and unused materials out of the site and deposited far away in conformity with environmental regimes.

**1.3.7. Consistence of unit prices**

The contractor should be well versed with the conditions that would influence the execution of the works especially:

* The nature and the quality of soils and grounds,
* The conditions of transport and access to the site,
* The water and rain regimes in the region,
* The conditions of accessing water to the site,
* Any other particular conditions related to the proposed project site (s).

The contractor should not therefore, raise any claims related to the difficulty or other eventualities except in case of major unexpected calamities, fully recognized by all parties. He should therefore calculate all the unit prices on the basis of the complete execution of the works and in accordance with the techniques of high labor intensity.

**2. Specifications of materials**

**2.1. General**

All materials must be of the best quality and free from any shortcoming that might compromise the solidity and durability of the work for all its lifetime.

The contractor at the request of the client should justify their origin either by presentation of the invoice or any other document agreeable upon by both parties. The contractor must present to the client the results to all tests that were requested.

All materials and tests requested will be done at the contractor’s expenses and delivered to their designated places. If the quantity of materials refused exceeds 10% of the materials submitted for testing, then all the materials submitted will be disqualified. The contractor, on a permanent basis, should facilitate for easy access, the client’s personnel to all quarries, factories, laboratories, workshops in order to follow up and monitor closely the execution of the tender document in whatever concerns the origin and quality of the materials.

The time allowed for necessary tests is 5 days from the time of sample submission, but if this time is passed due to the clients request the time will be prolonged to an equal number of days to the delay. The client can allow the use of the similar products to those that are prescribed, if he judges that these products’ value is of equal value in quality and efficiency. In case of doubt, he will proceed for tests.

**2.2. Prescription of materials**

**2.2.1. Stone size and gravel**

Stones and gravel shall always be collected from the best places identified. They will have qualities of healthy sandstone. Their density must be near to 2500 kg/m³ and their resistance equal or greater than 30 N/mm².

Before beginning all stones must be curved to the required shape with uniform surfaces

The quarry stones will have, as much as possible, a width doubles their height and a length doubles the width. The minimal length is 20 cm, the other measurements varying according to the drawing.

**2.2.2. Gravels and sand.**

Gravels and sand will be extracted from the best quarries. These gravels and sand can also be extracted from bottom of the rivers but should be well washed and purified to remove silt before their utilization. The Prescriptions fix minimal qualities, for their granular metric spindles and their utilizations. Their minimal resistance is 30 N/mm²s.

**2.2.3. Bricks.**

The bricks should be of the size of 20cm x 10 cm x 6 cm and of high quality. The bricks to be used will be confirmed after the following two tests:

**Crushing test:** the brick should remain intact after 24 hours of immersion in water

**Hardness test:** the brick should remain intact after falling on a hard surface from 2m.

**2.2.4. Forged laminated Iron and steel, griddles**

Iron and steel bars to be used shall be approved by the Client Expert ; they should be strong, resistant to cold weather and with the following characteristics:

* Apparent elasticity limit: 4200kg/cm2 (420mpa) (> 480 N/mm2)
* Tensile stress: 5000kg/cm2 (500mpa) (240 N/mm2)
* Compressive stress: 14% (< 10%)

Steels for reinforced concrete must be able to bend in cold weather without changing the diameter of the rod.

The griddle hovers must be united, shiny, of uniform thickness, without cracks nor rips. Clippings must detach themselves without breaking.

The wavy griddle will be in sheets whose measurements are those on market. The quality remains the one marketed locally factory or similar ones.

The works for putting on protective layers like galvanization, aluminum layers are made exclusively in the factory and according to the manufacturer's specifications.

**2.2.5. Prescription of materials for concrete**

**a) Sand 0-4 mm:**

The sand for concrete must come from natural layers or a crushing station. It must be free from all foreign bodies like organic matters, dusts, oxides, pyrites or silt or adhesive clays. It must not contain grains bigger than 5 mm. The equivalent of sand must be greater than 75%. The engineer can, if necessary, prescribe the washing of the sands. The granulometric test should be continuous with the following picture:

|  |  |
| --- | --- |
| Sieve opening in mm (square mesh) | Percentage of weight passing through the sieve |
| 5 | 100 |
| 2 | 50 |
| 0.5 | 20 |
| 0.08 | 5 |

**b) Gravel 5-25 mm**

The intended gravels to the concrete must be free from foreign bodies like organic matters, dusts and adhesive clays. They must come of layers whose sites are proposed by the contractor but must be approved by the engineer. Gravels should present a regular shape and should neither be long nor flat. Their toughness and origin should be from proven tests with the following granulometry picture:

|  |  |
| --- | --- |
| Sieve opening in mm (square mesh) | Percentage of weight passing through the sieve |
| 25 | 100 |
| 20 | 75 |
| 15 | 50 |
| 10 | 15 |
| 5 | 0 |

**c) The Cement**

The cement must come from factories accepted by the client. The contractor will provide a certificate showing the origin of the cement. The recommended cement is the Portland type Cement class P 325. In case of doubt on the quality of the cement, the client shall request for tests at the expense of the contractor.

The engineer reserves the right to exercise his control in factory on the manufacture, conservation and the expedition of the cements that will be provided for works. The cement will be delivered in intact sacks and stored in water tight stores. The delivery of cement in a jumble as well as the utilization of set cement is forbidden.

In the case that there would be cements of several qualities or several origins, the different supplies should be stored separately. Sacks will rest on the stilted boards and will be stacked in approximate blocks of 20 tons. A rotation of stocks must be respected. All cement presenting traces of humidity or hold at the time of work will be rejected.

* + 1. **Water**

The Water for concrete mixing must be clean, clear and odorless. It must not contain matters in abeyance beyond 2 grammes of liter. It must not provoke, on the cement, any chemical reaction that would prevent it from holding.

**e) Reinforcement steel bars**

The steels chosen by the contractor for the execution of the market will be firstly approved the client. They should have a diameter of not less than 40 mm in calculations; the characteristics of the reinforcements with high binding are as follows:

* Apparent elasticity limit: 4200kg/cm2 (420mpa)
* Tensile stress: 5000kg/cm2 (500mpa)
* Compressive stress: 14%

The properties of round and smooth reinforcement bars are as follows:

* Normal elastic limit: 2200kg/cm2 (220 mpa)
* Tensile stress: 3400kg/cm2 (340mpa)
* Compressive stress: 25%

The reinforcement iron bars for concrete are the high tensile and high adherence type with a diameter of not less than 40mm, with the following characteristics:

* Elastic limit   : 400 N/mm²
* Tensile stress : 480 N/mm²

They should always be free from any spot of oil, painting or soil particles; they will be ridded entirely of the adhesive rust. They will be stowed by ligatures of appropriate solidity and in sufficient number so that they can displace themselves during the setting up of the concrete.

For stirrups of Ø 6 mm, it will be used on smooth steels.

**f) Making and setting up of concretes**

All concretes are made mechanically, except if the quantity of the concrete to be made on the site is lower than 1 m3. All precautions should be taken such that the temperature at the time of concrete setting is not greater than 40 ° C. The tightening should be tidy and without provoking a beginning of segregation. The casting of concrete should be completed in an hour following the mixing and before it begins to set. Concretes should be maintained in good condition of humidity for at least 15 days and should be protect from direct sunshine.

**g) Casing frames and their removal**

All reinforced concrete will be made in casings of wooden frames. Framings will be strong enough to resist the weight and to the thrust of the concrete works. The vertical part of the frames can be removed 48 hours after setting but the horizontal ones should never be removed in less than 15 days. The contractor is not allowed to remove the frames before the guarantee of the client’s representative.

**h) Composition of concretes**

|  |  |  |  |
| --- | --- | --- | --- |
| **Type of concrete** | Dosage and application | **Composition of granulates**  **(in liters)** | **Resistance to the compression in 28 days** |
| **Concrete B 150** | Reinforced concrete to be spread under the foundations and the base of excavation dose of 150 kg/m3 | Cement : 200kg  Sand : 400litres  Gravel : 800 litres | 10 N/mm² |
| **Concrete B 250** | Reinforced concrete for the slab at a dose of 250 kg/m3 | Cement : 250kg  Sand : 400litres  Gravel : 800 litres | 16 N/mm² |
| **Concrete B 300** | Slightly reinforced concrete for pit covers dose of 300 kg/m3 | Cement : 300kg  Fine Sand : 400litres  Coarse Gravel : 800litres, Gros sable : 800 | 16 N/mm² |
| **Concrete B 350** | Reinforced concrete for columns slabs, and lintel.  Dose at 350 kg/m3 | Cement : 350kg  Sand: 400litres  Gravel : 800littres | 16 N/mm² |

**2.2.6 Prescriptions of materials for mortar**

**a) Sand 0, 03–3 mm:**

The sand for mortar should come from natural layers or crushing stations. It should be free from all foreign bodies like; organic matter, dusts, silt or adhesive clays. Spindle granulometry is continuous, sieving through meshes between 0.03 mm and 3 mm

**b) Cement**

The cement must come from factories accepted by the client. The contractor will provide a Quality certificate showing the origin of the cement. The recommended cement is the Portland type Cement class P 325. In case of doubt on the quality of the cement, the client shall request for tests at the expense of the contractor.

The engineer reserves the right to exercise his control in factory on the manufacture, conservation and the expedition of the cements that will be provided for works. The cement will be delivered in intact sacks and stored in water tight stores. The delivery of cement in a jumble as well as the utilization of set cement is forbidden.

In the case that there would be cements of several qualities or several origins, the different supplies should be stored separately. Sacks will rest on the stilted boards and will be stacked in approximate blocks of 20 tons. A rotation of stocks must be respected. All cement presenting traces of humidity or hold at the time of work will be rejected.

**c) Water**

The Water for concrete mixing must be clean, clear and odorless. It must not contain matters in abeyance beyond 2 grammes of liter. It must not provoke, on the cement, any chemical reaction that would prevent it from holding.

**d) Composition et préparation des mortiers :**

|  |  |  |
| --- | --- | --- |
| **Destination** | **Cement Dosing (kg/m³)** | **Sand (litres)** |
| Masonry of Cement bloc | 250 | 1.200 |
| Masonry of quarry stones (gravel) | 300 | 1.200 |
| Block masonry | 300 | 1.200 |
| Rough casting of walls (Plastering) | 350 | 1.200 |
| Joining works | 500 | 1.200 |

It is important to protect the mixed mortar from wind, rain and the sun. The prepared mortar must be put to use within 45 minutes of mixing. The mortar that has set should not be used.

**2.2.7. Prescriptions of brick masonry**

**a) Execution of masonries:**

All finished walls must be flat. Foundations must be horizontal. Joints have a uniform thickness of 1 cm. The vertical joints alternate themselves. Brick are joined by a back fill of M 250 mortar.

**c) The joints**

The thickness of joints won't exceed 30 mm. The masonry should be executed according to rules of the art with the very full joints that are regulars; care should be taken not to make the bricks dirty with the mortar. The external walls will be re-pointed with smooth cement mortar.

**2.2.8. Description of quarry stone masonries**

**a) Stone Masonry**

The stones to be used for masonry are those without visible fissures. The masonry will be executed according to rules of the art and the prescribed mortar is the M 300. Bigger sized stones will be put in the horizontal sense. At least not more than a third of the stones should be put to protrude through the thickness of the wall.

The big volumes of mortar should be avoided; the spaces between quarry stones should not exceed 6 cm, and should be filled with mortar. All direct contact between quarry stone should be avoided.

Before the temporary receipt, all the masonry work will be cleaned brushed and washed with water. Joints and the masonry work will be revisited in order to be made clean in appearance.

**b) Dry Masonry**

The dry-stone masonries are identical to masonries in stones, but their joints are not joined by mortar.

**2.2.9. PVC Pipes**

Materials to be used of polyvinyl chloride (PVC) shall have the following characteristics:

* **Lightness:** they are light, easy to manipulate and portable in big quantities**.**
* **Flexibility:** flexibility permits them to adjust to curliness of trenches on the hill sides, in shallow bottoms and in other curves as according to the tracing.
* **Low prix:** they are the cheapest of all the PVC types.
* **Resistance to waters corrosiveness:** they are not attacked by the chemical agents and offer the best-known resistance known.
* **Locally Available:** they are produced locally, consistently to the international norms.
* **Resistance to shocks, to sunburns and chlorine:** Since they are destined to be used underground, they are protected against all shocks.

**3. Particular Technical Specifications.**

**3.1. Site Installation**

**3.1.1 Access**

There is an existing access path and roads to the site.

**3.1.2 Local office**

A local office shall be established by the contractor and shall be placed in a place agreed upon by the client. The shape and materials in the office shall be approved by the engineer, this office shall provide good working environment as all documents relating to the present tender and reports on the progress of work on the site shall be consulted from there by the client, and site meetings shall be held in this office.

* + 1. **Shelter for workers, Toilets and site shed**

The contractor shall construct an appropriate shelter that can be closed and locked; it shall be made of materials accepted by the client’s engineer. This shelter shall not be used as a store of materials it shall be used by the workers as a resting shelter and must be supplied with temporary sanitary equipments. All shall be done to keep to the local hygienic standards.

Areas for storage of material shall be well prepared in order to avoid their contact with unwanted materials.

**3.1.4 Various connections**

**3.1.4.1 Water and electricity**

The contractor shall endeavor to get connected to the main water and electricity supply, all the costs for getting connected shall be at his expense. In case there is no public water distribution available he will have to get a permanent storage of water at the site.

**3.1.4.2 Telephone and radio**

The contractor shall ensure to have a fixed telephone or mobile at the site in order to have permanent link between the sites, headquarter and the client.

**3.1.5 Security and site protection**

The contractor is responsible for the site security. He must take all necessary measures to avoid accidents on the site and must respect all labor laws in relation to the protection of the workers. He must protect the site against theft or damages to installations or materials. He will be responsible for all this until temporary receipt of works

* + 1. **Water diversion**

The contractor shall take necessary measures to insure the out- flow of rain water and other exhaust.

* + 1. **Temporary enclosure**

The contractor shall ensure a temporary enclosure of the site up to the end of the works, this will be demolished and the surrounding restored.

**3.2. Felling and Extraction of Trees**

The felling and uprooting of trees concern all trees being in the surrounding of works. This work applies to trees with a circumference of 1 to 1.50 m above soil. Remnants of deforestation will be evacuated out of the site and taken to a place accepted by the engineer. Holes created by these works will be filled and compacted. In any case the engineer reserves the right to show which trees should or should not be removed.

**3.3. Bush Clearing**

**3.3.1. Removal of vegetation**

Only bushes and vegetation in the surrounding of works shall be removed. The contractor arranges their removal and evacuates them out of the site or destroys them at his expense.

**3.3.2. Protection of vegetation**

The contractor must protect efficiently, by means accepted by the District, trees and bushes planted long the limits of the site, as well as those of which the client asks for their conservation. He is prohibited from either cutting to pruning trees without the agreement of the District. Penalties, in case of no observation by the contractor of the instructions of the client, are envisaged and shall follow regulations in Rwanda in matters of environmental protection. Besides, trees or plants removed or damaged without the consent of the client shall be replaced by the contractor at his expense.

**3.4. Supply and Leveling of Soil on the Site**

**3.4.1. Supply of arable soil**

The mode of removal is left at the initiative of the contractor provided he respects the clauses in the tender document and in the Environmental Impact Assessment Report that their removal shall not damage the existing infrastructures.

**3.4.2. Leveling of arable soil**

The arable soil is leveled to a thickness of 20 cm especially for the soil in which some plantations will be done. The contractor shall ensure that no rubbish or garbage is mixed in this soil.

**3.5. Transport and Evacuation of the Soil**

The means of transport to be utilized on site for the evacuation and transport of the excess soil should not provoke or cause any damage to the excavations in progress, or to the existing infrastructures and other facilities. The excess soil becomes a property of the contractor and shall be deposited on a site of his choice provided it is in accordance with environmental regulations

**3.6. Excavations**

The excavation or terracing works shall be done mechanically by hand.

**3.6.1 Excavation of the topsoil**

Terracing and excavation of the topsoil shall conform to the following:

* the removal of the soil and its evacuation
* Works and supplies necessary to the good execution of works and the security of the site.
* Cleaning, sorting and temporary stocking of some materials whose reuse is envisaged.

**3.6.2. Excavation for the embankments**

Excavations for embankments should conform to:

* The weeding and garbage removal on the land to embank, as well as the evacuation of these products outside of the site.
* The filling of the pits with the soil, in case it is not enough soil from another identified site is brought provided it got prior approval by the engineer.
* The compaction of embankments

Before the constitution of embankments, the contractor must clean the area and must get it free of roots, stumps etc.

Embankments will be executed by successive layers of 10 to 15 cm to the maximum and according to the suitable compaction material. Soil will be added progressively and leveled horizontally watered and compacted.

The prescribed compactness must be at least equal to 90% of the optimum modified Proctor.

Materials used in embankments, must be free from any organic matters and other impurities.

**3.7. Common Prescriptions to all Excavations**

**3.7.1. Measurements of excavations**

Excavations for foundations, pipeline, drainage, ditches, etc., are opened according to measurements that permit works verification without difficulties. The calculation of quantities in cubes shall be made in accordance to the planned measurements for the excavations.

**3.7.2. Partitions of excavations**

Partitions of excavations will be vertical; however, if crumbling is feared during works, they will be sloped.

**3.7.3. Depth of excavations**

The depths of excavations are leveled according to the plan or the horizontal successive plans, in the steps form and consistently to plan.

**3.7.4. Access to excavations**

The appropriate accesses to the bottom of the excavation are established and maintained in good state, and should conform to security norms.

**3.7.5. Control measures**

The work is consistently traced from the plan by the contractor. With the completion of terracing works the engineer proceeds to the control of levels and the tracings for the excavations. However, these controls do not remove any responsibility of alignment, levels or corners from the contractor.

**3.8. Surface Concrete**

The surface concrete is constituted by the concrete B 200. It will be poured into the excavations, consistently to plan. It should have a thickness of 5cm and its width equal to the size of the excavations.

**3.9. Stone masonry**

**3.9.1. Destination of masonry**

Foundations shall be made of stone Masonries. This uses mortar of M 300. Different levels of the plan shall indicate where they should be used.

**3.10. Cement mortar tread on the foundation**

The stone foundation should be followed on its top by a tread of concrete covering its entire periphery. This layer serves as anti-termites; it should have a thickness of 5 cm and a width equal h to the thickness of the wall (40 cm.). Its composition is the concrete of sand B 250.

**3.11. Protection against the ascending humidity:**

An asphalt layer to prevent the rise of the humidity in the masonry is utilized; it covers the surface between the base of the stone masonry and the burnt bricks masonry.

**3.13. Ventilation**

Ventilation will be achieved by using confined ventilators preferably made of burnt soils or other available materials having the engineer’s approval before utilization.

**3.14. Reinforced concrete lining.**

The reinforced concrete utilized is the B 350 type. The frames will be made up of at least 4 steel bars of Ø 12 mm in the longitudinal sense and Ø 6 mm for the horizontal all 15 cm. However plans will be describe the frames in details.

**3.15. Frameworks**

**3.15.1. Timber frameworks.**

The timber frameworks shall be made in accordance to plans. All the timber to be utilized for these frames should be of eucalyptus or any other with the same mechanical characteristics. Frameworks will have the exact measurements indicated on plans; they should be assembled in a regular and a proper manner. They will immediately be raised tom the top as soon as their assembling is completed and protected against attacks by termites. The contractor shall ensure that they are well positioned. They must be strongly attached to the other elevated structures and the lintel, they are held to the wall by an intermediate timber of 20 cm x 20 cm. All structures (Frameworks, rampant, rafters etc ) must be tightened together to avoid their being flown up by wind estimated at 110 kg/m² and to be able to support a weight equal to 100 kg, representing a worker's weight intervening on top of them . The different elements of the framework will have the following minimal measurements:

* Major frames and rampant: 10 cm x 15 cm
* Pannes : 05 cm x 15 cm
* Rafters: 05 cm x 07 cm

**NB** Rafters will be used if the covers are made of tiles, but if it is to be covered by iron sheets they will be directly fixed on the panes.

**3.15.2. Metallic frameworks**

If metallic frame works are to be utilized, linear steel, bars prefabricated and will be brought to the site, they will be held together by welding and they should be welded according to plan and the dimensions in the plan. Always the contractor must seek approval of the engineer.

**3.15.3. Welded Assemblies: constructive Arrangements to respect**

The height of welding cords won't be lower than 3mm.it should have even accumulation of soldering in one point.

In the case of welding tip to tip or conjugation of a welding boils to tip and a welding of angle, meetings of assemblies in shape of T are admitted, while meetings in shape of cross are to be avoided.

In the case of an assembly of piece angle forming tried, it is recommended to truncate the top of the secondary piece of the assembly

Except special justifications, recommended are:

* Not to bring back some perpendicular welding cords to the axial effort on the surface of a tense wing
* Not to weld dishes of superior thickness to 30mm

**3.15.4. Drawings of execution**

For the execution of all metallic construction, the contractor will design all drawings including their details to define all elements of the construction precisely.

On the detailed drawings, the contractor will consign complete way:

* Arrangements of assemblies
* The adjusted ends
* Measurements of welding cords and their order of execution
* Beams.

In case the project id modified during the execution of works, drawings and calculations will be rectified so that the finished work is defined precisely by these pieces.

**3.16. Roofing**

**3.16.1. Roofing is done by using galvanized iron sheets (28 BG).**

Roofing will be by pre-painted iron sheets with a thickness of: 0,40mm (BG 28)

The uniform weight distributed for a scope of 2,75 ms between supports must be able to reach 95 kg/m2 for 2 continuous bays, with a lower arrow to 1/200 of the reach.

The fixing of the iron sheets to the metallic frames will be by Ø 90 mm hooks, with small discs in PVC hoods. The longitudinal recoveries will follow the manufacturer's prescriptions according to the product and the slope of the roofing. All measurements shall assure the strict tightness. They are notched according to the profile of ferries with tilted wings to 10%. Their development is 610 mms and the recovery of 260 mm wings. Joint foams to closed cells cut up according to the profile will assure the tightness.

* + 1. **Gutters for the descending water**

Steel gutters will be used to collect water from the roof while the PVC pipes of 110mm will be installed for the descending water. They will end, in an elbow at the lower end towards the discharging end into a plastic tank.

**3.17. Carpentry and joineries**

**3.17.1. Frames for doors**

In general, doors will be provided of first quality frame, they are to execute with the biggest care according to details of execution plans. All settings of doors are profiled HS.

**3.17.2. Wooden doors.**

The wood must be the dry type. Wood will be healthy, very dry, regular, of a state lower hygrometric to 15%, without knots decorates with moldings. Doors and all their accessories must be of the first quality (with a metallic frame for doors), wooden doors must be of eucalyptus type painted with chocolate color. Doors might be reinforced with two timber pieces fixed diagonally on each door (making a Z); Wood will be protected, by a suitable painting layer, against the infiltration of the rain waters. The contractor shall ensure that all doors are well set and that they close correctly. The upside of the doors must be opened in a trapezoidal form in order to allow for enough ventilation.

A sample of the door will have to be approved by client

**3.18. Plastering**

**3.18.1. Cement mortar plaster**

Plastering is usually executed when all hard work on construction is finished and should be done immediately when the masonry work has dried up. It is important to understand the following preparations before plastering and coatings or painting

* Removal of any dirt, grease, dusts, clay etc.
* removal of protruding nails and other non-smooth foreign bodies
* cleaning and leveling flat all objects that are not flat

After this, apply the single layer of coating made of cement mortar with a 350 kg/m3 composition. The thickness of the plaster should be between 1.5 cm to 2 cm and the wall surface must be flat.

The following have to be plastered: all internal walls, all sinks, urinals, lintels

**First layer**

This layer, called layer of grappling, has 5 mm of thickness. Its mortar is prepared with the thick sand.

**Second layer**

A second layer or layer of smoothening has 5 cm of thickness. It is executed with a mortar prepared with the thin sand (lower diameter to 0.2 mms).

**3.18.2. Coating of local flat stones**

The surface of the layer must be compacted and leveled. It must receive a layer of sand of 5 cm of thickness. Stones are carved and are thinned until a regular thickness of 15 to 20 cm The organized coating of layers on burnt soil is identical to the coating in local flat stones, but it has a uniform thickness of 10 cm.

**3.18.4. Plinth of cement mortar**

Plinth of cement mortarhave a thickness of 1, 2 cm, a height of

15 cm, with a dosage in cement 350 kg/m³s.

**3.19. Flooring**

**3.19.1. Stone under floor with tread of thin cement**

The under floor made of stones should be of 10 to 20 cm in which concrete is put. The first layer should not exceed a thickness of 15 cm. This shape can be achieved while mixing stones of different sizes, gravel and sand. On top of the under floor with a thin tread of cement of about 5cm of thickness can be put and thin polyethylene of not less than 90 μm of thickness. This thin layer of polyethylene will play the role blocking the upcoming humidity.

The cement for this layer is made at a concentration of 250kg/m3. After this a smoother layer of nearly 1.5cm of thickness will be put. Sometimes on top of the mixture of the different sizes of the stones can be put burnt brick pieces that will facilitate the better binding of the cement.

Veranda floor shall be of 60 cm to 180 cm of width making a 40 cm channel and will put all around the building. Its upper layer will be smoothed with cement and protected at its sides by small bricks or stones according to availability.

**3.20. Water and Sanitary installations**

**3.20.1. Water connection and distribution**

The water connection to the external distribution point shall be at the expense of the contractor. The internal and external water pipes shall be UPVC and shall be laid at least 80 cm deep on top of a layer of sand with a thickness of 15 cm. The backfilling shall be done in layers; the first layer shall be that of sand with 15 cm of thickness followed by successive layers of compacted materials free of organic matter.

**3.20.2. Water Distribution**

The interior water pipes should be only PPR pipes and should be laid technically. The state of laid and conned pipes should always be verified for any malfunctions before speeding up to finish the whole work.

**3.20.4. Water Drainage**

The water to be drained away from the building should be:

* Rain water from the roofs
* Water and other residues washing places.

**3.20.5. Drainage of used water.**

The drainage system for used water and rain waters should be separated and this is achieved by use of PVC pipes of different sizes in diameters (Ø 90 mm to Ø110mm).

**3.20.6. Sanitary equipment to be fixed**

All anticipated devices shall be well fixed; these shall include pipes, taps and other accessories needed for better adjustments. They must be obtained from the same manufacturer, white in color and first choice. Joints between devices and partitions against which they will be fixed will be achieved by adhesive and elastic putty. They will be connected to conductors made of chromium-plated copper. Taps shall be chromium-plated with protrusion of the tap nozzle of about 85mm.

**3.20.7 Accessories for people with disabilities**

The entrance to the room reserved for people with physical disabilities will be equipped with an access ramp constructed in concrete with rough cement surface and a specific sign drawn on the floor with Installation of wash Facilities Inside the Toilet as indicated on the Drawing

**3.20.8 Construction of Hand WASH facilities**

The Hand wash should be constructed in burnt brick, with connection to the Water supply system and Water tanks, with ¾ water Point and the same size of valve in each 50 cm (about 1.64 ft) at the Heigh 75 cm. Painting with Oils paints in black color (Hypox)

**3.20.9. External clearing**

Areas that are left free are planted with postpartum. This involves bringing in fresh soil that is spread over the whole area to make a thickness of at least 5cm into which the postpartum is planted and watered until it fixes and germinates well.