202.14.2.4 Formwork

Formwork shall be measured for payment in m², classified by type (unwrought, wrought and for fairface concrete). Measurement for payment shall be of the net area of contact of concrete with the forms, after deduction of all openings and gaps exceeding 0.25 m² in area. The unit rates shall include for the use and waste of timber and of other materials and the supply of nails, tie-wires and fasteners; erection of forms, including scaffolding, shoring and shuttering; forming of levels, fillets, rebates, recesses, openings, etc.; removal of forms and for all materials (including waste), labour and equipment necessary for obtaining the required finish of the surfaces. It will also include temporary structures necessary for execution of all structure works.

Where no specific items for formwork are inserted in the Bill of Quantities, the cost of formwork as above shall be deemed to be included by the Contractor in his unit rates for the various items for concrete work and shall not be paid for separately.

202.14.2.5 Manholes and Chambers

Chambers shall be measured and paid for as defined in the Particular Specification.

Sewer manholes shall be measured by the number of complete units, classified according to type and depth as defined in the Bill of Quantities. For this purpose the depth shall be taken as the difference between the level of the manhole cover and the invert of the lowest pipe where it leaves the manhole. The unit rates of manholes shall each include : the cost of the required excavation in all kinds of soil; the blinding layer under the concrete floor; construction of the floor, walls, and ceiling, inclusive of reinforcement, all in accordance with the Drawings and as specified in the Bill of Quantities; supply and fixing of hooks, step irons and/or ladders; the construction of inlets and outlets; benching of the floor as shown on the Drawings; applying the specified finish to all internal surfaces including lastering where required; supply and installation of frames and covers; supply and fixing of pipe stubs for future connections; compacted backfill around the structure and removal of all surplus spoil, and all ancillary works required to complete the manholes in accordance with the Drawings and specifications and to the Engineer's satisfaction.

The unit rates for manholes will not include for external drops, which will be measured and paid for as an extra over the rates of manholes and chambers. They will be measured by number and classified by diameter only, irrespective of depth. The unit rates shall include for the supply of all materials and all work necessary in the construction of the external drop to the details shown on the Drawings.

202.14.2.6 Thrust and Anchor Blocks

The thrust and anchor blocks shall be measured and paid for per cubic metre of concrete to the dimensions shown on the Drawings. The unit rate per cubic metre shall include excavation, erecting formwork, placing steel reinforcement, pouring concrete, backfilling works and all other related works.

202.14.2.7 Precast Concrete Elements

Precast concrete elements will be measured by number, length or area as detailed in the Bill of Quantities. The unit rates shall include for the costs involved incomplying with all requirements of Section 202.11.3 and in addition all material, labour and equipment required in the manufacture, transport and placing the precast units in the structure, including also reinforcement steel and other metal parts that are part of the precast element.

202.14.2.8 Cast-in-situ Reinforced Concrete Piles (Not applicable)

202.14.2.9 Joint Seals

Joint seals will be measured by length, and will be paid per linear metre.

The unit rates for joint seals shall include the cost of supplied materials and all necessary works to complete the joint sealing.

202.14.2.10 Elastomeric Support

Elastomeric supports will be measured by units and will be paid separately for each specified support as shown on the drawings.

202.14.2.11 Hourdis Slabs

Hourdis slabs shall be measured and paid for per cubic metre of finished monolithical slab measured to the dimensions shown on the Drawings.

The unit rate per cubic metre shall include for formwork, steel bars, hourdis blocks placing concrete and all related works unless otherwise specified in the bill of Quantities.

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205PLASTERING

205.1 General

205.1.1 Miscellaneous Requirements

Surfaces

i) Nature of surfaces

Plasterworks specified in this Section shall be applied to the following surfaces:

- traditional masonry made of stones, bricks, concrete blocks, traditional floors or with precast small girders.
- ordinary aggregate concrete or lightweight concrete.
- plaster tiles and plates including cellular plaster tiles.
- Plaster plates and perforated cardboard.
- methal lathing.

ii) Condition of Surfaces

All surfaces to be plastered shall be dry, clean, free from soot, efflorescence, dust and oil. They shall be rough and unevenness of joints shall not exceed one third the plastering thickness.

Plastering frozen surfaces is not permitted.

Plastering work shall be classified into internal and external work, each of which may be applied in one-coat or two-coat work as indicated on the Drawings and/or in the Particular Specification or as directed by the Engineer.

The Contractor shall not carry out any plastering on days of extremely dry weather without the prior approval of the Engineer, who may require special precautions to be taken by the Contractor to prevent the early drying out of the plaster. Each layer of plaster shall be wetted prior to placing the next layer and at least 24 hours shall elapse before an additional layer is placed. All corners, whether internal or external, shall be neat and true, special care being taken to ensure a true, straight line at the junction of walls to the ceilings. All finished plastered surfaces shall be even, smooth, straight, plumb, with true angles (except where curved surfaces are shown on the Drawings) and free from trowel marks, cracks and other blemishes. Plane surfaces shall contact a 3 m straight edge with not over 3 mm deviation either way. Plaster showing cracks, blisters, pits or discoloration will not be accepted. It shall be removed by the Contractor and made up again at his own expense to the complete satisfaction of the Engineer.

205.1.2Samples

Samples of each type of plaster to be used in the Works shall be prepared, each sample covering at least 1 square meter. Each sample shall be subject to approval by the Engineer, prior to actual commencement of plastering.

205.1.3Scaffolding

Scaffolding shall be of sturdy and stable construction. Where a decorative spray or thrown finish is required to the plaster, the scaffolding shall not be connected to the wall to be plastered.

205.1.4Repairs to Finished Plaster

Repairs of plaster, at skirting and elsewhere, as for instance around pipework, passages and channels, after the completion of other trades, shall be done in a neat manner so that all repairs will have a uniform appearance, indistinguishable from the general area of the plaster.

205.1.5Levelling Course

A levelling Course shall be applied under all plasterwork and where called for on the Drawings and/or in the Particular Specification or directed by the Engineer, in order to straighten or correct imperfections in the base (brickwork, concrete, etc.). The levelling course shall consist of a cement-sand mix containing not less than 400 kg cement per meter cube of material. The course shall be applied as a thick paste with the aid of trowels, the minimum thickness being not less than 3 mm. Should the thickness be 10 mm or more, reinforcing wire mesh shall be used.

205.2 Materials

Lime shall comply with the requirements of BS 890.

Lime shall be stored in a dry place protected from excessive temperature and wind.

Water shall be of potable quality, clean, fresh, free of salts, chemicals and impurities.

Sand shall be natural sand or quarry sand, free from dust, dirt and organic and foreign matter, complying with B.S. 1198 and 1199. Quarry sand shall not contain fines passing a No. 200 sieve in a quantity exceeding 6% - 8%. The sand for the first coat in two-coat work shall be coarse and graded. For the top-coat the sand shall be fine and well-screened, except where a special plaster made of coarse sand is required. Dune sand shall only be used for the top-coat of smooth internal plaster. The sand shall be supplied to the Site and stored according to type, each type separately. Sand in storage shall be placed on a layer of suitable material or any other stable surface in order to prevent contact and mixing with earth. The use of siliceous sand instead of calcareous sand is advisable.

Additives to control the workability or setting time of plaster may be used only with the prior approval of the Engineer, and shall be suited, in quality and quantity, to the type of cement used. No additional payment will be made to the Contractor for the use of any additive.

Coloured plaster shall be obtained by adding pigmenting powders to white or gray cement or by using coloured cement. Such cement shall comply in all respects with the requirements of the standards for ordinary Portland cement. Pigmenting powders shall be mineral oxide of metals. The use of compounds of organic origin will not be permitted. The pigmenting powders shall be obtained from approved manufacturers. They shall be thoroughly mixed with the dry cement before being introduced into the mixing machine.

Metal Lathing for plastering on false ceilings and partitions shall be expanded metal (XPM), at least 0.6 mm thick, with mesh size openings of at least 12 mm and the opened mesh weighing at least 1 kg per square meter. Wire Mesh used for plastering chases in brick or block work shall be XPM as above or chicken wire with a thickness of 0.7 mm and a mesh of at least 12 mm.

205.3 Workmanship

205.3.1 Preparation of Surfaces

Plastering shall be done only after all other finishing works such as window sills, terrazzo work, electrical work, drain pipes, etc., has been completed. Only with the Engineer's consent in writing will the Contractor be allowed to carry out plaster, prior to the completion of all other works. In exterior plasterwork, care shall be taken to avoid staining or damaging any completed elements of the building.

No plastering shall be done until at least two weeks have passed since completion of the brickwork or concrete on which the plaster is to be placed. All surfaces to be plastered shall be thoroughly brushed down with stiff brushes to remove any efflorescence and all loose and flaky particles. Grease and oil patches must be removed.

Prior to commencement of plastering, all necessary repairs shall be made to the base, protrusions shall be removed and any exposed steel reinforcement shall be covered with a 1:3 cement-sand mortar.

Considerable holes or local unevenness shall be patched with mortar, plaster mortal or plaster. Where holes or local unevenness exceed 5cm, they shall be filled with parts of brick and hollow blocks, as well as, with lime mortar or plaster mortar.

Patching on plaster masonry shall be carried out with plaster or plaster mortar.

Junctions between two different materials (e.g., concrete and blockwork) shall be covered with 15 cm wide strips of XPM mesh. No mesh will, however, be required where junction between brickwork and concrete is toothstepped.

Pipe chases containing two or more pipes shall be covered with wire mesh, the mesh being stretched across the chase with a 5 cm minimum overlap on each side, and fastened down with galvanized nails. The mesh shall be covered with a 1:3 cement-sand mortar. Minor chases, holes, etc., need not be covered with wire mesh, but shall be carefully filled with a 1:3 cement-sand mortar, the face of which shall be slightly roughened.

All repairs shall be thoroughly cured and allowed to dry, and moistened prior to commencing the plastering.

All smooth surfaces, such as concrete, shall be scarified in order to increase the bond of the plaster to the wall or ceiling. In blockwork the joints shall be raked out to a depth of 1 cm and all exterior surfaces shall be spatterdashed in 1:2 cement sand mortar to provide a key for the plastering. The spatterdash shall be wetted an hour or two after application to ensure adequate hydration and shall be allowed to harden thoroughly for 3 days during which time it shall be covered up for protection against the sun and kept moist by watering.

Surfaces to be plastered shall be cleaned and moistened, prior to application of plaster. Where necessary, ingrained dirt and other foreign materials shall be removed by wire brushing. Twenty-four hours prior to application of plaster the

surface shall be soaked with a light spray of water, but not to an excess causing water to flow down the face of the wall to be plastered. During warm, dry weather the area shall be lightly wetted for a second time immediately before commencing the plastering.

205.3.2Plastering

a) General

It is not allowed to re-mix plastering having began to dry out with or without adding fresh plaster.

Plaster mix shall consist of the following:

- cement mortar: 300 to 350 kg of cement per cubic meter of dry sand
- lime mortar: 350 kg of mix (one part of lime to two parts of cement) per cubic meter of dry sand
- plaster mortar: 300 to 350 kg of plaster per cubic meter of dry sand.

Smooth surfaces shall be roughened and cleaned from loose particles or treated with a sand cement or plaster sand mix to which an admixture is added to increase the bond (acetate or vinyl propionate).

b) Type of Plastering

Plastering shall be applied and smoothed by hand in two coats to a methal lathing.

c) Application of fine structural plaster or coarse structural plaster rendering

Plastering shall be applied in two coats, the first is a coarse structural plaster. The mix contains at least 100 kg of plaster per 100 liters of water.

The base coat shall be applied to the levelling course with a trowel but not smoothed. As soon as this coat hardens it shall be scarified with a special tool and the top coat applied.

The mix of the second layer shall be at least equal to that of the first applied. The total thickness shall reach 12mm with a tolerance of 2mm. Where a metal lathing is to be placed plastering shall be 6mm thick.

205.3.3Condition of surfaces

After the surface preparation (wire brushing and removal of loose particles) plastered surfaces shall show no cracks, holes flakes nor streaks of more than 1mm deep. Moreover, the number of holes and streaks of less than one mm deep shall also be limited. Surface unevenness shall be repaired by traditional surface preparation work taken into account the type of paint to be applied and the required finishing quality.

The deflection under a 0.20m long ruler drawn over the surface in all directions shall not exceed 1mm (local evenness). A two meters long ruler drawn over the surface shall not show a deflection exceeding 5mm (general evenness).

The tolerance on verticality shall be 5mm maximum for one floor.

205.3.4Reinforcement of Corners

External corners at intersections of plastered surfaces shall be reinforced by means of special approved angle beads of galvanized steel, aluminium or plastic, all as specified or shown on the Drawings. The height of the angle beads shall be not less than 1.8 m measured above the top of the skirting. The angle beads shall be securely fastened to the base wall under the plaster by use of galvanized nails. Plaster of the type used on the wall shall be carefully filled under and

around the angle bead. The apex of the angle shall coincide exactly with the edge of the corner with regard to position and plumb.

205.4 Methods of Measurement and Payment

205.4.1General

The unit rates for plastering shall include for the use of all tools scaffolding, labour and materials, including supply, processing and use of cement lime - slaked or otherwise - sands, gravels, additives and colouring pigments, mica flakes, and including for metal lath, all as specified and as applicable. Unless otherwise specified, the unit rates shall include for the use of ordinary Portland cement. The unit rates shall also include for all cleaning and wetting of all surfaces prior to plastering and the protection and curing of the plaster, inclusive of all surface treatments required.

205.4.2Measurement

Measurement will be in all cases be net in square meters, as measured on the Drawings, all openings, tiling, skirtings and other areas not covered by plaster being deducted with no allowance for waste, overlap, etc. Reveals, jambs, and rebates to openings (doors, windows, etc.) will be measured for payment together with the general area of the plaster and no special rates will be paid for them.

For purposes of measuring external plaster, the bottom edge will be taken as being 10 cm below final external ground level, unless otherwise shown on the Drawings.

205.4.3

Payment

Samples, making good to other trades and repairs will not be paid for separately and the cost thereof shall be included in the unit rates for plastering, which shall also allow for the supply of wire mesh for covering pipe chases, etc., where required.

Internal or external plaster will be paid under the same item in the Bill of Quantities.

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206 rendering

206.1 general

Rendering with hydraulic binders mortars shall be governed by related B.S. Standards. Rendering shall only be carried out on completed masonry works. It shall be made sure that rain and water have no pernicious action on the good hold of the rendering. It is advisable to render only on elements that have completed the major part of their shrinkage.

Rendering works shall not be started prior to the installation of electric and sanitary equipment, woodwork, metalwork, and all metal fittings. Works include, in additional to rendering, the fill-in of holes caused by the installation of electric and sanitary equipments, metal fittings, etc.. Fill-in shall be carried out with a mortar proportioned at 350 kg of cement per cubic meter of sand.

All finished surfaces shall be even and to the thickness required by the Engineer. They shall be, where specified, straight, plumb with true angles. Rendering showing defects shall be removed by the Contractor and made up again at his own expense to the complete satisfaction of the Engineer.

Samples of rendering to be used in the works shall be prepared, each sample covering at least 1 square meter. They shall be subject to the prior approval of the Engineer. Samples shall be kept on site until the completion of works. All finished rendered surfaces shall comply with the samples.

Markers shall be placed at the rate of one marker by square meter of wall to be coated. Rendering shall be carried out using a plumb line and a ruler.

Unless stated otherwise, rendered surfaces shall be brought even and smooth by using a felt. No rough patches, ridges, nor any imperfections shall be accepted. Connection with woodwork, skirtings, or metallic structures etc... shall be neatly finished and flawless.

Rendering shall be conducted and low-angled light will used so that any flaw such as undulations, ridges, blusters be detected and repaired.

Edges, salient angles, etc... shall be sized and rectified by means of straight wooden or metallic rulers.

Should several elements be set out at a stretch, they must be, after rendering, perfectly aligned and their dimensions rigourously unchanged.

A straight wooden ruler, a plumb line, an air level, a square, and an electric lamp shall be kept continuously on site.

The Contractor shall provide and install at his own expense all scaffoldings and ramps necessary for an easy and safe access to all surfaces to be rendered.

Prior to application of rendering and finishes, surfaces should be thoroughly cleaned and wetted for several hours.

Rendered surfaces shall be wetted after application to ensure adequate hydration and shall be allowed to harden thoroughly for 3 days during which time it shall be kept moist by watering.

Construction joints in rendering works shall be done in a neat manner so that the surface will have a uniform appearance, after having dried and shrinked, indistinguishable from the general area of the rendering.

206.2 mixing of mortar

Mortar can be mixed either manually or by means of mechanical mixers. Should mixing be done by hand, the dry solid constituents shall be mixed first, before water is added, in a very clean area to prevent contact and mixing with earth or other materials. Sand shall be measured in volumes by means of gauge boxes, in such a manner that each batch requires a whole number of 50 Kgs cement bags. Mortar shall be used half an hour maximum following its preparation.

206.3 rendering

Prior to the commencement of rendering, surfaces should be duly prepared.

Rendering generally includes:

- a roughcasting
- an intermediary coat
- a top coat which contributes partially to the structure waterproofing, and could be replaced or covered with a decorative plaster.

206.3.1.1 Roughcasting

External and concrete surfaces, especially if they are smooth, shall be roughcast. Internal rough surfaces shall not be roughcast (e.g. masonry with concrete blocks). This coat shall consist of a cement-sand mix containing 550 kg Portland cement per cubic meter of sand or one part of Portland cement for three parts of sand.

Grading of sand shall be 0.25/3.15 mm and shall contain 10% of fines maximum. Mortar shall be watered to obtain a good workability, and spatterdahsed by means of a broom or a mechanical tool. The surface shall be rough and shall not undergo any other process whatsoever. The roughcast shall cover uniformly the surface. It shall be kept moist by watering for three days at least and shall adhere strongly to the surface. Any roughcast which did not harden thoroughly during the three day time and disintegrates, shall be entirely removed and replaced at the expense of the Contractor. Intermediary and top coats shall be applied, in principle, in two distinct coats.

206.3.1.2 Intermediary coat

The intermediary coat shall give rendering its final shape, the required evenness and waterproofness. It shall be homogenous and compact and consists of lesser quantities of binders than in the roughcasting coat in order to limit its fissurability. Grading of sand shall be 0.1/3.15mm, contain 5% min. of fines < 0.089 mm and be graded.

Intermediary coat shall consist of 450 kg cement per cubic metre of dry sand graded 0.1/3.1 mm. Moisture expansion of sand which is conditional upon the water content and grading shall be taken into account when preparing the mix. This coat shall be applied only after the roughcasting coat has partially shrinked.

The intermediary coat shall not be applied until three days at least have passed since completion of the last coat. However, this period is conditional upon the atmospheric conditions.

Mortar shall be proportioned to a thick workable paste. This coat shall be applied either by hand or mechanically on a moistened roughcasting, in two or more passes depending on the thickness. The surface shall be finished with a float to an even and compact surface.

Smoothing the surface with a trowel is not permitted. It shall be roughened by suing a ruler and meet the requirements of finished rendering (evenness, straight angles, round grooves etc...).

Average thickness of both roughcasting and intermediary coats shall range between 15mm and 20mm according to the tolerances on the substrate in such a way as to cover the entire surface by 10mm at least.

206.3.1.3 Top coat

Top coat or finishing coat is decorative but also protects the intermediary coat and preserves its waterproofness.

Since the colour of grey content is not always uniform, it is advisable, to provide cement from the same source and date of manufacture in order to improve the uniformity of shades. The same applies to sand.

This coat shall be made with an ordinary or decorative hydraulic binders mortar.

Grading of sand shall be 0.1/2mm and contains fines in considerable quantities and free form impurities (clay, gypsum, coal, organic matters, etc...)

The coat shall consist of 350 kg or 400kg of binder per cubic meter of dry sand graded 0.1/2mm.

The top coat shall not be applied until eight to fifteen days have passed since completion of the intermediary coat (average atmospheric conditions).

top coat shall cover the surface uniformly and, in no case, improve the evenness. Troweling, as well as powdering with lime or cement shall not be permitted.

The thickness of the top coat will be 5 to 7 mm.

206.3.1.4 Rendering on metal lathing

The metal lath shall be well blasted 24 hours at the latest after application of the roughcasting coat and securely fastened using rustproof staples or other suitable fasteners. The metal lath shall be a rustproof wire mesh with square openings of at least 30mm x 30mm.

206.4 interior rendering

Interior rendering shall comply with previous clause requirements and consist of 350 kg of cement per cubic meter of sand.

It consists of two-coat rendering applied as follows; roughcasting and top coat.

206.5 exterior rendering

It consists of three coat rendering applied as follows; roughcasting - intermediary coat-top coat.

206.6 exterior admixed rendering

It shall have the same characteristics and specifications as those of the ordinary rendering coat (see rendering) and shall consist of 450 kgs of cement per cubic meter of sand and an additive to control plasticity and waterproofness according to a technical sheet and a technical certificate submitted for approval prior to commencing the works.

This coat shall mainly protect external walls subject to infiltrations and run-offs.

206.7 coloured cement rendering

Coloured cement rendering shall consist of:

- a roughcasting coat
- a first coat, 10 mm thick, containing 400 kg of white cement per cubic meter of sand, scratched in both directions.
- a second coat, 8mm thick maximum, containing 400 kg of white cement per cubic meter of chippings, powder and pigments where called for on the Drawings and as directed by the Engineer.

Mix proportions, quality and colours of chippings, powder and pigments shall be determined subsequently by the Employer. Rendered surfaces shall be smooth and even as shown on the Drawings and as specified by the Employer.

The second coat shall be wetted three days after application to ensure adequate hydration.

Any rendered surface showing imperfections such as: unevenness, cracks, disintegration of white cement mortar, scratches (especially along arises) etc... shall be removed and re-rendered at the expense of the Contractor and under his responsibility. Repair or rendering shall be done in a neat manner so that all repairs have a uniform appearance, indistinguishable from the general area of the rendering.

Coloured white cement rendering shall be consistent with the approved sample kept on site until completion of the works.

206.8 decorative spatter mortar (tyrolean)

Top coat of mortar shall be applied by hand (Tyrolean brush) or mechanically. The top coat shall be applied in two or three layers, having an average thickness of 3 to 5mm. The finished surface is conditional upon the water content, the number of layers, the spatter angle and any eventual finishing treatment. Top coat shall have the same mix proportion as that used in a coloured or white cement top coat, and be applied as follows:

- a roughcasting coat
- a second coat

- a third coat with decorative mortar

Mix proportions are as mentioned previously.

206.9 rendering of basement walls

N.B: Rendering applied to basement walls shall take into account the destination of the premises delimited by the walls, the soil nature and shape, as well as climatic conditions, the nature of support surfaces and the structure design.

Rendering of buried surfaces

General

Rendering applied to external facing of buried basement walls shall comply with the following paragraph.

Technical Specifications for exterior rendering

Minimum layers:

Rendering shall consist of at least:
- a roughcasting coat
- an intermediary coat

Minimum thickness:

Each coat shall be 8 to 15mm thick. The average thickness of both coats shall be 20 to 25mm according to the tolerances of each type of surface so as to ensure a uniform covering of at least 15mm.

Rendering

Rendering shall be applied by hand or mechanically. It shall consist of 450 to 550 kg of cement per cubic meter of dry sand. A waterproofing admixture shall be used according to the manufacturer specifications. Rendering applied to buried structures shall extend to about 20 cm above ground level.

Specifications for interior rendering

Interior rendering shall be ruled by the same conditions specified for 3 or 2 layer-rendering.

Rendering of non-buried surfaces

Rendering non-buried surfaces of basement walls shall comply with the conditions set for rendering exposed surfaces.

206.10 responsibility of the contractor

All rendering which have started to set before application shall be removed from site. Those falling, cracking or suffering any damage whatsoever in the year following the taking over shall be removed and made up again at the expense of the Contractor. He shall take all necessary measures during surface preparation, rendering and setting time so as to ensure quality work, namely, by protecting rendered surfaces with dampened hessian coverings if need be.

These constraints are included in the incidental expenses of the Contractor.

N.B: The use of lime as a plasticizer shall only be permitted upon the written approval of the Employer.

206.11 characteristics

Tolerance

Tolerance is checked by measuring deviation under a 2.00m ruler or a 0.20m ruler. The deviation shall not exceed the following values.

	Under 2.00 m ruler	Under 0.20 m ruler
Spatter rendering	1 cm	-
Between wall lines	0.5 cm	0.2 cm

Plumb

Rendering applied to vertical surfaces shall have a maximum tolerance of 0.01m for each three meters.

This tolerance is only applicable to renderings between wall lines.

Bond

Rendering shall bond to the surface and shall not give a hollow sound when hammered. The rate of bond shall be equal to 0.3 megapascal (3 bars) after 28 days of application.

Three core samples crossing the whole rendering thickness shall be taken randomly from surfaces $50m^2$ at least. The rate of bond shall be the arithmetic average of rates of bond measured in the various points. (The rate of bond shall never be less than 0.2 megapascal (2 bars)).

206.12 Methods of Measurement and Payment

206.12.1.1 General

The unit rates for rendering shall include for the use of all tools scaffolding, labour and materials, including supply, processing and use of cement, or otherwise - sands, gravels, additives and colouring pigments, mica flakes, and including for metal lath, all as specified and as applicable. Unless otherwise specified, the unit rates shall include for the use of ordinary Portland cement. The unit rates shall also include for all cleaning and wetting of all surfaces prior to rendering and the protection and curing of the render, inclusive of all surface treatments required.

Measurement

Measurement will be separate for the various types of render, and in all cases be net in square meters, as measured on the Drawings, all openings, tiling, skirtings and other areas not covered by render being deducted with no allowance for waste, overlap, etc. Reveals, jambs, and rebates to openings (doors, windows, etc.) will be measured for payment together with the general area of the plaster and no special rates will be paid for them.

For purposes of measuring external plaster, the bottom edge will be taken as being 10 cm below final external ground level, unless otherwise shown on the Drawings.

206.12.1.2 Payment

Samples, making good to other trades and repairs will not be paid for separately and the cost thereof shall be included in the unit rates for rendering, which shall also allow for the supply of wire mesh for covering, etc., where required.

Types of render will be itemized separately in the Bill of Quantities. The types will be further subdivided into render on plane surfaces and on curved surfaces.

Types of render to be paid for under separate items include (but are not limited to):

a) Interior rendering
b) Exterior rendering
c) Exterior admixed rendering
d) Coloured cement rendering
e) Decorative spatter mortar
f) Basement wall rendering.

207 - PAINTING

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207 painting

207.1 Material & application

The following subsections deal with paint work on all exposed surfaces such as walls, ceiling, woodwork or metalwork both indoor and outdoor. The term "paint" as used herein shall include:

* Stains,
* Varnishes,
* Emulsions,
* Enamels,
* Pain washes,

and all materials as:

* Oils,
* Putties,
* etc..

All paint materials shall meet the requirements of the relevant British Standards and shall be of an approved manufacturer.

a) The entire paint system used for painting a structure shall be of the same manufacturer. Mixing of paints of different manufacturers on the same structure shall not be permitted

.

b) All paints used shall be subject to prior approval of the Engineer's Representative.

c) The Contractor shall submit for the Engineer's approval a detailed list of the paints he intends to use on the job, stating:

- the name of the manufacturer
- the type of paint
- full specification of manufacturer including directions for handling and use, instructions for thinning (if any) and minimum drying time.

All paints shall be kept on the job site in the original unopened factory containers and shall be protected against the entry of air, water, dirt, or any other foreign matter.

- Paint shall be stored at shaded locations. Storage of paints, their mixing, thinning, etc., shall be carried out in a special paint shed provided by the Contractor for this purpose; on no account will the building under construction be used as paint store.

All paint work shall be performed by experienced and qualified painters, in accordance with the standards of practice.

- Prior to commencement of painting the Contractor shall clean the area and its surroundings and remove all waste building materials, cement bags and dirt. Care will be taken to avoid dropping paint on floors, sanitary installations, and other areas or objects not intended to be painted. All such areas and objects shall be covered for this purpose with sacking or other suitable protective material. Freshy painted surfaces of metal and woodwork shall be suitably protected.

Ironmongery, fittings and other attached fixtures such as:

* doors knobs,
* fasteners,
* locks,
* electric fittings,
* signs,

will be removed whenever possible from all windows, doors, walls, and suitably stored until completion of the paint work and then be properly re-attached to their original positions.

Application of final coats of paint shall be done only after completion of all other building works. No work will be undertaken under adverse weather conditions, in heavy mist, during dust storms, or in case of external paint work, during or immediately following rain.

The choice of every type of paint material shall be in conformity with the specific recommendations of the manufacturer specially concerning the different finishing conditions requested and nature of substrate.

207.1.1General conditions of intervention

Norms applicable are the relevant British Standards requirements, the paintworks include but limited to the following works:

- the preparation of surfaces,
- the material supply needed for the paint work execution
- the supply of the necessary stock of tools, ladders and scaffoldings etc.,
- the paint application on reference surfaces and sample specimen.
- the application of paint on all prepared substrates in conformity with BS, and the prescriptions of these specifications.

- obtaining of the required quality, the finishing aspect, the degree of brilliance, the coloring and the necessary set off colors as prescribed in the specifications.
- the cleaning of all dirts, caused by the painter intervention.
- etc.

207.1.2General co-ordination

The Contractor is instructed to maintain a perfect co-ordination between his paintworks and the other concerned works, aiming to execute in the right time all necessary scheduled works.

- All supply and application constraints shall be due for a complete finishing as defined in the specifications.

- It is strictly forbidden to the Contractor to start the paintworks before the execution of the tile-flooring and the first passage of the pouncing machine being executed and before all having dried perfectly.

- Only the wall preparation and the first paint coats (primer) can be executed before the pouncing machine passage be done. The Contractor can achieve the ceiling paints and wall paints leaving the last coat (only on walls) to be achieved once the polishing of tile-flooring is done.

- A perfect co-ordination must be achieved between all involved parties.

207.1.3General execution conditions

The Contractor must insure a perfect execution of all paintworks

- All paint material and products used and their application procedures must be of such quality to satisfy the Engineer requirements.

- In particular the Contractor must present to the Engineer approval and before any commencement of paintwork a sample of each approved material to use. The Engineer preserve for himself the right to proceed to testing and analysing of the materials at the reception and in the course of execution.

- If the controls operated reveal defects in the quality of products used or in the procedures of application, the Contractor must proceed to the complete reparation at his own cost and responsibility of all the disapproved works.

- The Contractor must bear all execution costs of such works as necessary sampling to determine on the job site the tint to be chosen after agreement of the Engineer.

207.1.4Particular execution conditions

The application of paints, varnishes, emulsions, mastics etc., shall start only when surface to be painted has thoroughly dried out, provided that at least one dry (or summer) month and two wet (or winter) months have elapsed since plaster or concrete have been placed.

- Ambient temperature of application must be higher than 18°C and the ambient atmosphere must not be too humid favouring condensation or too dusty.

- The substrate must not be overheated or frozen.

Cement renders and concrete shall not be painted before at least one weak after the execution.

Ceilings in particular, receivant oil paint must receive previously a layer of isolation product necessary to avoid absorption difference in the render substrate and uneven discoloration in careful finishing.

All ironmongery works must be chemically clean before painting with no trace of calamine, rust, humidity, grease and dirt, etc.,

- Decalamination must be obtained by natural oxidation, it must be later on followed by hammering and rubbing down.
- Calcium deposit shall be removed by hammer or abrasive disc if necessary.
- Rust must be cleared of by dry rubbing with a metal brush, by hammering, by rotative brush or by glass-paper.
- Mortar dirt must be cleaned by rubbing down with a metal bross.
- Grease will be removed by cleaning with "white spirit".
- Pouncing will be done with pouncing stone, so that it does not subsist on the surface no grain or roughness.
- No painting will be applied unless on a surface perfectly brushed, and all sandy particles or any non adherent mortar or any trace of dust has been removed.
- During painting works, the Contractor must ensure a suitable and complete protection of the soil, woodworks, glaziery, piping system, etc., and the gradual cleaning of all finished works.
- When instructed by the Engineer and for carefully finished surface, the paint will be applied on these surfaces with special preparation such as:
    * refitting,
    * filling up of all cracks, holes, pits or other surface imperfections,
    * cleaning all dirts and concrete traces,
    * etc.,

207.1.5Cleaning after painting

At the end of painting works, and when reception of these works is made possible, the contractor must proceed to the complete and perfect cleaning of all construction elements such as:

* floors
* walls
* plinth
* pipes

- All precautions must be taken by the Contractor to avoid damaging the places, using procedures or products nonadapted to a perfect execution of the cleaning works. If the cleaning is not realised as instructed, detailed and approved, the Engineer will reserve for himself the right to undertake new cleaning works by another special enterprise of his choice, all expenses for these operations being beared by the Contractor.
- Selection of paint materials

All paints to be used shall comply with the requirements of the relevant British Standards, or where specified in any other standard or specification, and shall be subject to prior approval of the Engineer's Representative.

- The Contractor shall attach to his approval request a detailed list of the paints he intends to use on the site. This list shall contain the following informations:

  * name of manufacturer
  * type of paint
  * full manufacturer original specification, including directions for handling and use, instructions for thinning (if any) and minimum drying time.
  * full original catalogue of the whole products form the manufacturer.
  * etc.,

- All paints shall be kept on the job site in the original unopened factory containers and shall be protected against the entry of air, water dirt, or any other foreign matter.
- Paints shall be stored in shaded locations.

- Thinning of paints will not be permitted except to manufacturer's instructions, if any.

Manufacturer's instructions as to storage, handling, thinning and application of paints shall be strictly adhered to.

- The entire paint system used for painting accessories of the same installation unit or structure shall be of the same manufacture.

Choice of product by the Contractor must take in account:

* the aptitude of the product to fulfil its function,
* the kind of protection needed,
* the finishing surface projected,
* all prescriptions of the specifications.

The following requirements shall apply to the different types of paints: (steel pipe installations and steel structures)

No.	Type of paint	Standard	Drying time
1	Oil-based red lead primer	/BS/2521 and /B.S./2523	24 hours minimum
2	Synthetic red lead primer	Federal specification: TT-P-86G type II	24 hours
3	Iron oxide paints	B.S./2524	12 hours minimum between coats
4	Aluminium paints for cover-coats	M/69	24 hours minimum
5	Cover-coats paints, (other than Aluminium paint)	These paints shall be synthetic paints for steel structures, and shall meet the requirements of the relevant B.S. standard and shall be of an approved manufacturer	As specified in Particular Specification and/or directed by the Engineer

N.B.: When more than one coat is specified (of primer or of the same paint) successive coats shall be of different, easy distinguishable tints.

Generally all surfaces to be painted shall be:

* clean,
* dry,
* smooth and
* free from dust, grit, and other foreign matter

- All nails shall be countersunk and stopped with putty, prior to painting.

Concrete and plaster surfaces: concrete and plaster surfaces receiving paint finishes shall be thoroughly cleaned of:

* dirt
* laitance
* incrustrations, and
* foreign matters
* etc...

- Cracks, holes pits or other surface imperfections shall be neatly and smoothly filled.

Metalwork: preliminary substrate preparation shall be done in accordance with Section 207.8 of these Specifications.

The primer coat shall be applied to cleaned surfaces within four hours from the completion of the cleaning.

207.1.7Preparation of Surfaces

a) General

All surfaces to be painted shall be clean, dry, smooth, and free from dust, grit and other foreign matter. All nails shall be countersunk and stopped with putty prior to painting.

b) Concrete and Plaster Surfaces

Concrete and plaster surfaces receiving paint finishes shall be thoroughly cleaned of dirt, laitance, instructions and foreign matter. Cracks, holes, pits or other surface imperfections shall be neatly and smoothly filled.

c) Metalwork

Preparation of steel work at the works shall be either:

- Hot dip galvanised to BS 729 with a median thickness of 85 microns (0.0034") or
- Grit blasted to BS 7079 Grade SA 2.5 and zinc sprayed within 4 hours to BS 2569 Part 1 to a thickness of 125 microns (0.005") followed by one coat of approved etch primer.

Typical finishes (with compatible primers) based on BS 5493 are given below.

- Steel work and ferrous castings exposed above water/sewage level

Either high build micaceous iron oxide or chlorinated rubber to give a minimum total dry film thickness of 300 microns or, one coat of two pack epoxy primer and further coats of epoxy paint to give a total dry film thickness of 270 microns.

- Steelwork below water/sewage level

Either epoxy system as above or coal tar epoxy paint system to give a minimum total dry film thickness of 450 microns.

- Ferrous castings and fittings without substrate below water level.

Coal tar epoxy paint system to give a minimum total dry film thickness of 450 microns. These coatings shall be subject to the Holiday test.

the surface of all non-ferrous parts usually painted shall be cleaned, rubbed down, stopped, filled and given one priming coat of paint.

Anti-corrosion coatings for any steel or iron used in pipework, pumps, valves, etc. in contact with potable water, shall be either a compatible bitumen material to BS 3416 or a polymeric anti-corrosion coating complying with Water Industry Specification WIS 4-52-01.

Any damage occurring to any part of a painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed. Any finish coat applied on site shall be considered for decorative purposes only.

Manufactured articles to be galvanised shall be hot dip galvanised after complete fabrication and no bending, cutting, drilling, riveting or threading shall be permitted after galvanising.

207.1.7.1 The care of galvanised articles when transporting, storing and erecting them shall be in accordance with the recommendations of BS 729. The renovation of small areas of damaged coating not exceeding 40mm^2 shall be in accordance with Appendix D of BS 729 and subject to the Engineer's approval.

207.1.7.2207.2 Painting application

207.2.1General

All paint application shall meet the requirements of the relevant British Standards and shall be applied in conformity with the manufacturer's recommendations.

- All paint cans must not be open before application, the product homogeneity must be insured by extended mixing with appropriated tools.
- In case the product is transferred to another can, it must be mixed before utilisation and it must to remain any deposit in the original can.
- Products shall be delivered with sufficient fluidity to permit normal application.
- Solvent additional or dilution of the product is forbidden unless approved by the Engineer.
- A detailed technical leaflet will be submitted to the approval of the Engineer before any application.
- A quality control of the surface will proceed any paint or primer application.
- All surfaces must be dry and drying time between coats must be respected by the Contractor.

207.2.2Primer or undercoat application

See preparation of surfaces.

207.2.3 Intermediate coats

These layers aim to constitute a lining which thickness and resistance can insure an effective protection system.

- Mode of application of the intermediate coat is left to the Contractor choice (Brush, roll, gun)
- In the case of several intermediate coats, each coat must be of different color easy to check and the product must ensure good adhesion to the finishing paint coats.

207.2.4 Finishing paint coats

The finishing coat(s) must answer:

By the nature of the applied lining, to the particular conditions of the ambient in which the protected surface exist. In particular, the immerged surface must be protected against parasitic attaques from animals or vegetals.

By the choice of conventional colors, to the relevant existing security prescriptions. colors fixtily is then required so as to satisfy imposed visibility conditions.

207.3 Interior paints: Latex Base concrete and mortar substrate

All interior paints must conform to the relevant British Standards.

- The interior room partitions will be covered by a washable LATEX -BASE paints, wherever indicated in the Drawings or ordered by the Engineer.
- The Contractor shall submit samples of the paints he intends to use to the Engineer's approval.
- Paints shall be washable, of a perfect solidity and shall allow a flawless application.
- A perfect resistance of the color so the effect of light is also required.
- Surfaces to be painted shall first be cleaned, and sand papered before the application of the first coat or sealer. A second sanding shall be followed by the application of a primer coat.
- Then two (2) paint coats shall be applied in conformity with the color and sample approved by the Engineer.

207.4 Exterior Paints

For exterior surfaces a plastic paint ready to use under the form of a unctuous thixotropic paste will be used.

- This product is composed of vinylmaleate resins or similar, in water dispersion of noble pigment (Titane rutile, or similar), and siliceous charges, and fungicide agents.
- Tints area obtained with pigments resistant to the effects of exterior light (U.V. specify).
- The product must adhere perfectly and be totally waterproof offering a perfect resistance to chemical agents, to heat and fire.
- The Engineer reserve for himself, the right to proceed to any chemical analysis of his choice to insure the quality of all components. All costs to be beard by the Contractor.

Exterior surfaces must be: neat and clean, without grease dustless after brushing.

- Before any commencement of application of the paint, the Contractor shall apply a primer coat (undercoat) acting as substrate surface regulator insuring an homogenous substrate which is extremely important when applying a plastic paint on these surfaces.
- The Contractor shall use in preference an alxeol roll that it soaks in the product paste garnishing all the cells of the roll.

Application must be in thick layer and always starting from down toward upper zones.

The product must be applied in important quantities but not spread.

- A compressor can be used for application of not less than 2.2 kg/m^2.

A technical detailed leaflet must be submitted by the Contractor to the Engineer approval.

Intermediate coat remains a facultative one when dealing with new works, but the durability of the paint will be improved by the application of:

- One (1) layer when new works are involved.
- Two (2) layers when dealing with rehabilitation works.

The finishing exterior layer aspect will be as approved by the Engineer:

- mat, poach, in elementary finishing
- mat, satinated, poached in current finishing
- mat, satinated or shinning in careful finishing,
- etc.

N.B.: for exterior works, quality criteria for protection and durability will prevale on finishing aspect criteria.

207.5 Interior paint - latex based with puttying

This type of paint shall be used in specially neat surfaces and where indicated on the Drawings, the specifications, and where ordered by the Engineer.

- The paints to use shall be of the same type and shall have the same specifications as those in Section 207.3.

- The mastic shall be of a quality approved by the Engineer. It shall be delivered to the site in closed boxes, or composed on the basis of 60 to 70% of zinc and linseed oil.

- After cleaning and sanding the surfaces to be painted a first coat of sealer shall be applied. The mastic shall then be applied in two coats along two perpendicular directions. Once dry the first coat shall be sanded and rubbed with sand paper. Then an undercoat shall be applied, followed by the latex based paint coats as specified in Section 207.3.

207.6 special paints

These paints shall be used in places that are exposed to knocks and dirt. They shall be washable, resistant to sand jet No. 1 at a pressure of 125 kg. Their colors shall be permanent and inorganic pigment based, the support being a polyester based synthetic resin without an evaporative solvent or alcoholized or toxic matters, and hardener by polymerisation.

They shall be applied by means of a spray gun or by roller and shall have a granular texture obtained by application of a fiber glass reinforcement. The application shall be in accordance with the manufacturer's instructions. At least two coats shall be applied, not counting the fiber glass reinforcement.

207.7 varnishing on wood (not used)

207.8 oil paint on wood or plaster

All interior wood carpentries such as doors, panels, cupboards, etc.. as well as all surfaces shown on the Drawings or specified, shall be coated with two oil paint coats on the undercoat together with all surface preparations: brushing, sanding, dusting, etc.

Undercoats shall be applied before the installation and after reception of the carpentry by the Engineer. All carpentries shall be perfectly undercoated on all faces, frames, and rebates. All necessary touch-ups shall be executed before starting the works. The paint coats shall be applied successively. Colors shall be as instructed by the Engineer.

Oil paints shall be of the best quality. They shall be composed of zinc oxide, turpentine and well purified linseed oil. Siccatives shall be turpentine-based.

The theoretical composition of paints shall be as follows:

- Fat dye:	
Zinc oxide	0.600
Linseed oil	0.270
Turpentine and siccative	0.130
	1.000
- Thin dye:	
Zinc oxide	0.550
Linseed oil	0.187
Turpentine and siccative	0.263
	1.000

Before installation, all iron fittings shall be coated with red lead paint, after brushing off the rust, degreasing and dusting.

The zinc oxide shall be 98% pure and shall not contain more than 2% of plumbiferous impurities.

The mastic, of an approved composition, shall be applied in two layers spread in opposite directions. Once the wood surface is perfectly equalized, the oil paint is applied in two layers according to the approved color and sample.

207.9 oil PAINT on metal

Metal works to receive oil paint shall be shown on the Drawings, specified herein, or where indicated by the Engineer. They shall include but not limited to sheet metal doors, gratings, metal chassis, balustrades.

- Surface preliminary works shall include:
  - * removing the rust
  - * degreasing
  - * dusting
  - * etc.
- Surface preparatory works shall include: two protective coats either of red paint or zinc chromate.

Then, two oil paint coats shall be applied. The shades shall be selected by the Engineer from samples submitted by the Contractor on site.

207.10 liquid epoxy coating

This coating shall be based on liquid, chemically cured epoxies. The curing agent may be an amine, amine-adduct, or polyamide. Materials used in both the primer and finish coats shall be products of one manufacturer.

The coating shall be suitable for use in irrigation water. It shall be used for:

* steel sluice gates,
* pipes,
* mechanical couplings,
* flanges,
* similar appurtenances for steel pipe fittings, nuts, bolts
* and other items used in conjunction with connections and attachments.

Surface preliminary works

- The surfaces shall be first cleaned to remove:
  * oil
  * grease, or
  * other foreign matters.

- Only approved procedures and solvents (that do not leave a residue) shall be used.

- The surface shall be abrasive blast-cleaned with sand, steel shot orgrit to achieve a near white metal surface.

Application of epoxy coating system.

- The coating system shall be applied as recommended by the manufacturer. It shall consist of at least:

  * a two part chemically cured epoxy primer as a preparatory surface coat.
  * two coats of a different two components, chemically cured epoxy top coat.

207.11Painting - Measurement and Payment

Painting shall be measured for payment by m2 of net area of surface which has actually been painted, after the deduction of all openings and areas which have not been painted. Painting shall be classified according to the types of paints and number of coats. Each unit rate shall include for the supply of all paints and materials, cleaning and preparation of all surfaces, application of all necessary painting and all extra work on corners and edges, and for all materials, equipment and labour necessary for the completion of painting in accordance with the Specification and Drawings and to the satisfaction of the Engineer.

Unless otherwise specified, painting of all steel structures, and structural elements, exposed steel pipe installations, non-structural metalwork and wood joinery in buildings shall not be paid for separately and the cost thereof shall be deemed to be included by the Contractor in his unit rates for the supply, installation, erection and fixing of these items.

209 - METALWORK

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208 metalwork

209.1 GENERAL

209.1.1 Scope

The work required under this Chapter includes doors and windows in buildings, gratings, hand-railings and miscellaneous non-structural metalwork and shall be in accordance with British Standards.

The Contractor shall supply all the metal, ironmongery, paints and auxiliary materials required, shall manufacture the metalwork and shall install them in the required positions and paint them - all in accordance with the Drawings and the Specification, or as directed by the Engineer.

Alternatively, the Contractor shall supply and install standard factory-made elements, approved by the Engineer. Such elements shall also meet all requirements of this Division.

Steel for doors, windows and other metalwork shall be new, first-grade quality mild steel, without mill defects, cracks, grooves or rough surfaces and shall comply with all requirements specified on the Drawings and/or in the Particular Specification.

Hardware, metal fittings and accessories

These elements shall comply with standards and be of first grade quality and approved manufacture. They shall be carefully installed, all notches having the required sizes and depths so as not to impair the solidity of rolled sections.

209.1.2Metalwork

All shapes, bars and plates shall be cut, drilled, bent and otherwise worked to the exact lines and dimensions shown on the Drawings. All burrs resulting from cutting and drilling shall be neatly removed. Where cutting is done by oxyacetylene torch, cut surfaces shall be clean and smooth.

Hinges and locks shall be secured by means of metal-screws for any eventual unmaking. Other accessories may be welded. Unless otherwise specified, bolts, casement bolts, locks, etc, shall be mortised. Hinges shall be solid and of quantity corresponding to door leaves size and weight. They shall have the exact required sizes and allow an easy setting and replacement. Locking devices such as locks, buttons, crutch handles, bolts, etc.. shall immobilize totally the door leaves in closed positions.

Metal fittings are integral parts of each door or hatch even when not explicitly stated in the work description.

The Contractor shall take on site all dimensions deemed necessary for metalwork and remain wholly responsible for their good adaptation to the concrete and masonry works in the building.

Jointings shall be notched and angles mitred. Electric welding shall be as continuous as possible along the joint after filing the metal elements.

After soldering, burrs and slags shall be trimmed completely. Holes shall be drilled by means of an electric drill fitted with a bit having a smaller diameter than the hole, then with another having the same diameter as the hole.

Distances between holes shall be as follows:

- Distance between hole edge and section edge ≥ hole diameter
- Distance between axes of two consecutive holes ≥ 3 × hole diameter
- Axes of aligned holes : a size margin equal to one tenth the hole diameter
- Irregularities in distance between holes $\leq \frac{1}{10} \times$ hole diameter.

The Contractor shall supply and install any material whether specified or not on the Drawings, but necessary for the good execution of the works.

Surface finishing

Surface finishing of works shall be in strict accordance with the General Technical Specification and shall include the protection of materials and the surface treatment.

Exposed surfaces shall have no unevenness, burrs, or metal run-out. Salient angles and projecting parts shall be rounded off. Welds shall be carefully ground. Screws shall be inserted and then painted. Accessible bolts shall be covered. Element showing appearance or assembly defects shall be rejected. It is expressly forbidden to cover and hide these defects.

Protection of metals against corrosion

No metal part shall be accepted on site unless previously protected against corrosion. Elements shall be in-factory protected according to relevant applicable standards. Unprotected iron parts shall be painted after removal of calamine, rust, and oil, with a rust proof zinc chromate paint, 60 microns thick, compatible with the top coat specified in the relevant Section (or eventually with two coats of red lead). Immediately after installation, any painted surface showing imperfections due to impacts or handling shall be wire brushed and repainted.

Contact between differents metals

All measures shall be taken to avoid electrolytic corrosion caused by the contact between metal parts and accessories (screws, bolts, washers, etc ...) of various natures.

Greasing

Upon the completion of works, the Contractor shall grease all mobile metal fittings such as hinges, locks, etc ...

209.2 Workmanship

209.2.1Manufacture

Details and profiles shown on the Drawings constitute the basic Drawings. Works shall be solid, rigid and have a perfect finish. The components shall be one-piece. Connections shall be right-angled in such a manner as to resist, without deformation nor rupture, mechanical tests and the efforts imparted to them.

Jointings shall be notched and angles mitred so that sections join at right angles without overlapping. Welding shall be continuous along the joint after bevelling the metal. Holes shall be drilled by means of a drill fitted with a bit having the same diameter of the hole. Elements shall be cleaned of all slag and burrs.

209.2.2 Assembly

Metalworks shall be fixed to their support (concrete and masonry works, partitions) by welded inserted plates, holdfasts, screws and expansion bolts or any other approved system. The use of a stud gun SPIT is prohibited. Anchor bolts shall only be used in concrete works or hollow blocks masonry; only traditional anchoring means are permitted for other surfaces. Anchors shall be screwed, bolted or welded on locks. Their section, shape, length and number are conditional upon the element sizes and installation conditions.

Fixing devices proposed by the Contractor shall be shown on shop Drawings. Fixing devices shall be placed close to hinges in order to diminish stresses.

All welding shall be done by the shielded electric-arc method by experienced welders, to the highest standards of workmanship and to the satisfaction of the Engineer. Electrodes for steel welding shall be of a kind and class approved by the Engineer. All surfaces of parts to be welded shall be well cleaned of dirt, rust, slag, and paint. All slag and splatter adhering to metal shall also be removed.

209.2.3Installation

Prior to installation, the Contractor shall wedge and adjust the different elements so as to ensure perfect plumb, alignment and levelling.

He shall ensure all required sealings and caulkings for fixing the works. He shall set out all his works and verify the location of openings left in the structure.

209.2.4 Tolerances

a) Tolerance on setting out

Maximal variation between the real position of each axis of metalwork and each axis of an opening in a wall shall not exceed 1 cm.

b) Tolerance on installation

Rectitude and plumb errors in door frames, stiles, and posts shall not entail a deviation exceeding 2 mm, provided that stiles and posts be parallel to ± 2 mm in all points and planes.

Rectitude and levelling errors in crosspieces shall not exceed 2 mm for the first meter and 1 mm for each additional meter with a maximum of 4 mm.

c) Tolerances on leaves play

The play between leaves and the finished ground shall vary between 5 and 10 mm regardless of the opening position.

d) Sealing

Air and watertightness between the structure and the metalworks shall be ensured by stable and 10 year guaranteed sealants. They shall be easily replaced. The unit rates of metalwork shall include the cost of all sealants.

209.2.5Handling and storage

Unloading and handling of elements shall be done without causing any permanent deformation or defect that might impair the good functioning of mobile parts, or their resistance to corrosion.

Elements shall be stored in dry premises on appropriate horizontal and vertical devices avoiding any deformation whatsoever.

209.2.6 Samples and mock-ups

Samples of hardware to be used shall be as shown on Drawings.

Prior to any serial manufacture, a mock-up of each type of work shall be submitted for approval, namely:

- Ventilation grilles
- Handrails
- Guard-rails
- Protection bars
- Etc ...

The Contractor shall submit to the satisfaction of the Employer all varnish samples.

209.2.7 Locks

Locks shall be supplied with 3 keys bearing each a permanent label indicating the premises they are intended for. The loss of a key on the day of taking over entails the changing of the relevant lock at the cost of the Contractor. Prior to installation, all types of locks shall be submitted to the Employer for approval. The outside locks shall be resistant to atmospheric conditions.

209.2.8 Sections, painted wrought iron

Hatches, balustrades, guard-rails, angle-irons for antennas, handrails, stiles, posts and crosspieces, rungs, ladders, etc, ... shall be made of sectional irons, flats, pipes, etc ... and have the dimensions shown on the Drawings. Works shall be carried out according to the above-mentioned specifications. Paint shall be consistent with the specifications mentioned in the relevant Section.

209.2.9 Ladders

Ladders shall be of galvanized tubes or sections to the dimensions shown on the Drawings. They shall be painted according to the relevant Section.

Ladders shall be fixed to the upper platform and to the floor taking into account all works to be performed under other Sections (ex: waterproofing works, ...) as well as all above-mentioned conditions. Where specified, ladders shall be fitted with safety hoops.

209.2.10 Metal shutters

Rolling shutters with fastened metal blades shall be of cold-rolled and galvanized steel, with a minimum thickness of 7/10 mm, with lateral bolting of each blade. The steel curtain should withstand without deformation a load of 400 kg/m².

Scroll axes, gears, winches, etc ... shall be of stainless metals or metals that are especially treated against rust by galvanization or any other approved process.

Guide bars shall be hot-rolled and galvanized channel irons of 30 mm minimum depth and embedded in the masonry or the concrete.

Operation shall be by winch and built-in crank, with a lock system constituted of six-turn brass lock with 35 cm cylinder. The scroll axis shall be fitted with springs that balance the curtain at any height.

The shutter case shall be of galvanized sections and 7/10 mm sheets with all necessary reinforcement to ensure a perfect rigidity and easy dismantling and maintenance. Components shall be galvanized, coated with an epoxy primer and painted, as specified in the relevant Section.

209.2.11Glazing (Not used)

209.3 Miscellaneous metalwork

Miscellaneous metalwork shall comprise grating, handrailing, hatches and other metal parts as shown on the Drawings or directed in the Particular Specification. The work shall be carried out to the exact details shown on the Drawings, to the highest standards of workmanship and to the satisfaction of the Engineer.

209.4 Methods of measurement and payment

Metalwork shall be measured either by number, according to type, size, etc. or by square meter, or by kilogram, all as shown on the Drawings and/or as specified. Each unit rate shall include for the manufacture, supply, transport, handling, fixing, glazing ironmongery, painting, and anodizing, and for all materials, equipment and labour necessary for the completion and installation of all metalwork item in accordance with the Drawings and the Specification and to the Engineer's satisfaction.

214 - WATER PROOFING AND THERMAL INSULTATION

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214 Water proofing, THERMAL INSULATION and disinfection

214.1 GENERAL

The provisions of this division shall apply to the:

a) Waterproofing of the inside surfaces of the new water retaining structures (reservoirs)

b) Waterproofing of old reservoirs under rehabilitation.

c) Waterproofing "old or new treatment plants" namely:

- the decanters,
- the filtering system
- the retention basin after filtering.

d) Waterproofing and eventual thermal insulation of all reservoir covers and building roofs.

e) Testing and disinfection of liquid retaining structures and roofs.

214.2 Waterproofing materials and application

214.2.1.1 New Reservoirs

The type of concrete for new reservoirs, is required to be waterproof as well as load bearing.

The inner surface of drinking water reservoirs (slab, walls and under roof) shall receive a surface waterproofing coating based on chemical treatment by crystallization or mineralisation and which will improves the waterproofness of the watertight concrete reservoir.

This surface coating shall be applied after concrete has almost complete shrinkage.

- This coating is applied in liquid and/or sludge form and will penetrate the concrete down to a variable depth depending upon the products, the porosity of concrete, the period of time elapsed since application, etc..

- The penetration develops in a naturally humid or moisturized concrete a chemical reaction between the impregnation compound and concrete free lime and forms insoluble crystals that seal the capillary system.

These products are constituted generally of a mixture of:

- siliceous products,
- active chemical products,
- Portland cement.

These products known under the name of crystallization or mineralization products have a long permanent action specially on concrete from artificial Portland cement C.P.A. which generate a large quantity of free lime during the hydration cycle.

The non-soluble crystals shall be activated to a depth of more than 20mm, depending on concrete compactness.

The Contractor shall contact the manufacturer to obtain all conditions of use and specifications concerning the product and specially:

- the methods for surface preparation,
- the number of vertical and horizontal coats,
- the treatment of all singular points,
- etc...

The products and applications shall be guaranteed for a period of ten (10) years from both the furnisher for the products and the Contractor for the good execution.

The advantages and limits of use of these products can be resumed as follows:

- The coat can be applied on a humid surface,
- Additional or repeated applications are possible,
- Singular points can be coated with special techniques stated in the technical sheet.
- These coats may be applied only on surfaces showing micro-cracks; existing cracks or those which appear after filling the reservoir shall be treated as specified in the technical specifications.
- These coats are deemed to improve the waterproofness of the concrete surface as well as its resistance to chemical actions (condensated water, etc.)

There is a wide range of surface waterproofing products, efficiency of which, must be checked.

Only products which have been subject to satisfactory test by a Control Bureau, shall be proposed by the Contractor to the approval of the Engineer for coating the inner surfaces of the new reservoirs.

The application of the surface waterproofing coats must be done on a duly prepared and sound concrete surface. The products penetrate to the necessary depth that is in relation with several conditions of concrete substrate and water pressure; the development of non soluble crystals (crystallization or mineralisation) allows the concrete to reach a degree of waterproofness that varies with the homogeneity of the concrete (compactness) and the size and pore's structure (capillary).

It is recommended, if approved by the Engineer, that the Contractor eventually backfills the external surfaces of the reservoir before application of the coats to insure a more constant temperature of the inner surface to be coated.

The concrete surface shall be cleaned with a strong water blasting or wet sand blasting to remove all loose particules and open all surface pores, thus facilitating the penetration of the product during application.

The Contractor shall reduce the inside high relative humidity by natural or forced ventilation to obtain a dryer inner condition avoiding eventual condensation (generally 3 days dehydration are deemed necessary before and after application). The condensation effects often cause water rivulets to seep on reservoir vertical walls washing away the unset coating.

No application must take place when extreme high humidity exist in the inside of the reservoir (> 90%) because this will prevents the adhesion of the coats on a humid substrate.

Condensated water is very soft and adversely affects the cement curing process, and in extreme cases it can prevent the coating material from quick setting and causes it to disintegrate later.

The Contractor is asked to dehumidify the interior of the reservoir before and after placing the inner final coating to prevent condensed water from running down incurred surfaces.

The surface waterproofing coating must provide on the concrete a smooth and homogeneous surface.

That is why qualified personnel under the supervision of an expert from the manufacturer must insure that the products are applied in conformity with the manufacturer's technical specifications.

Special attention shall be paid to coating singular points such as:

- eventual construction joints, and specially,

- pipe penetration, location and treatment of which must be previously agreed with the Engineer.

The Contractor shall follow all the steps and the several phases of application in conformity with the technical specifications of the manufacturer as well as with the site instructions of the Engineer.

In some cases the inner surfaces of potable water reservoirs shall receive a flexible protective and waterprofing slurry. The product shall be composed of a cement based two component polymer modified waterprofing slurry (liquid and powder) and shall be applied to concrete to prevent water infiltrations. The product shall be suitable for external and internal waterproofing. Concrete surfaces must be clean-free from grease, oil and loosely adhering particles and as flat as possible. Application on saturated surfaces of two coats minimum. is always required. Mixing, application, curing and cleaning must be in conformity of technical data sheet of approved material.

214.2.1.2 Existing Reservoirs under Rehabilitation

These underlined provisions shall apply to the materials, execution procedures related to the rehabilitation of the existing reservoir's concrete structures.

The waterproofing materials and products concerns mainly: the inner reservoir surfaces (walls, slab and under cover); the exterior surfaces and the upper cover are not included in these provisions).

The rehabilitation of existing reservoirs concerns the execution of the following steps (non limited list)

- the Concrete repairs of the inner surface
- the application of a new waterproofing treatment based on an approved thin ready-mix mortar as a "first layer" and a final protection coating as a "second layer"

a) The concrete repairs and protection to existing reservoir structures

The purpose of damage assessment made previously on existing reservoirs aimed to facilitate to the Engineer and the Contractor the research of the specific causes of the reservoir structural damages, prior to planning the repairs procedures works by the Contractor.

The structural investigation must meet later on, confirmation by the contractor using appropriate methods of analysis to examine the damaged members and zones of the existent reservoir (case by case) and produces a diagnosis to form the basis for successful repairs.

Otherwise specified by the Engineer the Contractor shall follow several defined steps under the supervision of the Engineer.

Step one or site survey: concerns the general description of the structure it consists of the production by the Contractor of the following: (non limited list).

- Plans, sections and elevations of the existing structures (with at least 5 colored photos) by site reservoir,

- Indications on the plans and sections of all zones where cracks, defects, weak points, penetration pipes etc. appears in the reservoir structures.

N.B.: This first step is important and is needed for to confirm and complete previous damage assessments, and most of all to elaborate for each reservoir a basic record which could help to resolve future eventual conflicts.

Step two or structural survey: concerns the preliminary works on the inner surfaces of the reservoir; the works are resumed as follows (non limited list).

- Removing of all existing render and coating and deteriorated concrete substrate from the inner surface of the reservoir.

- Applying a high water jetting pressure on the nuded concrete substrate surfaces aiming to remove all dirts, contamination and loose friable matters (pressure of water jetting ≥ 200 bars)

- A first visual examination or "auscultation" and an analysis must reveal to both the Engineer and the Contractor: the several weak points and singularities, to be treated, as well as the average depth of carbonation of concrete substrate.

- A special attention is to be given by the Contractor when analyzing the ground floor slab, and the foundation of each reservoir to insure that no differential settlement may have been the cause of living cracks.

N.B.: The Contractor must at this stage be able to submit to the Engineer his proposal for the materials to be used and the procedure for repairing, using approved materials.

Third step: concerns the carry on to the repairs after the detection and listing of the various defects in the structure, substructure and cover, and after the approval by the Engineer of the Contractor's proposal for both the materials and repair procedures.

The common defects and weak points encountered can be resumed as follows: (non limited list)

- Inside cracks in the inner concrete surface (dead cracks, moving cracks, trespassing cracks)
- Construction joints (concreting stopping)
- Blasted concrete zones and corroded steel reinforcement.
- Penetration leaks and other leaks.
- Bad inserts to be removed.
- Bad accessories (cover inlet, ladder)
- etc..

N.B.: The Contractor at the end of this stage must have the approval of the Engineer concerning the substrate's final and good preparation state, and ready to receive the new waterproofing treatment based on the approved thin ready-mix mortar as a first layer before the second application of the second final layer concerning the final protection coating described in part c.

b) Thin ready-mix mortar render

This provision concerns the first inner layer sealing following the approval by the Engineer of the final substrate preparation of the inner concrete support.

This cementitious sealing mortar is normally used to render the internal surfaces of the potable water reservoirs.

This ready-mix mortar render has to meet extremely high standards. This product consists of specially selected and graded sands, special cements and various admixtures. Factory production and continuous inspection are a guarantee of consistent high quality.

The ready-mix mortar specifications must indicate having been tested, to food and drink regulation standards and having been approved for potable water contact.

The pre-batched mortar is delivered to site in palleted bags which take up little storage space (in a dry place). The mortar can be produced using a mixing tank and a small mechanical mixer. Its good workability and laying time for only two layers also helps to reduce the contract time.

N.B.: The Engineer has decided to forbid the in-situ traditional heavy mortar fabrication (applied in 3 or 4 stages) and instruct the Contractor to use the only thin ready mix mortar approved by the Engineer.

The main properties of the thin ready-mix render are the following: (non limited list)

- Two layers are enough generally (unless some specific zones need a thickness that could reach 20mm thick in surface restoration and where more layers may be necessary to render the substrate homogeneous).

- A well balanced water retention capacity in thin layers of fresh mortar is very important, if it is too low the mortar wall dry out quickly. A well balanced water retention capacity (also prevents the formation of shrinkage cracks) greatly improves the waterproofing qualities of the coating. If the water reduction is too great, mortar adhesion may be decreased.

- This thin first seal coat should also be frost-resistant when it is fully set, because it is quite possible (for the empty top section part of a reservoir) to freeze.

- The most important quality of the thin ready-mix render is waterproofing. Practically even a good surface coating does not by itself make a reservoir waterproof. Because zones of weakness are often found at the inserts and construction joints. Therefore the details of the connections at insert pipe entry and at construction joints must be carefully executed and designed by the Contractor because a water reservoir is only as watertight as its weakest point.

c) Final Surface Sealing Coat (second coat)

This final application on the thin ready-mix render must be very precise and accurate in order to produce a high final quality seal and protection.

A clean, sound plaster render is essential for good adhesion; grease, oil residues and other foreign substances must be carefully removed and fins and projection must be scraped off.

Climate conditions are an important factors in the placement of the final surface sealing coat. Ideally the temperature should be around 10°C to 15°C and relative humidity around 70% to 80%.

Condensation in very high humidity is a particular difficulty because adhesion problems may occur if there is too much moisture in the thin ready-mix plaster substrate.

The condensated water is also very soft and may adversely affect the curing process in extreme cases because it can prevent the coating material setting process on the surface and cause it to run off later.

Condensation can also appear sometime in vertical rivulets on the wall which washes away the unset coating.

The Contractor must contact the manufacturer and obtain all latest original technical specifications concerning the material and obtain approval from the Engineer concerning the steps and procedure of execution.

214.2.1.3 Water Treatment Plants

The underline provisions shall apply to either new or existing water treatment plant under rehabilitation.

New treatment plants consist mainly of:

- Decanters or settling tanks
- Treatment stations or filter zones
- Retention basin after filtering
- etc.

N.B.: The waterproofing materials and application procedures are the same than for the new concrete reservoirs (see 214.2.1) by application of a surface water proofing coating acting by crystallization or mineralisation.

If the substrate is rendered by a mortar, only the kind of product that may change. The Engineer's criteria will in this case prevail in the choice of the materials and the procedures.

214.2.1.4 Reservoir roof covers and Building roof terraces, Waterproofing and eventual thermal insulation

The provisions here below shall apply to the materials, products and execution procedures concerning the waterproofing of the reservoir roof covers and the building roof terraces.

The Engineer criteria will determine which reservoir cover or roof terrace are to be thermally insulated or not.

Waterproofing approved membranes (for both reservoir covers and roof building terraces) will be one layer of 4mm minimum thickness (minimum 4.7 kg/m^2 with protection):

- Elastomeric (styrene-butadiene styrene = SBS) (for altitude above 300m) or
- Plastomeric (Atactic Polypropylene = APP) (for altitude below 300m).

The assembly of manufactured sheets will be by torch welding.

These membranes will generally be self-protected from the factory (mineral self-protection).

The general characteristics of the membranes are as follows: (non limited list)

- Elongation at break (for reinforced membrane ≥ 50%).

The Contractor shall comply with the technical certificate of SBS and APP membranes defined by the UEAtc tests and requirements.

In case of special architectural designed roof (dome) the waterproofing coat could be constituted by a liquid elastomeric bitumen which characteristics must be proposed by the Contractor for the approval of the Engineer. Anyhow a U.V. radiations resistance shall be required in any case.

The particular characteristics of the SBS and APP membranes are resumed here below (non limited list)

a) SBS elastomeric membranes are classified according to the type of reinforcement.

- Rolls reinforced with polyester (PY = 180 to 350 g/m^2)

b) APP Polymeric membranes are modified bitumen base sheet with APP polymers.

- 4mm thick reinforced with polyester min weight 180 g/m^2 non woven polyester (PY)

The Contractor must in his offer enumerate all the characteristics of the membranes, namely: (non limited list):

- their dimensions (rolls) (1 m x 10m)
- their thickness or their weight (minimum thickness 4mm, minimum weight 4.7 kg/m^2)
- the type of bitumen
- the kind and weight of reinforcement (g/m2)
- the surface protection
- their mechanical characteristics
- the overlapping size (overlapping waterproofing membrane shall be not less than 10 cm).
- etc.

SBS and APP membranes shall be applied by the Contractor on site according to the technical sheets specifications of each product and to the manufacturer's prescriptions.

All reservoir roof covers and roof building terraces are deemed to be not accessible unless to repairs necessity.

- Horizontal and vertical exposed membrane will be mineral self-protected.

Thermal insulation

A normal insulation with extruded polystyrene thermal insulation is approved.

- The insulation panels must be protected against weather.

- The Contractor shall propose to the Engineer's approval all insulation material and specific original documentation from the manufacturer, mainly (non limited list):

  - the thermal conductivity ($\lambda \cong 0.029$ w/m °C)
  - the laying procedure
  - all limitations of use, according to associated waterproofing, destination of reservoir cover or roof terraces.
  - the thickness of the insulation panels with the way this thickness was determined according to the total thermal resistance of the reservoir cover or roof terrace. (thickness ≥ 50mm)
  - separation and protection sheet layer (non woven polyester) thermally bounded non woven polypropylene: Mass: 100 – 105 g/m^2.
  - the protection needed (graded gravels, screed, circulation slabs (500 x 500 x 50 mm)

214.3 water proofing for wastewater bearing structures

214.3.1.1 General

Special performance criteria in sewage treatment is to be achieved by the contractor by the simultaneous use of:

- A high performance concrete, and
  A high performance protection, applied to the concrete substrate

214.3.1.2 High Performance Concrete in Sewage Treatment Applications

The concrete used in the construction of sewage treatment plants and related structures has to meet a very different set of performance criteria from those that apply in normal civil engineering works. It is usual for the mix-design to be generally determined by the need for strength and specific loading properties. The principal requirements for concrete in sewage treatment industry are more extensive and are as follows:

a) Resistance to aggressive effluents and sludge.

b) A dense and unpermeable concrete free from cracks (to protect steel reinforcement against corrosion).

c) Resistance to wear and abrasion, particularly with regard to overflows energy conversion areas and the bearing surfaces for sludge scrapers, etc...

d) Smooth and crack-free surfaces (to minimise routine cleaning and maintenance).

The aggressive effect of water-borne waste on concrete depends not only on its chemical constituents and the concentrations in which these are present, but also on such factors as:

- The pH value
- Temperature
- Oxygen supply
- etc...

- Acids with a pH value below 4.5 have a particularly aggressive effect on concrete due to the fact that they interact with the components of the set cement to form salts, which for the most part are soluble.

- However concrete may be attacked by certain alkaline solutions, salts and organic substances (especially vegetable and animal fats and oils).

  The speed of the chemical reaction increases dramatically with the rise in ambient temperature.

  In the absence of an adequate supply of oxygen (in long enclosed pipe runs, pits, tanks, etc.) fermentation processes may be set up that decisively alter the aggressively of the effluent (formation of hydrogen sulphide, sulphurous acid, etc.).

Durability of Concrete is largely determined by its resistance to the (A) ingress of liquid or gaseous substances

- Since nearly all the attack mechanisms to which concrete is subject (including chemical and physical attack, corrosion of the steel reinforcement, etc.) are associated with the transport of moisture, the following may be stated as a general principle: "The more dense and impermeable the set cement, the greater the resistance of the concrete to chemical attack." It is generally recognised that this is also associated with an increase in compressive strength and improved resistance to wear and abrasion: hence the fact that high compressive strength is frequently equated in civil engineering practice with outstanding durability.

  The inference is only valid, of course, if the increase in compressive strength results from a minimization of the capillary porosity of the set cement and a reduction in the diameter of the remaining pores.

- Damage to concrete or the underlying reinforcement via chemical attack is usually caused by the ingress of aggressive substances or water into the capillary pore system of the set cement (or into the contact zones between the set cement and aggregate). The aggressive medium may occur in liquid or gaseous form.

- The transport mechanism is activated by the following:

  a) An unbalance of pressures (permeation), as in the exerted by water on the wall of a tank or basin.

  b) Movements of molecules or ions resulting from differences in concentration (diffusion), as in the penetration of carbon dioxide from the air (carbonation).

  c) The absorption of wetting liquids through porous substances (capillary action), as in the case of rising groundwater in a concrete foundation.

- The principal factors influencing the rate of transport are:

  - the presence of cracks in the concrete
  - its capillary porosity and
  - the size of the pores

- An additional factor in the case of gazes is the moisture content of the concrete (the higher the moisture content, the more difficult the transport of gaz.

214.3.1.3 Design and production of High-Performance Concrete

The pore structure of the concrete is largely determined by:

- the degree of compaction,
- the entrained air content
- the water content of the fresh concrete, and

- the degree of hydration in the set concrete

In order to maximize the density of the set concrete matrix and thereby achieve a high degree of chemical resistance. The well-compacted concrete must exhibit the following properties:

a) A proper distribution of aggregate gradings, including a sufficient proportion of fines (particle diameter < 0,125 mm: approximative 350-400 kg/m^3)

b) Low water/cement ration around 0.40 - 0.45

c) High degree of hydration

d) Absence of cracks.

– To insure that the concrete remains workable at low W/C ratios and to minimize the entrainment of air bubbles during compaction, the contractor is asked to use a super plasticizer.

The best way to maximise hydration and avoid cracks is that contractor follow the correct curing procedures (keeping the concrete damp for an extended period of time using a suitable curing compound).

– The insistence on a proper distribution of aggregate grading and an adequate fines content has to do with the attempt to maximise the density and uniformity of the internal structure of the set concrete. At the same time correct granulometrie also improve the workability of the fresh concrete and greatly reduces its tendency to bleed. Bleeding produces a localized increase in the water/cement ratio and a corresponding enlargement of the pore structure in the set cement matrix close to the surface of the concrete, thus rendering it specially vulnerable to chemical attack. Many of the sands used have a low fines content (particle size < 0.125 mm) but a relatively high proportion of particles in the 0.125 - 0.25 mm grading zone. Since these require a relatively large amount of water to achieve thorough wetting, but possess only a limited capacity to retain water themselves, the contractor will make mistake to try and make up the deficiency in fines content by overdosing the mix with sand (result: bleeding of the fresh concrete). Instead the contractor's mix needs to be supplemented by a suitable alternative fines content which must be particularly effective.

(A) The use of Silica Fume Products in High Performance Concrete

The Contractor is invited to use a silica fume product (minimum 90% pure latently reactive silicone dioxide) to enhance the performance of structural concrete in a number of significant ways:

a) Reduction in porosity: silica fume is finer than cement, mineral fillers, (powdered quartz) or commercially available fly ash.

Since the mean particle size of silicate fume is approximately 100 times smaller than a normal grain of cement, it is able to lodge in the interstices between the finest particles in the set cement matrix. The super plasticiser allows low water/cement ratios whilst maintaining good workability. This ensures a dense, tightly packed particle structure even at the micro capillary system.

b) Increased strength: A pozzolanic reaction takes place between the silica fume and the free lime that is present in the set cement in the form of calcium hydroxide, a natural by-product of cement hydration. As a result of this reaction the weakest and most readily soluble component of the set cement is transformed into solid calcium silicate hydrate, this combined with the low water/cement ration produces significant gains in concrete strength.

As mentioned in 214.3.2(A) the chief requirement for concrete in sewage treatment applications is not so much for compressive strength in the core zone, but rather for a high degree of density and strength in the surface zone: This is the critical factor affecting the durability of structural components under these conditions.

c) Retarding the process of carbonation : The high alkalinity of the cement provides a measure of natural protection to the reinforcement steel. The pH value of the cement paste is around 12.5 which is sufficient to passivate the steel and prevent it from rusting even in the event of the ingress of oxygen and moisture. However exposure to carbon dioxide from the atmosphere means that the alkalinity is being constantly reduced as the lime content is neutralised.

If the carbonated zone reaches the steel reinforcement, the latter begins to rust. The use of silica fume significantly retards the process of carbonation in concrete.

d) Increased resistance to abrasion: the use of silica fume products (silica fume/plasticiser technology) in concrete can also effect a marked improvement in its resistance to abrasion. Tests carried out at the French CEBTP in Paris on mortar samples incorporating silica fume demonstrate this very clearly.

e) Improved workability of fresh concrete: The addition of silica fume products to the mix produces a fresh concrete of outstanding stability and cohesion, with no loss of workability. Bleeding, segregation and sedimentation during transport are effectively prevented even with mixes of very plastic consistency.

(B) Curing procedures for High-Performance Concrete

The chemical reaction of silica fume with the free lime in the set cement generates the same hardening product that is produced during the hardening of cement. The reaction proceeds somewhat more slowly than in the case of cement but is more or less complete after 28 days. In order to achieve a concrete surface offering the maximum resistance to chemical attack, thorough and careful curing of the concrete is an essential requirement and the contractor must take in account the curing time in his construction schedule. At the end of the curing period the strength of the concrete in the surface zone should be at least 50% of the specified cube strength. This normally requires a curing period of at least 3-5 days; under unfavorable conditions (strong winds and sunlight or low relative humidity) the curing period should be extended by an addition 2-3 days in order to prevent premature drying-out of the concrete.

N.B. Concrete that will be exposed to "very severe" chemical attack (as defined, for example, in DIN 4030) for long periods during its service life should be finished with a suitable coating material designed to afford additional protection against the aggressive medium. However the application of such a coating is no substitute for a well-made concrete not least because a high-quality coating material needs a high quality concrete substrate in order to perform effectively. The contractor must in practice furnish a concrete capable to withstand "severe" chemical attack without taking in account the additional protection.

214.3.1.4 Protection of the Concrete Surface

a) Substrate preparation

Before applying the protection on the concrete, the concrete surface must receive a preparation to unable this substrate to be ideal for the application of the protective coating. High pressure water jet, pressure stream clearing or wet blast cleaning will be used by the contractor after reception of the concrete surface by the Engineer.

Any joint sealing must be done by the Contractor usually before the application of the protection coating.

Any joint sealing material must receive the early approval of the Engineer.

Any joint sealing will be purchased from the same furnisher than the protective coating.

b) Pore sealing :

The pore seal is necessary and must allow a rapid application of the coating protection - the pore sealing must be compatible with all the applied products (superplasticizer, silica fume, water stop....) and purchased from the same furnisher it must fill all blowholes and act as a vapour - release intermediate coat.

c) The protective coating :

The known causes of damage to structures in the sewage industry show that the best concrete is still affected by some substances, which should be separated from its surface by suitable coating, or surface protection systems.

Often the concrete cover on the reinforcement does not comply with the standards.

Concrete for sewage must be coated to meat certain long term standards and the surface protection is also required to meet these standards long term.

The protection is also designed for the relevant mechanical constraints and withstand the interaction between concrete substrate and the protection system and also the mechanical, chemical, thermal and other stresses...

The Coating material requirements are:

- Chemical resistance
- Abrasion resistance
- Aging and weather resistance
- Alkali and water resistance
- Water vapour diffusion or vapour barrier qualities.
- Impermeability to gase (carbon dioxide, sulphur dioxide)
- Specific strength properties
- Adhesion to surface to be coated
- Crack bridging or sealing function

- The protective coating will generally be applied in two or three coats.

  As all coating material properties listed above can be influenced by the system and formulation used, the contractor is asked to submit to the Engineer's approval all the coating materials and furnisher specifications concerning the protective coating and glass fabric reinforcement.
- All details arising additional difficulties (pipe connection, openings, angles etc), must receive adequate solutions from the contractor to be submitted to the Engineer's approval before any application.
- The protective system, covers usually:
  - Epoxy resin
  - Epoxy / Tar modified systems
  - Epoxy / polyurethane coating system
  - etc....

  Apart from general protection, the protective coat system has to fulfil two functions.
  - Restoration and levelling of the concrete surface which may be extremely rough after preparation.
  - The formation of a non-porous protective film with possibility to work directly on the damp concrete surface without long waiting times while the structure is drying out.

A very important feature which should not be ignored by the contractor, is the prevention of heating in the structure in areas not in contact with water. This reduces the stresses in the coating system, the concrete and (even more important) at the coating system/concrete interface. Damage can also be avoided by the contractor by choosing the right colour.

The contractor technology must offer the maximum advantages to permit execution of the protection directly on the damp concrete surface without long waiting times while the structure is drying out.

The durability of a correctly applied coating varies considerably. The longest life span can be expected in the underwater section since the protective system is in a constant environment and not exposed to the UV and thermal shock i.e. it can remain in a low stress state.

The durability of coatings is affected by maximum stresses due to several loading, since there are exposed (in addition to high mechanical stress) to additional thermal shock caused by de-icing salts and weather and are used at the most susceptible construction points (areas at risk from cracking).

Systems which are exposed to abrasion and constant water turbulence and are used in water line zone are said to be subject to average stress.

Protective systems in digested tanks suffer the highest stresses.

The contractor is deemed to choose the protection system taken in account the importance of the stresses applied and the water covering situation.

214.3.1.5 Concrete Additives

The contractor is deemed having made all necessary contacts with the various furnisher of materials related with the project in order to select the best adequate materials such as:

- Superplasticiser
- The water proofing mass additive
- The waterstops
- The silica fume
- The curing material
- etc..

The superplasticiser, waterstop and waterproofing will give high impermeability to the concrete structure.

The superplasticiser and silica fume will insure reduction of porosity, increase in the surface strength, resistance to abrasion, improved workability of the fresh concrete with low water/cement ration.

The curing procedures will achieve a concrete surface offering the maximum resistance to chemical attach.

214.3.1.6 Sealing Joints in Concrete Construction in Sewage Installation

Although flexible sealant have an important part to play in sealing structural joints in sewage installations, they cannot seal structures containing water without additional measures. Concrete constructed with integral or surface mounted waterstop systems are obviously essential.

The Contractor will submit to the Engineer's approval all joints sealing material and waterstops which specifications must meet the Drawings Specifications.

a) Flexible Joint Sealant: of the various raw materials normally used in the production of joint sealant (polyurethane, acrylic, silicone and polysulphide) the two-part polyurethane sealant (often containing tar) have proved most effective in sewage treatment applications.

   Pouring grade is used for horizontal joints and thixotropic grade for vertical joints.

b) Flexible Elastomeric Strip: Joints liable to greater movement and construction joints may be sealed with a flexible elastomeric strip (hypalon or butyl rubber) kept in place with a compatible epoxy adhesive. Strip thickness varies from 1 to 3 mm; standard width are : 100 mm, 150 mm, and 200 mm.

   The Contractor is asked to submit his solution for sealing the various joints to the approval of the Engineer before any application.

214.3.1.7 Later Repairs

Effective concrete protection gives long-term security to all structural members, even if the effluent composition changes over time. High performance coatings greatly assist the prevention of damage from a number of sources. That is why detailed advance planning of concrete coating in sewage plants is to be seriously taken into account by the Contractor. If repairs are necessary later, this will be an expensive operation because of costly cleaning and re-preparation of contaminated substrate...

The Contractor must be aware that sewage plants cannot be shutdown and that later repairs and costs are out of proportion to the cost of providing good and effective protective coating on concrete initially.

The cost of all later repairs must be borne by the Contractor.

214.4 WATERPROOFING OF PLANTED ZONES

214.4.1.1 General

The waterproofing complex will consist in a two-ply waterproofing membrane chosen to resist roots penetration and puncturing by gardening implements .

Waterproofing membranes will be applied to zones intended to be planted such as gardens, roof terraces and flower tubs.

A screed to form a slope shall be executed before applying the waterproofing membranes.

The waterproofing membrane shall consist of:

- a first lower bitumen layer reinforced by a non-woven polyester sheet (NW PY ≥ 180 g/m^2, weight ≥ 4.7 kg/m^2)

- an upper bitumen layer reinforced (non-woven polyester ≥ 180 g/m^2, weight ≥ 4.7 kg/m^2) with anti-root additif.

The application of the waterproofing membrane shall usually be by welding using a propane blowtorch.

The waterproofing shall be applied to an approved substrate and comprise:

- an under layer membrane
- a top layer membrane shall be fully adherent on the first layer.
- a drainage layer (rounded gravels, size > 5mm).
- the agronomic soil.

The design of terrace-gardens and the choice of the agronomic soil thickness shall take into account the type of plants.

Overflows and water gullies shall be designed to limit the height of stagnant water so as to facilitate plants growth.

The substrate slope will generally be between 1% and 5%. The substrate surface shall be after completion, neat, straight and free from foreign matters. The allowable deflections, the surface tolerances, the differences in height between jointed elements shall be defined for each substrate as prescribed in the applicable standards.

214.4.1.2 Materials

214.4.1.2.1 Membranes

a) The first layer of the system shall consist of :

- SBS-elastomeric membrane reinforced with non-woven polyester, weight ≥ 180 gr/m^2.
- Thickness: 4 mm minimum.
- Packing: Rolls of (10 m x 1.00m) - Weight 44 kg.

Characteristics of the under layer:

- Tensile strength: longitudinal L = 900 N/5 cm, transversal T = 700 N/5 cm.
- Elongation at break: longitudinal L = 50%, transversal T = 55%.
- Puncture resistance static L4.

b) The top layer of the system shall consist of:

- SBS-elastomeric membrane reinforced with non-woven polyester, weight ≥ 180 gr/m2.
- Anti-roots admixture: Preventol B2 or equivalent, minimal quantity: 20gr/m^2.
- Thickness : 4 mm minimum.
- Packing: in rolls of (10 m x 1.00 m) - weight 44 kg.

Characteristics of the upper layer:

- Tensile strength longitudinal L = 800 N/5 cm, transversal T = 600 N/5 cm
- Elongation at break: longitudinal L = 45%, transversal T = 50%.
- Puncture resistance static L4.

214.4.1.2.2 Other Materials

a) The drainage layer

The drainage layer will be executed by the waterproofing Contractor. This layer shall protect the waterproofing membrane from mechanical stresses and allow the drainage of water.

This layer shall have a minimum thickness of 10 cm and consist of 25/40 gravels.
Other drainage system can be proposed by the Contractor to the Engineer's approval. The drainage layer shall be applied by hand directly to the upper layer of the waterproofing membrane.

b) The percolating filter

The percolating filter has no waterproofing function, it is used generally to prevent the clogging of the drainage layer, retain the nutrients of the soil and distribute humidity required for plants growth. It also keeps the pH of the soil and fertilizers above 3, and ensures that the pressure exerted by the agronomic soil and plants do not exceed that admissible by the bearing surface.

The percolating layer is applied to all the parapets till 10 cm over the highest level of the agronomic soil.

Laps between succeeding rolls shall be 10 cm. The percolating layer may be constituted by any special filtering material having a minimum thickness of 25mm.

c) Waterproofing for expansion joints

An SBS elastomeric membrane shall be applied to expansion joints. Its characteristics are:

- width : 1000 mm
- weight: 4.7 kg/m^2
- thickness > 4 mm

d) Agronomic Soil

The agronomic soil layer will be applied by the waterproofing Contractor. Its thickness varies according to the type of plants, it must not however be less than 30 cm before settlement (25% reduction after settlement)

Agronomic soil shall be placed directly on the percolating filter without causing any displacement nor damage to the filtering material.

e) Upstands

The waterproofing membrane shall be raised 15 cm above the graded agronomic soil.
The upper part of the parapet must include a device preventing the run-offs from penetrating behind the upstand.

The waterproofing of upstands shall be as follow:

- the first horizontal layer is raised to 10 cm.
- the first vertical layer is applied to the entire upstand and continued 10 cm over the first horizontal layer and welded on both ends.
- the second horizontal layer is raised to 10 cm over the first vertical upstand.
- the second vertical upstand is extended 15 cm over the horizontal second layer.

Joints between horizontal layers and vertical upstands shall be staggered.
Laps between two layers shall be ≥ 60 mm

f) Ancillary works

- All other works as fittings, edges, penetrations, joints, gullies etc.. will be treated in compliance with applicable standards.
- The connection between the waterproofing membrane and the gullies will be made as specified by the manufacturer.
- Water inlets shall be protected by a special device to prevent pipe obstruction.
- Removable paved blocks over the expansion joint must permit the repairs and checking of the joint. These elements must be executed by the Contractor at no additional cost.

g) Flower Tub

- The waterproofing membrane for the flower tub will be identical to that used for terrace-gardens.
- A 1% minimum concrete sloping shall ensure the evacuation of water to the gully.
- The waterproofing of the upstand will be continued over the horizontal section of the flower tub parapet.

NB: Before starting waterproofing works, the Contractor shall submit to the Engineer's approval:

- the material samples
- the execution details in the horizontal parts, upstands, and intersections.
- all details of waterproofing penetration, expansion joints.
- the details of the waterproofing protection (if any).

214.5 WATERPROOFING WORKS ON BURIED WALLS

214.5.1.1 General

Prior to backfilling, all buried walls shall be waterproofed. The waterproofing product shall be applied to the vertical surface of walls down to the footing of the foundation.

The waterproofing of the foundation walls is conditional upon several parameters, namely:

Nature of the foundation ground (pervious, impervious)

- Nature of the backfilling material
- Existence of a drainage system
- Existence of waterproof structures near the buildings (slabs, sidewalks, ...) or protection of the surroundings of the foundation peripheral wall by protruding structures (protection slabs, protruding roofs, ...)
- Importance of run-offs eventually in contact with the peripheral walls of the building
- Eventual existence of an aquifer

After the excavation of trenches, all measures that bind the Contractor alone shall be consulted beforehand with the Engineer.

214.5.1.2 Selection of the waterproofing coating

- The specifications given in this Section are applicable only when water is not likely to be in contact with the peripheral walls for a long time, or when no differential settling of the building is expected.
- The choice of the wall coating shall be efficient only if:
  - a drainage system is unnecessary (pervious ground)
  - or, a drainage system is necessary and provided for.

In fact, should the drainage system be necessary but not provided for, the application of the coating shall not be sufficient because water may infiltrate from beneath the foundation or through any crack in the wall. In this case, tanking will be the best solution.

a) No drainage system is required (pervious foundation ground)

Buried walls shall be waterproofed by applying a rendering to the external facing of the wall. Rendering shall consist of:

- A traditional rendering consistent with standards specifications.
- A hydraulic binders based waterproofing coat having a technical certificate that proves its suitability to the type of buried masonry.

In both cases, the coating shall only be applied to the external facing of the buried wall; the waterproofing of the inner side would prevent the capillary rise.
In some cases a bitumen coating shall be applied for walls protection.

b) A drainage system is required (impervious or slightly pervious foundation ground)

The waterproofing system shall be reinforced and shall consist of:

- An SBS or APP elasto-plastic membrane applied directly to the substrate or to a rendering and consisting of:
  - Cold-applied primer : 350 kg/m^2
  - Hot welded SBS or APP elasto-plastic membrane as specified in 214.4.1.

* non-woven polyester (180 kg/m^2 minimum)

* separation layer.

It is advisable to protect the membranes from shocks, especially during backfilling, as well as from any eventual settling of the backfill material. Should the Engineer disapprove the quality of the backfilling material and the workmanship, a 10 cm thick concrete blocks protection shall be obligatorily provided for, with non woven thermally bounded textile separation layer or by 3.2mm thick semi rigid bituminous board.

The application of waterproofing membranes to singular points especially to the footings, etc.. shall be carefully studied (details to be provided by the Contractor).

Prior to any backfilling, the Contractor shall submit to the Engineer's approval the method of laying the drainage system in the bottom of the trench, the quality of filtering material, the size and location of the trench with regard to the building and the foundations, the diameter and length of drains as well as the eventual protection of the drainage layer with a non-woven textile.

214.5.1.3 Manholes (a drainage system is required)

Manholes shall be constructed:

- At the upstream of the drain
- At each change of direction
- At the connection of two drains.

The manholes shall have such diameters as to allow eventual cleaning operations. The Contractor shall submit for approval the shop drawing of the manhole which is equipped with a cover preventing the intrusion of earth, gravels or any foreign matters.

The Contractor shall submit for approval waterproofing works of buried parts:

- Samples of waterproofing products
- Samples of the drains

as well as all shop drawings of waterproofing and drainage works.

214.6 TESTING AND disinfection

214.6.1 Testing

The Contractor shall perform all cleaning, flushing, testing of all liquid retaining structures, reservoirs and buildings roofs, including conveyance of test water to point of use, and including all disposal thereof, complete and acceptable, all in accordance with the requirements of the BS 8007 and the contract documents.

All testing operations shall be done in the presence of the Engineer.

a) Roofs

The roofs of liquid retaining structures and buildings should be watertight and be tested by flooding the roof with water. The roof should be considered satisfactory if no leaks or damp patches shown on the soffit. The roof insulation, covering and waterproofing should be completed only, and as soon as possible, after remedial work if needed is done and satisfactory testing.

b) Liquid retaining structures

After construction is completed, the interior of the liquid retaining structures shall be completely hosed and cleaned of all dirt and loose material. Testing shall be done prior to backfilling if any, and shall not be sooner than 14 days after all portions of structure walls and associated roof systems have been completed.

The structure shall be filled to the normal maximum level with the specified liquid at a uniform rate of not greater than 2m in 24 h. The liquid level should be maintained by the addition of further liquid for a stabilizing period which may vary between 7 and 21 days according to the maximum design cracks.

After the stabilizing period and during a 7 days test period the total permissible drop in level, after allowing for evaporation and rainfall should not exceed 1/500th of the average water depth of the full tank or 10mm.

In case of seepage of the liquid or leakage, necessary remedial treatment of the concrete, or joints, holes or cracks shall be carried out from the liquid face (pumped and sealed with a two part water-insensitive epoxy, nontoxic for potable water reservoirs). Retesting after the completion of remedial work shall be carried out according to this clause.

Interior waterproofing if required, shall be applied after satisfactory results.

214.6.2 Disinfection

The Contractor shall perform disinfection of reservoirs and appurtenant piping for potable water. Disinfection shall be accomplished by chlorination and performed in accordance with the relative requirements after completing all repairs and waterproofing works if any. All chlorinating operations shall be done in the presence of the Engineer. Disinfection operations shall be scheduled by the Contractor as late as possible during the Contract time period so as to assure the maximum degree of sterility of the facilities at the time the work is accepted by the Engineer.

Bacteriological analyses shall be performed by a certified testing laboratory acceptable to the Engineer.

a) Chlorination

A strong chlorine solution (about 200 mg/l) shall be sprayed on all interior surfaces of the structure, including the underside of the roof areas. Following this, the structure shall be partially filled with water to depth of approximately 30 cm. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution-feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the inflaming water. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 50 mg/l upon completion of the partial filling operation. Precaution shall be taken to prevent the strong chlorine solution from flowing back into the lines supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the heavily chlorinated water.

b) Retention Period

Chlorinated water shall be retained in the partially filled structure and appurtenant piping long enough to destroy all non-spore-forming bacteria, and in any event, for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 25 mg/l. All valves shall be operated while the lines are filled with the heavily chlorinated water.

c) Final Filling of Structure

After the free chlorine residual has been checked, and has been found to satisfy the above requirements, the reservoir shall be filled in approximately 2m increments every 24 hours by addition of potable water. The existing chlorinated water, may not be used as part of the final filling. Final filling water, when the water level is raised to its final elevation, shall produce a free chlorine residual of between 1 and 2 mg/l. If the free chlorine residual is less than

one mg/l, an additional dosage shall be applied to the water in the structure. If the free chlorine residual is greater than 2 mg/l, the structure shall be partially emptied and additional potable water added. In no case shall water be released prior to the expiration of the required retention period (24 hours).

214.6.3 Bacteriological Analyses

The Contractor shall have a laboratory certified by the Engineer to take samples of water from the tank in order to perform bacteriological analyses according to the relevant section.

If the volatile organic or coliform bacteria levels exceed those allowed, the tank content, shall be drained to waste. The tank shall be refilled at the Contractor's expense, soaked and retested for coliform bacteria and volatile organic until satisfactory test results are obtained. Failure of the reservoir to attain acceptable levels shall be the responsibility of the Contractor and remedial measures shall be at his expense.

214.6.4 Measurement and Payment

214.6.4.1 Inner Waterproofing of new reservoir, new or existing treatment plants, etc...

Waterproofing shall be measured for payment by square meters (m^2) of net area of surfaces to which waterproofing has been applied, after the deduction of all openings and areas which have not been waterproofed.

The unit rates shall include:

- The supply of material,
- Cleaning and preparation of the surfaces as specified,
- Treatment of all singular points,
- Application of the inner coating as specified, to horizontal, vertical and under roof surfaces including all overlaps and extra work on corners, edges and around drain outlet and other structures in walls and slab, and including all materials, equipment and workmanship necessary for the completion of the inner waterproofing of the reservoir in accordance with the Specifications and Drawings, and to the satisfaction of the Engineer.

214.6.4.2 Existing reservoirs under rehabilitation

Waterproofing shall be measured for payment by square meters (m^2) of net area of surfaces to which waterproofing has been applied, after deduction of all openings and areas which have not been waterproofed.

The unit rates shall include :

- The site survey (step one of the specifications) showing the general characteristics of the existing reservoir, pipe chamber, pipes and hydraulic connections, etc...

- The structural survey (step two of the specifications) which includes :

  - the removing of the existing render and coating and deteriorated concrete substrate...
  - the application of high water jetting pressure,
  - the visual examination, the "auscultation" and analysis of all weak points to be treated,
  - the submittal of procedures and materials for rehabilitation and repairing,
  - etc.

- The repairing works (third step of the specifications) as approved by the Engineer,

- The application of the ready mix mortar as specified,

- The final surface seal coating (second coat) as specified,

- Etc.

214.6.4.3 Waterproofing of roof covers, Building terraces and Eventual Thermal Insulation

Waterproofing shall be measured for payment by square meters (m²) of net area of surfaces on which waterproofing has actually been applied, after deduction of all openings and areas which have not been waterproofed.

The unit rates shall include :

- For the supply of all approval materials.
- Cleaning and preparation of substrates, including the execution of the necessary concrete slopping towards the outlets,
- Application of primer,
- Heating and application by torch welding of the elastomeric or plastomeric membrane 4 mm thick (~ 6 kg/m²) including the overlaps and upstanding extending over the parapet wall, and any reinforcement on the Detailed Drawings approval by the Engineer,
- Any circulating concrete pads necessary for repairs installed over the waterproofing (pads 500 x 500 x 40 mm) as ordered by the Engineer,
- All drain outlets and any extra works around them and around any existing opening or penetration throughout the roof,
- All necessary protection of the waterproofing, and all materials and equipment and labour necessary for the completion of waterproofing of roofs and reservoir covers in accordance with the Specification and Drawings and to the satisfaction of the Engineer.

N.B. Normal or inversed extruded polystyrene thermal insulation shall be installed when directed by the Engineer Thermal insulation ≥ 50 mm thick will be paid for as separate item and will be measured by square meters (m²) of net area of surfaces where thermal insulation is applied.

Normal thermal insulation unit rate is deemed to comprise the cost of furnishing and applying a vapor barrier approved by the Engineer.

214.6.4.4 Waterproofing Protection for Wastewater Bearing Structures

Waterproofing of external surface of the concrete substrate (Protection of the concrete surface by applying a protective coating) shall be measured for payment by square meters (m²) of net area of surfaces on which waterproofing has actually been laid, after deduction of all openings and areas which have not been waterproofed. The unit rates shall include for :

- The supply of all the approved material,
- Cleaning and preparation of the concrete substrate as specified,
- Supply and execution of all joint sealing,
- The pore sealing as specified,
- The application of the approved protective coating in two or three coats reinforced with the glass fabric material, as specified,
- The treatment of eventual defects encountered throughout the works according to the Engineer's instructions,
- All extra works required for extending the protective layer over all kind of pitched surfaces, around drains, over parapets etc...,
- All furniture for materials, equipment and workmanship necessary for the completion of the protection coating over the total substrate surfaces in accordance with the Specifications and Drawings and to the satisfaction of the Engineer.

214.6.4.5 Waterproofing of planted zones

Waterproofing shall be measured for payment by square meters (m^2) of horizontal net-area of surfaces to which waterproofing has been applied, after deduction of all openings and areas which have not been waterproofed.

The unit rates shall include:

- The supply of all approved materials.
- Cleaning and preparation of substrates, including the execution of the necessary concrete sloping toward the outlets.
- A lower membrane.
- An upper membrane
- A drainage layer
- A percolating filter
- All drain outlets (overflows, water gullies) and any extra works around them and around any existing opening.
- Bridging joints, upstands, waterproofing protections or any other material required to accomplish the work according to the standards.

The agronomic soil shall be measured by cubic meters (m3) according to the Engineer's instructions.

214.6.4.6 Waterproofing works on buried walls

a) No drainage system is required

The waterproofing shall be measured for payment by square meters (m^2) of net area of rendered surfaces.

The unit rates shall include:

The rendering, hydraulic binders based waterproofing coat and eventually two coats of asphalt. It also includes scaffolding, workmanship, expenses, supply, transport, equipment, and all works required for waterproofing.

In case a bituminous coating is required, no extra payment shall be done. The price must be included in concrete works or in backfilling materials.

b) A drainage system is required

The waterproofing shall be measured for payment by square meters (m^2) of net area of surfaces where the waterproofing system is applied.

The unit rates shall include:

- The elasto-plastic membranes (primer, membranes, fibreglass and non-woven polyester)
- The membranes protection.
- Singular points and drainage system required (pipes, manholes, gravels, geotextile,...)

All necessary materials, equipment, workmanship, and expenses in order to achieve the waterproofing work.

214.6.4.7 Testing

All water used in testing the liquid retaining structure and roofs including that used for retesting which requires disposal following such testing, retesting shall be provided and disposed by the Contractor at his hole expense. The price of such work are deemed to be included in concrete works unless otherwise noted and shall include all expenses to reach satisfactory result.

214.6.4.8 Disinfection and Bacteriological Analyses

All water used in disinfecting the reservoir including that used for retesting and disinfecting shall be provided and disposed by the Contractor at his hole expense. Fees for all laboratory analysis shall be borne by the Contractor.

The disinfection and analyses shall be paid on the basis of a lump sum price unless noted otherwise, and shall include all expenses to reach satisfactory results.

217- PIPELINES AND PIPEWORKS
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217PIPELINES AND PIPEWORKS

217.1 Scope

This part of the specification shall apply to the supply, delivery, laying, jointing and testing of all pipes, fittings and accessories, and includes:

Cast Iron and ductile Iron pipes

217.2 Cast Iron and Ductile Iron Pipes and Fittings

217.2.1Quality Requirements

All cast iron and ductile iron pipes and fittings to be supplied under this Specification shall be obtained from approved manufacturers. They shall be of the class and shall have joint ends as shown on the Drawings or as specified and shall otherwise comply in all respects with B.S. 4622 - Grey Iron Pipes and Fittings, and B.S. 4772 - Ductile Iron Pipes and Fittings.

- External Coating: pipes and fittings shall be given an external coating of zinc in accordance with ISO 8179 or BS 4772 and a finishing coating of either cold applied bitumen complying with the performance requirements of BS 3416 Type II material, or hot applied bitumen to BS 4147 Type I Grade C.

- Internal Lining: All pipes and fittings shall be lined internally with cement motar and shall comply with ISO 4179 or BS 4772. The inside of the sockets shall be coated with bitumen as used for the finishing coating to the pipes.

While the pipes are still suspended over the trench before lowering or before mounting, they shall be inspected for defects and rung with a light hammer to detect cracks. Defective pipes shall be dismounted, removed from the site and replaced by flawless pipes. Only pipes inspected and accepted on the site by the Engineer shall be incorporated into the works.

217.2.2 Hauling and Handling of Pipes

The Contractor shall check each pipe before loading and shall reject all damaged or defective pipes. The Contractor shall load and properly secure the pipes on the vehicles and take all necessary measures to prevent any damage to the pipes during transport. The Contractor shall be responsible for the quality of the pipes and for their condition upon and after delivery to the site, and shall immediately remove from the site any damaged or defective pipes and replace them at his own expense.

No pipes or fittings shall be allowed to drop, roll freely or strike objects which are likely to damage them. Special care shall be taken not to spoil the tar or bitumen coating.

217.2.3 Laying and Jointing

(a) Laying - Before C.I. or Ductile pipes are laid, all dirt and foreign matter shall be removed from inside and all lumps blisters, excess coal tar, oil, grease and moisture shall be eliminated from the surfaces of the joints. After the pipe is laid and mounted, care shall be taken to avoid entrance of dirt, water and foreign matter from the trench or from elsewhere by the use of tight bulkheads.

(b) Jointing of cast iron pipes and fittings - Joints shall be flanged; or mechanical joints; or rubber gasket "push-in" flexible joints, all as specified and/or shown on Drawings.

(c) Jointing of ductile iron pipes and fittings - Joints in ductile iron pipes and fittings shall be of one of the following types according to the Drawing and the Particular Specification:

- Spigot and socket joint with rubber gasket
- Flanged joints
- Mechanical joints

All joints shall conform to B.S. 4772.

217.2.4 Testing

Testing instructions and requirements for Cast Iron and Ductile Iron pipelines shall be as specified in Subsection 217.4.12 for steel pipelines.

217.2.5 Methods of Measurement and Payment

Cast Iron pipes and Ductile Iron pipes and fittings shall be classified for payment according to type, diameter and class and shall be measured in linear meters of completed pipeline in place, measured along the crown of the pipeline. The length measured for payment shall include the lengths of all fittings, valves and specials installed in the line.

The price for fittings, bends, junctions, specials, detachable joints, flanges (when not integral part of pipe or fitting) etc. shall be considered as included in the cost of pipes, unless otherwise specified in the particular specifications or the B.O.Q.

Alternatively, if so stated in the Particular Specification and/or in the Bill of Quantities, C.I. and Ductile Iron pipes and fittings may be measured by number of pipes of defined net lengths and by number of fittings.

The payment for C.I. and Ductile Iron pipes and (under separate items) for fittings, bends, junctions etc. shall include:

- Supply, hauling, unloading and stacking of pipes and fittings including all necessary joints and jointing materials.

- Removal from stacks, hauling and stringing alongside the trench, laying and jointing of pipes and fittings at any depth of trench, connections to manholes and/or chambers and final cleaning and flushing of pipeline. The unit rates for this item for each type, class and diameter of pipe and fitting shall be the same for all depths of trench in which the pipes and fittings are to be installed.

- Testing of completed pipeline
  - For pressure and gravity pipelines shall be paid for under a separate item in the Bill of Quantities, by linear meters of pipe tested.

Only pipes, fittings, junctions, bends etc. actually laid, jointed and tested and accepted by the Engineer shall be taken into account for payment under items and no allowance whatsoever will be made for any breakage, loss, etc.
Excavation and backfill, special beddings, surrounds and manholes and chambers shall be paid for under separate items in the Bill of Quantities, unless otherwise noted.

217.3 VALVES AND PENSTOKES

217.3.1 General Requirements for Valves

General

Small valves of ND less than or equal to 40 mm shall be provided with self locking handles or handwheels to prevent accidental operation.

Emergency isolation valves shall be gate, ball or plug valves.

Drain and vent valves shall be provided with a plug or blind on the discharge side.

Flangeless valves shall not be used as the first block valves against storage tank.

Unless otherwise specified, valves shall be epoxy coated internally and externally. The coating shall have a minimum thickness of 150 µm.

Threaded ends shall not be used for valve sizes larger than 50 mm ND.

All handwheels, headstock, foot brackets, guide bracket and thrust tubes shall be of cast iron.

Fixing nuts and bolts supplied by the manufacturer shall be as specified in the general requirements for fastners.

Valves shall be sized such that the velocity through the valve when fully open does not exceed 2.50 metres per second at the rated throughput. They shall have flanges to not less than BS.4504 NP.16 and shall be capable of withstanding the same test pressures as the pipeline on which they operate. All nuts and studs subject to vibration shall be fitted with spring washer or locking tabs.

Types and Operating Conditions

Valves shall be designed to meet the operational and environmental conditions specified for the types indicated in the specific valve schedule.

The closure rates of all valves shall be designed to prevent the effects of surge. Where necessary, valves with a varying closure rate shall be used.

Valve flanges or couplings shall be as specified in the valve schedule and match those specified for the pipework installation.

Identification

Each valve shall be identified by a unique reference as approved which shall identify the medium/plant controlled and be numbered in a logical sequence.

The reference shall be either engraved on a 3mm thick laminated white/black/white traffolyte disc or stamped on a 1.0mm (19g) thick brass disc. The discs shall be at least 35mm dia. with reference letters and numerals not less than 4mm and 8mm high respectively.

The discs shall be mounted on the hub of the handwheel or where this is impractical, they shall be attached to the valve stem by means of suitable brass 'S' hooks and/or jack chain through a hole at the top of the disc.

Access

All valves, spindles and handwheels shall be positioned to give good access for operational personnel. It shall be possible either to remove and replace or to recondition seats, gates or gland packings which shall be accessible without removal of the valve from the pipework or, in the case of power operated valves, without removal of the actuator from the valve.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements.

Hand Operation

All handwheels shall be arranged to turn in a clockwise direction to close the valve or penstock, the direction of rotation for opening and closing being indicated on the handwheels.

The handwheels shall be coated with black plastic and incorporate facilities for padlocking in either the open or closed position.

Bituminous paints shall not be applied to any valve handwheel.

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified service value and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 55kgf.

Power operated valves shall include equipment for manual operation by means of a handwheel or other suitable device which shall be interlocked with, and fixed to, the power unit.

Headstocks and valves of 125mm nominal bore and above shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. 0.25, 0.50, 0.75, 1 etc.

217.3.2 Valve Materials

Valve bodies and other components shall be of corrosion resistant materials, compatible with the medium and of robust industrial design.

For water applications and where specified, valve bodies, discs and wedges shall be of cast iron, with facing rings, seating rings, wedge nut and other trim of corrosion resistant bronze or gun metal.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

For water works applications, wedge gate, metal seated valve materials shall be in accordance with BS 5163 Table 6A, fitted with a stuffing box and gland seal on the stem. Oil or grease shall not be used on any bearing or seal that may be in contact with the water being controlled.

The type and size of valve to be used to any particular location shall be as indicated on the contract drawings. Valve materials shall comply with the following minimum requirements.

ENVIRONMENT	BODY	TRIM**	REMARKS
Air	Carbon Steel or Bronze	410 SS Bronze	Blower discharge valves can be supplied to blower manufacturer standard.
Cl_2 Gas	Carbon Steel	410 SS	
Cl_2 Water	PVC	PVC	
Diesel Oil	Carbon Steel	410 SS	
Sewage	Ductile Iron Cast Iron PVC	Bronze* Bronze* PVC	Zinc free.
Potable Water	Bronze PVC Ductile Iron Cast Iron	Bronze* PVC Bronze* Bronze*	Less than 1000 mg/l total dissolved solids. Zinc free.

* Alternate acceptable materials for stem is aluminum bronze, or nickel aluminum bronze

** Trim material includes stem, body and closure seating surface, seat rings, bushings, springs, or any small parts in contact with service fluid.

217.3.3 Sluice Valves

All sluice valves, unless otherwise specified shall be of the rising spindle type, have wedge gates and be in accordance with the relevant clauses of BS 5150 and BS 5163.

Valves up to and including 300 mm ND shall be of the resilient seal or metal seal type. Valves larger than 300 mm ND shall have metal seals.

The valves shall be suitable for unbalanced head. A by-pass with gate valve forming an integral part of the valve shall be provided where recommended by the manufacturer for the pressures specified.

Where specified, sluice valves shall be fitted with easing screws and a clean-out box in the base.

Unless otherwise specified, each valve shall be provided with a suitable handwheel of adequate diameter for the duty required. Gearing shall be supplied where necessary, to ensure that the required operating force applied by hand to the rim of the wheel does not exceed 55 kgf.

Stem seals shall be of the stuffing box and gland type, arranged for easy replacement of packing and shall be accessible for maintenance without removal of the valve from service.

Extension spindles, headstocks and foot brackets shall be provided where required.

Where valves are required to be operated by tee keys spindle caps shall be fitted. The caps shall be drilled and each provided with nut and bolt for securing to the spindle, which shall likewise be drilled to accept the bolt. Each cap where fitted shall be supplied complete with operating tee key.

217.3.4 Telescopic Valves

All bellmouth telescopic valves shall have cast iron outer sleeves and bellmouths. The outer sleeves shall have machined labyrinth seals and the sliding tubes shall be manufactured from zinc free bronze.

A cast iron stirrup shall be affixed over the top of each bellmouth and these shall be connected to the rising screw thread by means of a stainless steel 'Rose' type coupling. To minimise fouling by rags etc. the valves shall not be fitted with outer guide rods.

217.3.5 Non-Return Valves

Check valves shall comply with BS 5153.

All non-return valves shall be of a type that will operate without shock.

Valve bodies shall be of cast iron unless otherwise specified and shall be fitted with renewable type seatings.

Covers shall be provided to allow ample access for cleaning and service and shall be supplied complete with tapped bosses.

In the case of swing gate type valves the hinge pin shall be of stainless steel, mounted in zinc free bronze bushes and extended and fitted with external levers and counter balance weights, all protected by a screen guard.

Other types of valves will be considered. In every case the non return valve shall be selected with full consideration of the system characteristics, and shall avoid valve slam, and have low maintenance requirements.

Where specified, limit switches shall be provided to operate from the external lever. The screen guard being slotted to allow the guard to be removed without disturbing the switch cabling.

217.3.6 Butterfly Valves

Butterfly valves shall have a resilient disc seating and be designed for a positive leak-proof shut off at a minimum pressure of 16 bar. Non-wafer types are preferred.

Butterfly valves shall conform to BS 5155

The disc shall be in grey or ductile cast iron unless otherwise specified with a resilient seating ring in moulded rubber, or other material to the approval of the Engineer.

For valves of 350 mm ND and above, a suitably lubricated axial thrust bearing shall be fitted.

A stuffing box and gland shall be fitted on the operation shalft extension to seal the pressure side of the valve. The design shall be such as to facilitate packing replacement without removal of the valve from the pipeline.

A valve position indicator, to show the position of the disc, shall be provided on the valve operating gear.

Suitable stops shall be incorporated to prevent movement beyond the disc "fully open" and "fully closed" positions.

Valves for flow regulation shall be of all metal construction.

217.3.7 Plug Valves

Plug valves shall be of the wedge gate type, with cast bodies. The plug surface shall be coated or lubricated to ensure low torque operation with bubble tight shut-off and 'non-sticking' materials.

217.3.8 Slide valves

Unless otherwise specified, slide valves shall be of the lightweight pattern type with cast or ductile iron body, stainless steel slide and chromium steel outside rising screw spindle.

The valve body shall incorporate a transverse slide seal so arranged for easy replacement of the packing, which shall be accessible without removal of the valve from the pipeline.

Handwheels shall have smooth rims and of such diameter to enable one man to operate the valve. The direction of opening and closing shall be cast on the handwheel. The direction of closing shall be clockwise.

Valves of 125 mm, nominal bore and over shall be fitted with position indicators showing the amount which the valve is open or closed in relation to its full travel.

217.3.9 Isolating Cocks

For isolation of small bore pipework tappings for instrumentation equipment etc. and for individual component isolation, the cocks shall be stainless steel, quarter-turn, ball or plug valves with the operating handle arranged to indicate the open and closed positions. Where specified, means shall be provided for securing the valve body to a front panel or rear surface.

Where corporation cocks are specified, these shall be similar to the above isolating cocks but shall have a detachable key handle for fitting onto a squared operating shaft, the shaft end being marked to indicate the open and closed valve positions.

217.3.10 Penstocks

General

All penstocks shall be designed and installed so that the maximum working pressure acts in a seating direction on the gate. Both gate and frames shall be sufficiently rigid to withstand twice the maximum working pressure and any eccentric pressures created by the tightening of the anchor bolts during installation. All penstock frames shall have a spigot back.

The frame shall be designed to ensure that the gate is supported over not less than two thirds of its depth when the gate is fully raised.

Penstocks shall be of the rising spindle type unless otherwise specified, and the spindles shall be of adequate size to avoid buckling under load.

All spindle nuts shall be self aligning and their length shall be not less than twice the spindle diameter.

The top part of the penstock frames shall be sufficiently robust and substantial to prevent the frames bowing and if necessary, additional holding down bolts shall be fitted. The penstocks shall be fitted with matching wedges on doors and guides, the wedges shall be fitted with renewable seatings of zinc free bronze. Under no circumstances shall wedges be fitted to the bottom or lower sections of the penstock doors. The wedges shall be adjustable with stainless steel adjusting screws and shall be readily removable.

On rectangular penstocks the inverts shall be flush with renewable synthetic rubber seals on the bottom of the doors. The rubber shall be suitable for the application and of an approved type.

The doors shall have lifting eyes cast in, or eye bolts of sufficient size to permit the lifting of the door against seating pressure.

Where extended spindles installations require to be operated at elevated floor level, spindle guides or guide brackets shall be provided close to the floor level.

Where penstocks are required to be operated by the tee keys, spindles caps shall be fitted. The caps shall be drilled and each provided with nut and bolt for securing to the spindle which shall also be drilled. Where caps are fitted they shall each be supplied complete with operating tee key.

All penstock shall be provided with headstocks (except where the Handwheels can be mounted on the penstock frames). For penstocks of 300 mm ND. (square or circular) and above and for all motorized and actuator operated penstocks, unless otherwise stated, thrust tubes shall be provided between the penstocks frame and the headstock, in order to absorb the operating thrust in both directions. Thrust tubes shall incorporate all necessary fixing brackets and spindle quid plates.

Headstocks and foot brackets shall be provided for non-rising spindle penstocks where the latter are specifically called for. Guide brackets shall be provided where necessary. Non-rising spindles shall be fitted with thrust collars and arranged so as to transmit the thrust arising from operation of the penstock directly to the Penstocks frame. Where headstocks are required on non-rings spindles installations they shall incorporate a penstock position indicator.

Penstock shall be water-tight under the conditions of head and direction of flow as stated in the appropriate clause or schedule of the specifications and/or the contract drawings.

Penstock shall be water-tight under the conditions of head and direction of flow as stated in the appropriate clause or schedule of the specification and/or the contract drawings.

All bolt holes shall be drilled and spot faced.

Simple templates shall be supplied as soon as possible after approval of drawings to enable the Civil contractor to position the holes for holding down bolts for all penstocks over 1.0 m square.

Penstock Materials

Penstock doors, wedge support beams, frames, guides, frame extensions, headstocks and bridge pieces shall be cast iron, of minimum grade 220 to BS 1452. Doors and frames shall be fitted with renewable seatings of zinc free bronze.

Spindles shall be manufactured from stainless steel 431S29 (EN 57) or similar approved material.

Extension Spindles

Extension spindles shall be adequately sized to prevent buckling and shall be attached to the valve/penstock stem by a suitable adaptor incorporating two muff couplings, scarf lap jointed and pinned with at least two coupling joints included. Universal joints and waterproof sleeves shall be provided where specified. Extension spindles shall be manufactured from 080M40 (EN 8) steel.

Intermediate bearing support or guide brackets of cast iron, with slotted holes for site adjustment, shall be fitted to long shafts where necessary. Bearings shall be of PTFE or similar approved type.

Pedestals and Spindle Covers

Penstock and valve pedestals shall be of cast iron or heavy duty, welded, mild steel construction with a substantial base and fixing provision. The base and top of the pedestals shall be machined normal to the axis of the drive shaft.

Where necessary, support guide bushes shall be fitted as the base of the pedestal.

The pedestal height shall be such that the handwheel is approximately 1 metre above the operator's floor level.

Clear polycarbonate covers of an approved type shall be provided for all rising spindles to totally enclose them when in the fully raised position.

Each tube shall be clearly and permanently engraved to indicate the position of the penstock.

217.3.11 Air Valves

Air valves shall be of two types:

a) Single (small) orifice valves (SOV), for the discharge of air during the normal operation of the pipeline.
b) Double orifice valves (DOV), consisting of a large orifice and a small orifice. These shall permit the bulk discharge of air from the main during filling and air inflow when emptying in addition to the discharge of small quantities of air during normal operating conditions.

Air valves shall be supplied with an independent isolating butterfly valve (DOV) or cook (SOV) which permits the complete removal of the air valve from the main, without affecting the flow of water in the main.

The sizing of the air valve and isolating assembly shall be such that the pressure drop at design flow capacity does not exceed 0.5 bar.

Each air valve assembly shall be suitable for connection to a flange on the pipeline.

At the connection between the air valve and its isolating valve a BSP tapping shall be made suitable for fitting of a pressure gauge. All tappings shall be sealed by a brass plug and copper compression ring gasket.

Air valves shall operate automatically and be constructed so that the operating mechanism will not jam in either the open or closed positions.

217.3.12 Handstops (for Sewage Only)

Handstops shall have cast iron frames with galvanised mild steel doors.

Handstops shall be semi-circular or rectangular pattern according to the application or as specified.

Handstops shall be suitable for channel or wall mounting according to the installation requirements.

Handstops doors shall be provided with hand-slots to facilitate operation and a peg and chain shall be provided to hold the door in the open position. Pegs and chains shall be of stainless steel.

On deep channels or where specified, handstop doors shall be provided with lifting handles. Lifting handles shall be of identical material to the doors and guide/retaining brackets shall be provided.

All materials used in the manufacture of handstops shall conform with the requirements for Penstocks specified herein.

217.3.13 Flap Valves

Flap valves shall be of the following categories :

i) General purpose (excluding category (ii) applications).

ii) Seawater and other aggressive applications.

Flap valves shall be normally closed, by weight of the door only, and shall open under minimum flow conditions. They shall be capable of withstanding 1.5 times the specified maximum seating head.

Flap valves on tidal installations shall be capable of withstanding a minimum static head of 6 metres and a minimum surge head of 10 metres.`

Where flap valves are required for flange mounting, they shall be supplied with rubber gasket and the full number of holes to BS.4504 NP 16.

Fixing nuts and bolts shall be as specified in the fastners general requirements with the exception of seawater and other aggressive locations in which case they shall be of stainless steel only.

All flap valves shall be operated and painted in accordance with metal painting and protection requirements.

General purpose flap valves shall be of the double hung type and all valves of 600 mm opening and above shall be of the double door type.

All doors shall be provided with lifting rings and those of 600 mm opening and above shall be fitted with galvanised lifting chains.

217.3.14 pressure relief valves

Pressure relief valves shall protect pipes from accidental overpressure and surge.

It shall consist either of a low inertia valve guided by a flexible diaphragm ensuring a rapid response, and easily adjusted on site, or of a spring operating under compression, a fixed tapered discharge nozzle and a flat-disc mobile shutter.

These valves shall only open under a determined pressure slightly higher (almost 5%) than the maximum pressure for normal working conditions.

The body, sleeve, and gland shall be cast iron. The spring shall be stainless steel.

They shall be wafer type and occupy minimal space.

217.3.15 Pressure / flow control valves (reducing/regulating)

Control valves shall function efficiently of line pressure or flow without human intervention. They shall be hydraulically or electrically operated depending on the availability of a power source. The basic valve shall be heavy duty globe type to BS 5152 & 5160. It shall have no packing glands or stuffing boxes and shall be maintained with ease without removal from the pipeline.

The valve shall be coated internally and externally with epoxy 150 µm minimum thickness. The material of the valve and its elements shall be selected to suit the fluid in the line and the environmental factors such as abrasion, corrosion, pressure and temperature.

218 – ROAD WORKS
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218 road works

218.1 Roads and Paved Areas

218.1.1.1 General

Road construction under this division shall include construction of new roads and paved areas and repairs to existing roads and paved areas where such repairs are necessitated by the performance of the Works, and the term "road" as used in this division shall also include other areas on which a road surfacing is required.

All roads shall be constructed to the lines, levels and cross-sections shown on the Drawings and as detailed in the Particular specification. Road surfacing may consist of compacted local soil, gravel, laterite or similar suitable material, with or without a stabilizing spray of bitumen, or of asphalt concrete placed on a bearing course of compacted gravel, laterite or other suitable base course material.

All roads shall be fitted with a stormwater drainage system, sidewalks, etc.

218.1.1.2 Earthworks for Road Construction (Subgrade)

All excavation and fill required for road construction shall be carried out in accordance with the applicable requirements of Division 201. The materials to be used and the degree of compaction to be obtained in each layer of the road structure shall be as shown on the Drawings or as required in the Particular Specification.

218.1.1.3 Sub-Base and Base Courses

Sub-base preparation shall consist of the following:

- Scraping of the natural ground
- Earthworks and levelling of the surface
- Compaction with a pneumatic roller.

Unless otherwise specified, sub-base material shall consist of hard, durable particles or fragments of stone or gravel, screened and crushed to the required size and grading or an equivalent material, subject to the Engineer's approval. The material shall be free from vegetable matter, lumps or balls of clay and other objectionable matter.

The sub-base shall be levelled, watered, rolled and compacted to 96% of the Modified AASHTO Density. In case it consists of non-rock ground, the California Bearing Ratio CBR shall be greater than 30. The Material shall have a specific weight greater than 2.45 kg/dm^3.

If the bearing of the foundation soil be inadequate, the top soil shall be stripped to a 20cm depth. The stripped area shall be backfilled with material that meets the requirements and have a minimum CBR of 15 when compacted to 96% of Modified AASHTO Density. The frequency of tests shall be determined by the Engineer.

The sub-base course material layer shall conform to the following grading:

A.S.T.M.Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
1"½	100%
1"	60-100
¾"	55-85
No. 4	35-60
No. 10	25-50
No. 40	15-30
No. 200	0-15

The material shall have the following properties:

- Plasticity Index (AASHTO T90) 4-8
- Plastic Limit (AASHTO T89) 25 maximum
- Sand Equivalent (AASHTO T176) 50 minimum

Unless otherwise specified, base course material shall be crushed aggregate which shall consist of hard, durable particles or fragments of stone or gravel crushed to the required size, and a filler of sand or other finely divided mineral mater. When produced from gravel, not less than 50 percent by weight of the coarse aggregate shall be particles having at least one fractured face and, if necessary to meet his requirement or to eliminate an excess of filler, the gravel shall be screened before crushing. All suitable oversize material less than 10 inches in diameter shall be crushed. The material shall be free from vegetable matter, lumps or balls of clay and other objectionable matter.

The sub-base and base courses shall consist of a minimum of 20 cm thick each course of compacted layers of screened and crushed material.

The sub-base shall be watered prior to the placing of the base course. The material shall then be laid, watered and compacted with a pneumatic roller to 98% of Modified AASHTO Density.

The last base course shall be levelled to ± 1 cm according to the levels shown on the drawings or specified by the Employer. Newly placed base courses shall not be opened to traffic.

The base course material shall have a specific weight greater than 2.45 kg/dm^3 and shall conform to one of the following gradings:

A.S.T.M.Sieve designation	Percentage by Weight Passing Square Mesh Sieves								
	A	B	B-1	C	C-1	D	D-1	E	E-1
3 inch	100	-	-	-	-	-	-	-	-
2 inch	-	100	100	-	-	-	-	-	-
1 1/2 inch	-	-	70-100	100	100	-	-	-	-
1 inch	-	-	55-85	-	70-100	100	100	-	-
3/4 inch	-	-	50-80	-	60-90	-	70-100	100	100
3/8 inch	-	-	40-70	-	45-75	-	50-80	-	-
No. 4	15-45	20-50	30-60	25-55	30-60	30-60	35-65	35-65	45-80
No. 10	-	-	20-50	-	20-50	0	25-50	-	30-60
No. 40	-	-	10-30	-	10-30	0	15-30	-	20-35
No. 200	0-10	0-10	5-15(*)	0-10	5-15(*)	0 - 10	5-15(*)	0-10	5-15(*)

(*) For gradings B-1, C-1, D-1 and E-1, the fraction passing the No. 200 sieve shall not be greater than two-thirds of the fraction passing the No. 40 sieve.

If no specific grading is specified, the grading shall comply with C above.

If fine aggregate or filler in addition to that naturally present in the base-course material is necessary in order to meet the grading requirements or for satisfactory bonding of the material, it shall be uniformly blended with the base-course material at the screening and crushing plant or on the road. The material for such purpose shall be obtained from sources approved by the engineer and shall be free from hard lumps.

That portion of the base course material passing No. 40 sieve shall be nonplastic.

The base course material shall be tested for abrasion in accordance with B.S. 812 and the following maximum values shall be acceptable.

Aggregate fraction	Maximum abrasion (%)
3/4" - 1"	40
1/2" - 3/4"	35
3/8" - 1/2"	30
1/8" - 3/16"	28

Sub-base and base courses shall be placed in layers not exceeding 15 cm in thickness, after compaction. Unless otherwise specified, base course materials shall be placed only by means of spreader boxes or equivalent equipment. Placing base course materials directly by means of trucks, shovel dozers and other loading or hauling equipment will not be permitted. Blending material, where required, shall be added by means of spreader boxes or other approved equipment and the whole base course layer shall be thoroughly mixed to its full depth by means of graders, mixers or other approved equipment.

During placing and mixing, water shall be added in the amount necessary to provide the optimum moisture content for compacting.

Compaction shall be carried out in accordance with the applicable parts of Section 201.7.

Unless otherwise specified, the following densities shall be required:

- For sub-bases: 96% of the Modified A.A.S.H.T.O. Density
- For base-courses: 98% of the Modified A.A.S.H.T.O. Density

218.1.1.4 Bituminous Prime Coat and Tack Coat

Unless otherwise specified, a prime coat of medium curing cut-back bitumen of grade MC-70 shall be applied on top of finished base course, at the rate of 1.0 kg/m^2, and a tack coat of rapid curing cut-back bitumen of grade RC-250 shall be applied between asphalt concrete layers (where more than one wearing course is specified), at the rate of 0.25 kg/m^2.

Bituminous coats shall be applied one day before the next layer is placed on top of them. Prior to applying bituminous coats, the road surface shall be thoroughly cleaned of all dirt, oil, grease and other objectionable matter, to the satisfaction of the Engineer. The bitumen shall be heated in boilers of an approved type and spreading shall be carried out by means of mechanical pressure distributors.

218.1.1.5 Asphalt Concrete Wearing Courses

The number of asphalt concrete layers to be placed in the road surfacing and the thickness of each of them shall be as shown on the Drawings and/or required in the Particular Specification.

All aggregates and bituminous materials to be used in asphalt concrete shall be subject to approval by the Engineer. Samples of the materials shall be submitted to the Engineer at least 30 days prior to their use.

All aggregates, except natural sand, shall be obtained by crushing natural quarry stone, and the use of river gravel, whether crushed or not, will not be permitted. Coarse aggregate shall be of uniform quality, with the particles as nearly cubiform as possible, clean of dust or foreign matter, and shall comply with the requirements of Subsection 218.1.3 above for base course aggregate. Quarry sand shall be clean and free of clay, silt or other deleterious matter; it shall all pass sieve No. 10 and not more than 10 percent of it shall pass sieve 200. The grading of the aggregates shall be if not specified in the Particular Specification as follows:

A.S.T.M.Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
¾“	100%
½”	80-100
No. 4	50-70
No. 10	32-47
No. 40	16-26
No. 80	10-18
No. 200	4-10

Mix design shall be carried out as follows. The proposed aggregate mixture shall be mixed with 5.5% bitumen (if no other percentage is required in the Particular Specification). This sample shall be subjected to a set of Marshall tests (A.S.T.M.-D-1559 and A.S.T.M.-D-1188) at a laboratory in order to determine the optimum bitumen content. The Engineer may change the grading of the aggregates and the bitumen content according to the results of laboratory tests conducted on samples of materials supplied from time to time by the Contractor at the request of the Engineer.

Placing of asphalt concrete, unless otherwise specified, shall be carried out by means of paving finishers, specially designed for that purpose. The asphalt concrete layers shall be compacted by tandem rollers, heavy pneumatic rollers and three-wheeled rollers, in that order to reach a density not less than 97% of the Marshall density. Parts of the layers inaccessible to heavy mechanical rollers shall be compacted by small vibratory tampers. Rolling shall proceed from the outer edges towards the centre of the road and the whole area shall receive a uniform compaction throughout and shall be finished accurately to the required lines and levels. When asphalt concrete is placed in more than one layer, longitudinal joints shall be staggered by 30 cm and transversal joints by 60 cm between layers. The permissible variations of the top surface from the design levels shall be -0 + 15 mm. The permissible variations from the plane in the top surface shall be 5 mm over a length of 5 m.
Newly paved asphalt concrete surfaces shall be opened to traffic only after permission to do so is given in writing by the Engineer.

Placing of asphalted concrete shall ensure an inclination for drainage of stormwaters in accordance with the drawings and as specified by the Engineer.

218.1.1.6 Bituminous Surface Treatment

Where shown on the Drawings or required in the Particular Specification, a surface treatment shall be applied to the base course by spraying cut-back bitumen followed by a rolled blinding layer of stone chippings. Unless otherwise specified, bituminous surface treatment shall consist of the following two layers:

- Cut-back bitumen MC-3000 at the rate of 2.8 kg/m^2, followed immediately by stone chippings of 3/4" - 1" size at the rate of 27 kg/m^2.

- Cut-back bitumen MC-3000 at the rate of 1.35 kg/m^2, followed immediately by stone chippings of No. 4 - 1/2" size at the rate of 22 kg/m^2.

The second layer shall be placed after the first layer has been rolled.

Prior to application of bituminous spray the base course surface shall be checked for accuracy and any irregularities shall be repaired. The surface shall then be swept clean of all loose material, foreign matter, dust and dirt. Areas contaminated by kerosene or diesel oil shall be removed and made good with clean and stable base course material.

The bitumen shall be heated in kettles of an approved type equipped with enclosed thermometers, the heat being conducted by oil or steam. Heating of bitumen in the barrels will not be permitted.

The entire area of the base course shall be sprayed uniformly at the prescribed rate by means of approved mechanical spraying equipment. Pools of excess liquid bitumen shall be sprinkled with fine sand which shall be swept off after it has absorbed the surplus bitumen.

The stone chippings shall be uniformly applied upon the entire sprayed surface. Trucks or other equipment for spreading the chippings shall be operated backwards so that the bituminous spray will be covered before wheels or workmen pass over it. Supplementary spreading and smoothing, where necessary, shall be done manually.

Following spreading and smoothing of chippings, each layer shall be rolled, to the satisfaction of the Engineer.

The completed road surface shall not be opened to traffic until permitted by the Engineer.

218.2 Drainage system

Stomrwater discharge channels and drainage systems shall be installed as shown on the drawings.

Excavation limits of channels and pipes as shown on the drawings shall be extended by 10 cm at the bottom and 30 cm on either sides.

Such over excavations shall be backfilled with graded fills and compacted to the satisfaction of the Engineer.

Excavations shall have a longitudinal slope as specified by the Engineer to facilitate water discharge.

The concrete drainage channels shall be either of precast or of cast-in-place concrete complying with the requirements of division 202.

Where specified, construction and expansion joints shall be performed to the details shown on the drawings and as directed by the Engineer.

A collector fitted with a metallic grid shall be mounted on channels and pipes as shown on shop drawings.

218.3 sidewalks

Where specified on Drawings and required by the Engineer, sidewalks shall be executed.

Prior to the construction of sidewalks, the base course shall be prepared as determined in the previous articles. The Contractor shall be held liable for any future settlement of such layer.

Pavement works shall start upon the approval of the Engineer, and as shown on shop drawings.

For concrete paving, the flags shall be of an approved colour and laid in compliance with the requirements of the division 208, and in strict accordance with the lines and levels shown on shop drawings.

218.4 Concrete Kerb-Stones

Precast concrete kerbs, channels, etc. shall be to the types and dimensions shown on the Drawings and/or defined in the Particular Specification. They shall be whole, sound, without cracks, air bubbles or other defects, and shall comply with the requirements of B.S. 340. Where specified, kerbs, channels etc. shall be bedded and backed with C 15 P concrete. Joints between units shall be filled with a 1:2 cement mortar.

All kerbs, channels, etc. shall be aligned in strict accordance with the lines shown on the Drawings. Special terminal units shall be provided at the edges of the alignment. Where required, units shall be cast-in-situ to the lines and dimensions shown on Drawings.

Kerbs, channels, etc. in sharp curves shall be shorter than those used on straight lines, in order to ensure proper alignment.

218.5 testing

218.5.1.1 Testing on fill materials

All natural fine fills shall conform to the below listed requirements:

i) Complete Identification Tests

- Sieve analysis and sedimentometry
- Atterberg limits (liquid limit, plasticity index, shrinkage)

ii) Test on organic soils

iii) Standard Proctor tests with complete determination of compaction diagram

iv) Modified Proctor tests with complete determination of compaction diagram

v) CBR tests at 95% of the maximum dry density.

The number of the aforesaid tests shall be as determined by the Engineer.

218.5.1.2 Tests on Backfill

Placing natural fine fill shall be controlled by the Engineer in the following manner:

Three series of the following tests shall be conducted on each backfilled layer or on every 250 m^3 of placed backfills:

Measurement of moisture content
Measurement of compactness (dry density)

218.5.1.3 CBR tests on natural ground

CBR tests shall be conducted according to relevant standards.

The frequency of tests shall be as determined by the Engineer.

218.5.1.4 Tests on crushed aggregates

The required tests on crushed aggregates to be used for roads are the following:

- Measurement of the specific gravity
- Measurement of the compressive strength on 7 cm side cube
- Los Angeles test
- Sieve analysis
- tests on organic soils according to French Standards
- Measurement of the sand equivalent.

A series of tests shall be carried out on each 500 m^3 of aggregates or as directed by the Engineer.

Following are the two density control tests to be carried out on site on each placed crushed aggregate layer:

- Either on each finished layer,
- Or on each 250 m^3 of placed aggregates,
- Or as directed by the Engineer.

218.5.1.5 Tests on concrete asphalt aggregates

Following are the required tests to be carried out on concrete asphalt aggregates:

- Los Angeles Test
- Specific gravity
- Sieve analysis
- Loss in weight
- Sand equivalent
- Any other test as specified by standard ASTM D 693-54.

Three series of tests shall be conducted on each 500 m^3 of furnished material or on any volume exceeding by 50% this number, as required in writing by the Engineer.

218.5.1.6 Tests on bitumen

- Penetration at 25° C
- Penetration at 163° C
- Ductility at 25° C
- Flash point
- Solubility in carbon sulphide at 20° C
- Paraffin content.

Whenever required in writing by the Engineer, the tests above shall be carried out on each furnished bitumen volume prior to manufacture of asphalt concrete, or on bitumen that is being used.

218.5.1.7 Tests on asphalt concrete mixture

The Contractor shall conduct:

1) Tests to determine the grading of aggregates and the bitumen content

2) Marshall tests to determine the stability and density of bitumen-covered aggregates.

These tests shall be carried out before the commencement of works and repeated to the satisfaction of the Engineer.

218.5.1.8 Quality Control Tests

- Control of grading
- Control of moisture content and temperature
- Control of bituminous mixture, 2 samples to be tested daily/mixing plant
- Control of mixing plant.

Grading control shall be conducted once a day on 10 kg of samples of aggregates before putting them in the mixing plant, and whenever required by the Engineer.

Control of moisture content and temperature shall be carried out twice a day; moisture content shall not exceed 0.5% and temperature variations ± 5° C.

The control of bituminous mixture shall be carried out on the bitumen content and grading. Each tested sample consisting of four distinct samplings shall be taken from the mixing plant at short intervals as to ascertain that the proportioning remains unchanged.

The tolerance on bitumen content is relatively ± 5% of the measurements daily average.

Permissible tolerances are:

- ± 5% of the percentage fixed for the average bitumen content
- ± 10% of the percentage fixed for the corrector filler content.

218.5.1.9 Control of placing asphalt concrete

Throughout placing and compacting aggregates works, the temperature shall be controlled permanently in order to be ≥ 135° C.

After compaction, density shall be equal to 98% of the Marshall density; one core sample shall be taken of each 1000 m² of finished layer. These samples shall also be used to control the layer thickness.

Where specifically called for, the level and regularity of the surfacing shall be controlled.

No layer shall be executed by the Contractor unless the underlaying one has been duly taken over by the Engineer.

218.6 Roads - Methods of Measurement and Payment

Unless otherwise specified, roads constructed in accordance with the Drawings or on specific instructions of the Engineer, shall be measured for payment. Access and construction roads for the Contractor's own use and reinstatement of paved areas are referred to in Subsection 201.1.10 respectively, and shall not be paid for under this division.

Unless otherwise specified, roads, shoulders and sidewalks shall be measured for payment - each separately - by m^2 of completed road shoulder or sidewalk, classified by type of surface and/or by cross-section. The unit rates shall include for all necessary earthwork; supply, hauling, spreading and compaction of all sub-base and base materials, bituminous coatings, chippings and asphalt concrete; and for all materials, equipment and labour necessary for completing roads, shoulders or sidewalks, in accordance with the Drawings and the Specification, and to the satisfaction of the Engineer.

Concrete kerbstones, channels etc. shall be measured for payment in linear meters of kerbstone etc. in place, classified by type and size. The unit rates shall include for supply of units and all necessary materials for bedding and support, laying and jointing. The same unit rates shall be paid for both straight and curved alignment.

VOLUME 2
PARTICULAR SPECIFICATIONS

Part 1 - General Requirements
Part 2 - Civil Works

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PART 1

GENERAL REQUIREMENTS

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PART 1

101 GENERAL REQUIREMENTS

101.1 INTRODUCTION

General requirement items will not be mentioned as separate items in the bill of quantities of the project. It is the contractor's responsibility to include its cost while pricing the mentioned items in the BOQ.

101.2 APPLICATION OF PARTICULAR SPECIFICATION

This Particular Specification is to be read and construed together with the General Specification contained in Volume 3 of the Contract Documents for this Tender. In case of ambiguities or discrepancies between this Particular Specification and the General Specification, the Particular Specification shall prevail, except if and to the extent otherwise provided by the Contract or directed by the Engineer.

Whenever the term "Specification" without further qualification is used in the Contract Documents, it shall mean the General Specification together with the Particular Specification.

101.3 LOCATION OF WORKS

The Works cover the construction of essential parts of Ghineh reservoir and equipping of its valve chamber, including all related civil and electromechanical works to ensure the proper functioning of the system.
The Contractor shall cooperate with all parties such as municipalities, Public Works Department, Electricity of Lebanon, Telecommunications Authority, adjacent plot owner and all other necessary authority (where needed) for any required work inside or outside the mentioned working area.

101.4 THE SITE

For works within reservoirs and valve chambers, the limits of the Site shall be the limits of land in public ownership.

In some areas the width of the Site will be physically restricted by physical boundaries such as boundary wall or by natural topographic features. The Contractor shall have inspected the Site and shall have included for the provision of any additional working area that he may require outside the limits of the Site.

101.5 SCOPE OF WORK

The construction works in the present contract are listed below:

The works cover the following items:
- Concrete works
- Metal Works
- Finishing works
- Electromechanical works for the valve chamber

101.6 CONDITIONS PREVAILING AT SITE OF WORKS

The Contractor's attention is drawn to his obligation to satisfy himself, before submitting his Tender, as to the conditions prevailing at the Site of Works and its surroundings and relevant sections of the General Specification.

101.7PRIVATE LANDS

The Contractor shall not enter upon or occupy with men, tools, or materials of any nature, any lands other than the working areas shown on the Drawings, except after consent shall have been received by him from the proper parties and a certified copy of such consent shall have been furnished to the Engineer. Any rentals or damages paid for occupying private lands shall be at the Contractor's expense.

101.8EXISTING SERVICES

In the course of works, the Contractor will encounter within the limits of the working areas and in the vicinity, miscellaneous above ground and underground services such as drains, pipes, cables, telephone and electric poles and lines, water supply and similar existing services. The Contractor's attention is directed to the provisions of Clause 101.12.4 of the General Specification with regard to such existing services.

101.9ACCESS ROADS

The necessity of construction of Access Roads and/or temporary roads may arise, in which case it shall be executed at the contractor's responsibility and expenses in coordination with the concerned Authorities and according to the Engineer's requirements.

101.10 program and monitoring

It is a primary requirement of the Employer that a comprehensive knowledge of the status of progress to date, predicted progress, costs and cash flow forecasts is available at all times. The Contractor shall be responsible of the requisite information and shall be responsible for programming the Works, preparation of cash flow estimates and measuring and reporting the progress of the works in an approved format. In order that programming, progress measurements and reporting is executed in a timely and efficient manner, the Contractor shall program the Works, monitor progress and generate cost reports and cash flow projections by utilizing a recognized industry standard approved P.C. based Project Management software package.

The Contractor's master program and cash flow estimates and subsequent updates, shall, as a minimum, detail the sequence of procurement, installing, testing and commissioning, and handing over for each of the work items including each item described in the Bill of Quantities.

At least 21 days prior to taking possession of any portion of the Site and starting of work, the Contractor shall submit a detailed construction program for that portion of the Site. The detailed construction program shall be to a level to adequately identify the intended sequence of working on each individual item of work. The minimum level of detail shall not be less than that needed to identify each individual payment item included in the Bill of Quantities.
The Engineer's obligation to measure the Works shall be dependent on the Work being programmed and progress being monitored and reported in accordance with the requirements of the Contract.

101.11 LIST OF ABREVIATIONS

In the Contract Documents, the following abbreviations have been employed:

uPVC	- Unplasticized Polyvinyl Chloride
D.I.	- Ductile Iron
R.C.	- Reinforced Concrete
C.I.	- Cast Iron
G.S.	- General Specification
C.O.C.	- Conditions of Contract

B.O.Q.	- Bill of Quantity
PN	- Nominal Pressure
DN	- Nominal Diameter
ID	- Inner Diameter
OD	- Outer Diameter

101.12 OR EQUAL CLAUSE

Wherever references to Standard Specifications, such as British Standards, are made, they shall not be construed to restrict materials to British products. Materials from other scheduled countries will be considered provided that the producer of the material certifies its conformity to the appropriate Standard Specification.

Similarly, whenever a required material or article is specified or shown in the plans by using the name of the proprietary product or of a particular manufacturer or vendor, any material or article which will perform adequately the duties imposed by the general design will be considered equal and satisfactory provided the material or article so proposed is of equal substance and function in the Engineer's opinion. It shall not be purchased or installed without his written approval.

101.13 GOVERNMENT REGULATIONS

The Contractor shall comply with all provisions of the rules, regulations and orders of Government and Municipal agencies, such as the Public Works Department, Electricity of Lebanon, and Telecommunications Authority.

The Contractor shall co-operate with the Employer in promptly furnishing any information that may be required by such governmental agencies. It shall be the obligation of the Contractor to keep himself informed of these governmental rules, regulations, and orders and the Contractor shall make the requirements of this article a part of any sub-contract he may enter into.

101.14 ACCESS TO WORK

The Engineer and his duly appointed representatives and the Employer or his representatives or agents may at any time and for any purpose whatsoever enter into and upon the work and the premises used by the Contractor. The Contractor shall provide free, proper, and safe facilities therefore.

101.15 SURVEY AND SETTING OUT

All levels used for construction shall be referred to the National Height Datum.
The Contractor shall be responsible for obtaining the location and values of the permanent bench Marks. In cases where such bench Marks do not exist, a site datum shall be agreed with the Engineer.

Prior to the commencement of the work the Engineer shall approve all plans showing benchmarks, limits of plot and auxiliary baselines. The Contractor, under the supervision of the Engineer, shall set out on-site and erect appropriate permanent markers where instructed by the Engineer.

The Contractor shall employ an experienced licensed Surveyor for the duration of the Contract. He shall furnish the Engineer with a duly signed map showing the various centerlines, baselines, reference points permitting the renewal of markers and boundaries of parcels and blocks, if destroyed. Before starting and during earthwork on the site, the Contractor shall set out a net of square coordinates at distances not exceeding 10 m in each direction. A peg shall be driven at each intersection and at other relevant points and levels of peg tops and of ground at the same spot shall be measured.

The levels of the ground and the levels and dimensions of existing features shown on the Drawings are not guaranteed to be correct.

Wherever dimensions or levels are marked on the Drawings such dimensions or levels shall take precedence over dimensions scaled from the Drawings. Where no dimensions or levels are shown on the Drawings, instructions shall be obtained from the Engineer. Large scale drawings shall be taken in preference to drawings of smaller scale.

101.16 MANUFACTURE'S certificates

The Contractor shall furnish the Engineer with a manufacture's certificate confirming compliance to the specification in respect of all items of equipment.

The original and one copy of the manufacturer's certificate shall be delivered to the Engineer not later than 14 days prior to the intended date of delivery of the Item to site.

101.17 precautions against contamination of THE work

The Contractor shall at all times take every possible precaution against contamination of the works. The site and all permanent and temporary works shall be kept in a clean, tidy and sanitary condition. The Contractor shall at all times take measures to avoid contamination of the existing water courses and drains by petrol, oil or other harmful materials.

101.18 access to properties

The Contractor shall not disrupt any private or public access way without first providing alternative arrangements.

101.19 drawings and DOCUMENTS

All drawings and documents submitted by the Contractor shall have been checked and signed, shall be ready for issue and shall bear the title of the drawing, the scale, the date, the Contract number and name, the document number complying with an approved numbering system, the name and references of the Contractor, the name of the Employer and the Engineer, the date of approval by the Contractor and the signature of the person responsible for the approval.

Unless otherwise specified, the Contractor shall allow a minimum of 15 days for approval of drawings and documents by the Engineer.

101.20 MEASUREMENT AND PAYMENT

Unless otherwise provided for in the B.O.Q, all costs incurred in complying with the requirements of this Division 101 shall be deemed to be included by the Contractor in his unit rates in the Bill of Quantities and shall not be paid for separately.

PART 2

CIVIL WORKS

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201 EARTHWORKS

201.1 PROGRAMME AND METHODS OF WORK

In addition to the information furnished by the Contractor with his Tender, the Contractor shall, after award of Contract but no later than two weeks prior to commencement of Works, submit for the Engineer's approval detailed proposed methods of excavating, proposed shoring system. transporting and placing earth fill material, watering and compacting and any subsequent modifications thereof, together with a detailed list of quantities and type of plant to be used for all these operations. Amendments shall be made by the Contractor in accordance with any instructions issued by the Engineer before commencement of works and from time to time.

201.2EXCAVATION WORKS

A. This Section pertains to the earthwork generally consisting of excavation, filling, backfilling and subgrade preparation as required for construction of site retaining walls/structures, slab on grade walks, pavement surfaces, landscaped areas and the general shaping of the site as shown, described or reasonably inferred on the drawings.

B. Contractor is urged to carefully analyze the site conditions.

C. Construction Means, Methods, Techniques, Sequences and Procedures:

1. The Contractor is solely responsible for, and has sole control over, construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work.

2. Shoring that is required to complete the Work, is considered a method or technique and is the sole responsibility of the Contractor. If a regulatory agency requires a licensed engineer to design, approve or provide drawings for shoring, then it is the sole responsibility of the Contractor to engage the services of a qualified Engineer for shoring design services.

Related works:

- Clearing and Grubbing
- Trenching, Backfilling and Compaction
- Erosion and Sedimentation Control
- Asphalt Concrete Paving
- Concrete Paving
- Excavation and Fill
- Contractor shall comply with all current, applicable codes and regulations, including the Uniform Building Code.
- Contractor shall comply as applicable with Standard Specifications for Public Works Construction, Current Edition, including all site-specific City and County Amendments (herein after referred to as "Standard Specifications").

201.3 COMPACTION CONTROL

Suitable compaction equipment commonly used to meet the requirements for this type of compaction work should be used.

2. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The surface grade shall be consistent with the drainage intent shown on the plans such that no unwanted ponding shall occur.

3. Surface shall not be more than 0.10 feet above or below the established grade, and all ground surfaces shall vary uniformly between indicated grades.

4. Cut material from the site may be used for fill material if approved by site engineer. Where cut material is used as fill, each lift of such material shall be properly mixed to obtain a uniform material, with clay being the predominant material when mixed with silt, maintaining a plasticity index less than 20.

The following are the minimum requirements for compaction of cohesive and cohesionless fill materials for both general and structural fill as presented in the following table:

MINIMUM COMPACTION REQUIREMENTS

Type of Fill	Type of Fill Material	Minimum Relative Compaction (% of Max. Dry Density per ASTM D 1557 (D))	Minimum Relative Density in percent, as per ASTM D 4254
General fill	Cohesive	90	-
	Cohesionless	90	70
Structure	Cohesive	95	-
	Cohesionless	95	74

Where :

- Structural Fill:

All types of fill material placed to support all structural elements and or piping, both vertically and horizontally.

- General Fill:

All mass earthwork, including earth embankments, placed primarily for the purpose of elevating ground levels

- Cohesive Material:

All fine-grained soils such as clayey or silty soils which exhibit cohesion properties. Additionally for purposes of this specification, coarse-grained soils containing 12 % or more fines that pass through No. 200 sieve, are also included in this category.

- Cohesionless Material: Cohesionless material includes all relatively free-draining granular material such as sands or gravels which contain less than 12 % of fines that will pass through No. 200 sieve.

For the performance of all the above-mentioned tests, the Contractor shall provide a fully-equipped field laboratory and the necessary trained personnel for sampling and testing, all subject to the Engineer's prior approval. All costs for providing the field laboratory and the necessary personnel and for sampling, testing, transportation, etc., shall be deemed to be included by the Contractor in his unit rates for the various items of earthworks in the Bill of Quantities and shall not be paid for separately.

202 CONCRETE WORKS

202.1 GENERAL

202.1.1 Life Span of Concrete Structure

New works are to be designed for a life of 60 years.

202.1.2 Codes and Standards

Complementary or new design shall as far as possible be carried out in compliance with relevant International Standards such as:

- BS Standards.
- ACI and Uniform Building code.
- EUROCODES
- AFPS 90
- BAEL 1992

or equivalent standards

202.2 SOIL PARAMETERS

The Contractor shall carry out soil investigations to satisfy himself with the prevailing soil conditions for all sites.

202.3 MATERIALS

202.3.1 Grades of Concrete

The minimum grades of concrete for the various structures are given as follows:

Grade	Component
C30	Reinforced concrete for Reservoirs (400 Kg cement/cu.m)
C30	Reinforced concrete for Buildings and Structures (350 Kg cement/cu.m)
C25	Reinforced concrete for thrust blocks (350 Kg cement/cu.m)
C20	Mass concrete and Blinding concrete (250 Kg cement/cu.m)

Reinforced and mass concrete must be vibrated. Cement used for structures in contact with wastewater and buried surfaces in contact with underground water shall be sulfate resisting Portland cement (BS 4027). Cement for all other structures shall be ordinary or/and rapid hardening Portland cement (BS12).

Admixtures and mix design of the different Grades of concrete shall be submitted for approval prior to commencing the work.

202.3.2 REINFORCEMENT

All reinforcing steels shall be Type 2 High Yield Bars and comply with the requirement of BS 8110 and shall have a specified characteristic strength of 420 N/mm^2.

Dowel bars and stirrups shall be Mild Steel grade 25, fy = 250 N/mm^2.

Lap lengths shall be 50 diameters. Mechanical bending for $\phi \geq 12$ mm is required.

202.3.3 MINIMUM COVER OF REINFORCEMENT

The concrete cover for all steel bars including stirrups shall not be less than 50 mm in structures where concrete surfaces are in contact with water.

Where concrete surfaces are in contact with soil, the cover of reinforcement shall not be less than 35 mm.

The cover of reinforcement in external surfaces of structures, and all elements of buildings shall not be less than 30 mm.

Formwork for all concrete surfaces in contact with water and/or soil and internal surface (walls and ceilings) of technical rooms shall be of form panels (marine plywood or metallic formwork) in order to obtain a regular and smooth finish.
All concrete structures except the underground valve room should be fair faced.

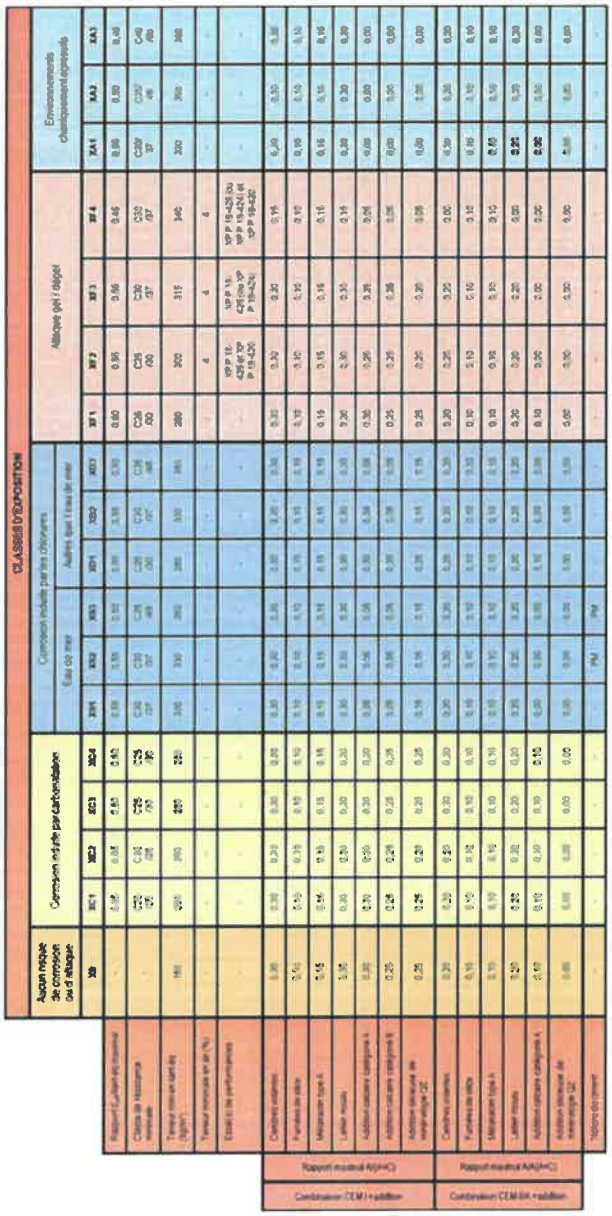
202.3.4 CLASSES OF EXPOSURE AND CRACK WIDTH

External and internal walls, columns and beams are to be considered as subject to severe exposure as defined in Sub-Clause 3.3.4 of BS 8110.
Concrete surfaces in contact with water are designed for a maximum crack width of 0.2 mm. (Class XC4)
The faces of structures in contact with soil shall also be considered as subject to severe exposure (class XA1) (Sulfate resisting).
For all other concrete a class of XC1/XF1 shall be adopted.
In addition, concrete environmental class exposure is based on BS EN 206 Concrete Specifications. As shown below (table 1 – exposure classes - BS EN 206) ,

Minimum required concrete compressive strength is adopted according to annex F - BS EN 206 (f'c = 30 MPa on cylindric test and f'c = 37 MPa on cubic test)for all structures with minimum cement content of 400 kg/m3 for water tank, and 350 kg/m3 for other structures).

Class designation	Description of the environment	Informative examples where exposure classes may occur
1 No risk of corrosion or attack		
X0	For concrete without reinforcement or embedded metal: All exposures except where there is freeze/thaw, abrasion or chemical attack. For concrete with reinforcement or embedded metal: Very dry	Concrete inside buildings with very low air humidity
2 Corrosion induced by carbonation		
Where concrete containing reinforcement or other embedded metal is exposed to air and moisture, the exposure shall be classified as follows:		
XC1	Dry or permanently wet	Concrete inside buildings with low air humidity; Concrete permanently submerged in water
XC2	Wet, rarely dry	Concrete surfaces subject to long-term water contact; Many foundations
XC3	Moderate humidity	Concrete inside buildings with moderate or high air humidity; External concrete sheltered from rain
XC4	Cyclic wet and dry	Concrete surfaces subject to water contact, not within exposure class XC2

Class designation	Description of the environment	Informative examples where exposure classes may occur
3 Corrosion induced by chlorides other than from sea water		
Where concrete containing reinforcement or other embedded metal is subject to contact with water containing chlorides, including de-icing salts, from sources other than from sea water, the exposure shall be classified as follows:		
XD1	Moderate humidity	Concrete surfaces exposed to airborne chlorides
XD2	Wet, rarely dry	Swimming pools; Concrete exposed to industrial waters containing chlorides
XD3	Cyclic wet and dry	Parts of bridges exposed to spray containing chlorides. Pavements, Car park slabs
4 Corrosion induced by chlorides from sea water		
Where concrete containing reinforcement or other embedded metal is subject to contact with chlorides from sea water or air carrying salt originating from sea water, the exposure shall be classified as follows:		
XS1	Exposed to airborne salt but not in direct contact with sea water	Structures near to or on the coast
XS2	Permanently submerged	Parts of marine structures
XS3	Tidal, splash and spray zones	Parts of marine structures
5 Freeze/thaw attack with or without de-icing agents		
Where concrete is exposed to significant attack by freeze/thaw cycles whilst wet, the exposure shall be classified as follows:		
XF1	Moderate water saturation, without de-icing agent	Vertical concrete surfaces exposed to rain and freezing
XF2	Moderate water saturation, with de-icing agent	Vertical concrete surfaces of road structures exposed to freezing and airborne de-icing agents
XF3	High water saturation, without de-icing agent	Horizontal concrete surfaces exposed to rain and freezing
XF4	High water saturation, with de-icing agent or sea water	Road and bridge decks exposed to de-icing agents; Concrete surfaces exposed to direct spray containing de-icing agents and freezing Splash zones of marine structures exposed to freezing
6 Chemical attack		
Where concrete is exposed to chemical attack from natural soils and ground water, the exposure shall be classified as follows:		
XA1	Slightly aggressive chemical environment	Concrete exposed to natural soil and ground water according to Table 2
XA2	Moderately aggressive chemical environment	Concrete exposed to natural soil and ground water according to Table 2
XA3	Highly aggressive chemical environment	Concrete exposed to natural soil and ground water according to Table 2



202.3.5 ADMIXTURES

Admixtures (retarders, mass waterproofing, silica fume, ...) are to be added to concrete in contact with liquid. Technical sheets and the mix design of concrete shall be submitted for approval.

203 METAL WORKS

203.1 PART 1 - GENERAL

203.1.1 DESCRIPTION

A. Section specifies Metal works.
B. Types: Industrial / Metal

203.1.2 SUBMITTALS

Shop Drawings: Show design, fabrication details, installation, connections, material, and size of members.

203.2 PART 2 - PRODUCTS

203.2.1 DESIGN CRITERIA

A. Structural design, fabrication and assembly in accordance with requirements of NAAMM Metal Stairs Manual, except as otherwise specified or shown.
B. Wind load calculation is based on basic wind speed on 35 m/s

203.2.2 MATERIALS

A. Steel Pipe: ASTM A53, Standard Weight, zinc coated.
B. Steel Grating: Metal bar type grating NAAMM BG.
C. Sheet Steel: ASTM A366.
D. Structural Steel: ASTM A36.
E. Steel Floor Plate: ASTM 786.
F. Steel Decking: Form from zinc coated steel conforming to ASTM A446, with properties conforming to AISI Specification for the Design of Cold-Formed Steel Structural Members.
G. Steel Plate: ASTM A570.
H. Iron Castings: ASTM A48, Class 30.
I. Malleable Iron Castings: ASTM A47.

203.2.3 FABRICATION GENERAL

A. Fasteners:
   1. Conceal bolts and screws wherever possible.
   2. Use countersunk heads on exposed bolts and screws with ends of bolts and screws dressed flush after nuts are set.
   3. bolts and screws material (hot-dip galvanized steel)
B. Welding:
   1. Structural steel, AWS D1.1 and sheet steel, AWS D1.3.
   2. Where possible, locate welds on unexposed side.
   3. Grind exposed welds smooth and true to contour of welded member.
   4. Remove welding splatter.
C. Remove sharp edges and burrs.
D. Fit stringers to head channel and close ends with steel plates welded in place where shown.
E. Fit face stringer to newel post by tenoning into newel post, or by notching and fitting face stringer to side of newel where shown.

F. Shop Prime Painting: Prepare surface and apply primer as specified for ferrous metals in Section, PAINTING.

203.2.4 RAILINGS

Handrailing shall be approximately 1000mm in height with 3 intermediate horizontal rail with standards not more than 2000mm apart.

Handrailing shall be designed for a horizontal loading of not less than 220N/mm.
Hoops shall be welded on where required for fixing guard chains.

Standards and rails shall be manufactured from black mild steel tube to BS 1357:1967, from steel tubing to BS 1775, from steel pipe ASTM A120 or from extruded aluminum alloy approved by the Engineer. The nominal bore of steel tubing shall be not less than 40mm.

Tubular Handrails and Ladders in contact with wastewater shall be of Stainless Steel Grade 316 – Contractor shall submit for approval prior to ordering the materials.

Adequate provision shall be made for thermal movement.

Guardrails shall be approximately 750mm in height with a single top rail. In all other respects it shall comply with the specification for handrailing.

Steel handrailing and guardrails shall be hot dip galvanized after fabrication.
Chains across openings in handrails at tops of ladders shall be galvanized mild steel having 3 SWG x 3 links per 100mm and shall be supplied complete with 'S' hooks and split rings.

A. Fabricate railings, including handrails, from steel pipe with flush.
   1. Connections may be standard fittings designed for welding, or coped or mitered pipe with full welds.
   2. Wall handrails are provided under Section, METAL FABRICATIONS.
B. Return ends of handrail to wall and close free end.
C. Provide standard terminal castings where fastened to newel.
D. Space intermediate posts not over six feet on center between end post // or newel post.
E. Fabricate handrail brackets from cast malleable iron.
F. Provide standard terminal fittings at ends of post and rails.

203.2.5 INDUSTRIAL STAIRS / LADDERS

Ladders shall comply with BS 421 1 and shall be of mild steel and shall consist of 65mm x 12mm flats and stringers 400mm apart with 20mm diameter solid rungs at a maximum of 250mm centers shouldered and riveted over. Stringers shall have welded-on feet and brackets for fixing to floors and walls, which fixings shall be not more than 2 meters apart. Brackets shall be 25 x 10mm flats.

Stringers shall be extended 1000mm above the upper platform and suitably opened out for access, or where ladders are below manhole covers, separate hand holds shall be fixed to the upper platform.

Unless otherwise shown on the drawings ladders rising 2500mm or more shall be fitted with safety hoops. The hoops shall have a diameter of 760mm and be of 50 x 8mm flats at not more than 900mm centers, fixed to the strimers and with three vertical straps of 50 x 8mm flats extending from the top to the bottom hoop.

Steel ladders shall be hot dipped galvanized after fabrication.

A. Provide treads, platforms, railings, stringers and other supporting members as shown. Checkered steel for treads and platforms shall not be less than 6-mm thick.

B. Treads and platforms of checkered steel floor plate:
   1. Turn floor plate down to form nosing on treads and edge of platform at head of stairs.
   2. Support tread and platforms with angles welded to plate.
   3. Do not leave exposed fasteners on top of treads or platform surfaces.
   4. Provide flat sheet steel risers for stairs with steel plate treads where shown //.

C. Treads and platforms of steel grating:
   1. Fabricate steel grating treads and platforms in accordance with requirements of NAAMM Metal Bar Grating Manuals.
   2. Provide end banding bars, except where carrier angle are used at tread ends.
   3. Support treads by use of carrier plates or carrier angle. Use carrier plate end banding bars on exterior stairs.
   4. Provide abrasive nosing on treads and edge of platforms at head of stairs.
   5. Provide toe plates on platforms where shown.

203.3 PART 3 - EXECUTION

203.3.1 STAIR INSTALLATION

A. Provide lateral bracing required to support the imposed lateral loads.
B. Perform job site welding and bolting as specified for shop fabrication.
C. Set all strucutral members in position and secure to existing structure as shown.
D. Install plumb, level and true to line verification.

203.3.2 RAILING INSTALLATION

A. Install standard terminal fittings at ends of posts and rails.
B. Secure brackets, posts and rails to steel by welds, and to masonry or concrete with expansion sleeves and bolts, except secure posts at concrete by setting in sleeves filled with commercial non-shrink grout.
C. Set rails horizontal or parallel to rake of stairs to within 3 mm in 3650 mm (1/8-inch in 12 feet).
D. Set posts plumb and aligned to within 3 mm in 3650 mm (1/8-inch in 12 feet).

203.3 .3FIELD PAINTING

A. When installation is complete, clean field welds and surrounding areas to bright metal, and coat with same primer paint used for shop priming.
B. Touch-up abraded areas with same primer paint used for shop priming.
C. Touch up abraded galvanized areas with zinc rich paint as specified in section PAINTING
D. Resin painting for the internal stair inside the water tank.

204 STEEL DOORS AND FRAMES

204.1 PART 1 - GENERAL

204.1.1 DESCRIPTION

A. This section specifies steel doors, steel frames and related components.
B. Terms relating to steel doors and frames as defined in ANSI A123.1 and as specified.

204.1.2 TESTING

Performed by an independent testing laboratory.

204.1.3 SUBMITTALS

A. Submit SAMPLES AND SHOP DRAWINGS.
B. Manufacturers Literature and Data:
   1. Fire rated doors and frames, showing conformance with NFPA 80 and Underwriters Laboratory, Inc., or Inchcape Testing Services or Factory Mutual fire rating requirements // and temperature rise rating for stairwell doors. Submit proof of temperature rating //.
   2. Sound rated doors, including test report from Testing Laboratory.

Contractor shall submit for approval prior to ordering all the materials, shop drawings, execution equipments and methods.

204.1.4 STORAGE AND HANDLING

A. Store doors and frames at the site under cover.
B. Protect from rust and damage during storage and erection until completion.

204.2 PART 2 - PRODUCTS

204.2.1 MATERIALS

A. Stainless Steel: ASTM A167, Type 302 or 304; finish, NAAMM Number 4.
B. Sheet Steel: ASTM A366, cold-rolled, stretcher leveled degree of flatness for panels (face sheets) of doors and panels.
C. Anchors, Fastenings and Accessories: Fastenings anchors, clips connecting members and sleeves from zinc coated steel.
D. Insect Screening: ASTM D3656, 18 by 18 regular mesh.
E. Prime Paint: Paint that meets or exceeds the requirements of A250.8.

204.2.2 FABRICATION GENERAL

A. GENERAL:
   1. Follow SDI A250.8 for fabrication of standard steel doors, except as specified otherwise. Doors to receive hardware specified in Section 08710, Door Hardware. Tolerances as per SDI A250.8. Thickness, 44 mm (1-3/4 inches), unless otherwise shown.
   2. Close top edge of exterior doors flush and seal to prevent water intrusion.
   3. When vertical steel stiffeners are used for core construction, fill spaces between stiffeners with mineral fiber insulation.

B. Custom Metal Hollow Doors:
Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages and finish shall be as specified for of standard steel doors.

C. Tubular Steel Doors:
1. Industrial type.
2. Stiles and rails minimum of 125 mm (5 inches) by 44 mm (1-3/4 inches), formed of 1.3 mm (0.053 inch) thick steel tubular design, with locked seam. Bottom rail be 250 mm (10 inches) wide.
3. Louver and glazed opening sizes as shown.

4. Door panels; consist of two sheets of 1 mm (0.042 inch) thick steel with a resilient separator, nominally 9 mm (3/8 inch) thick, interlocked into the stiles and rails.

204.2.3 METAL FRAMES

A. General:
1. SDI A250.8, 1.3 mm (0.053 inch) thick sheet steel, types and styles as shown or scheduled.

B. Reinforcement and Covers:
1. SDI A250.8 for, minimum thickness of steel reinforcement welded to back of frames.
2. Provide mortar guards securely fastened to back of hardware reinforcements except on lead-lined frames.

C. Terminated Stops: SDI A250.8.

D. Frame Anchors:
1. Floor anchors:
   a. Where floor fills occur, provide extension type floor anchors to compensate for depth of fill.
   b. At bottom of jamb use 1.3 mm (0.053 inch) thick steel clip angles welded to jamb and drilled to receive two 6 mm (1/4 inch) floor bolts. Use 50 mm x 50 mm (2 inch by 2 inch) 9 mm by (3/8 inch) clip angle for lead lined frames, drilled for 9 mm (3/8 inch) floor bolts.
   c. Where mullions occur, provide 2.3 mm (0.093 inch) thick steel channel anchors, drilled for two 6 mm (1/4 inch) floor bolts and frame anchor screws.
   d. Where sill sections occur, provide continuous 1 mm (0.042 inch) thick steel rough bucks drilled for 6 mm (1/4 inch) floor bolts and frame anchor screws. Space floor bolts at 50 mm (24 inches) on center.
2. Jamb anchors:
   a. Locate anchors on jambs near top and bottom of each frame, and at intermediate points not over 600 mm (24 inches) apart, // except for fire rated frames space anchors as required by labeling authority //.
   b. Form jamb anchors of not less than 1 mm (0.042 inch) thick steel unless otherwise specified.
   c. Anchors set in masonry: Use adjustable anchors designed for friction fit against the frame and for extension into the masonry not less than 250 mm (10 inches). Use one of following type:
      1) Wire loop type of 5 mm (3/16 inch) diameter wire.
      2) T-shape or strap and stirrup type of corrugated or perforated sheet steel.
   d. Anchors for stud partitions: Either weld to frame or use lock-in snap-in type. Provide tabs for securing anchor to the sides of the studs.
   e. Anchors for frames set in prepared openings:
      1) Steel pipe spacers with 6 mm (1/4 inch) inside diameter welded to plate reinforcing at jamb stops or hat shaped formed strap spacers, 50 mm (2 inches) wide, welded to jamb near stop.

2) Drill jamb stop and strap spacers for 6 mm (1/4 inch) flat head bolts to pass thru frame and spacers.

3) Two piece frames: Subframe or rough buck drilled for 6 mm (1/4 inch) bolts.

f. Anchors for observation windows and other continuous frames set in stud partitions.

1) In addition to jamb anchors, weld clip anchors to sills and heads of continuous frames over 1200 mm (4 feet) long.

2) Anchors spaced 600 mm (24 inches) on centers maximum.

g. Modify frame anchors to fit special frame and wall construction and provide special anchors where shown or required.

204.2.4 SHOP PAINTING

Shop painting for steel frames are regulated with reference to SDI A250.

A. Prime Finish:

Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: steel beams and frames are to be cleaned, and chemically treated to insure maximum finish paint adhesion. All steel beams, frames, and frame components shall be cleaned, phosphatized, and finished with one coat of baked-on rust inhibiting primer in accordance with the ANSI A250.10

Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel beams and Frames. The prime finish is not intended to be the final layer of protection from the elements. Field painting using a good grade of paint to be provided in accordance with the recommendations of the door and frame manufacturer.

B. Paint System for exterior/ interior doors:

1. Zinc Rich Epoxy anti corrosive metal primer, factory applied.
2. Solvent based 2-component aliphatic polyurethane finish coat.

204.3 PART 3 - EXECUTION

204.3.1 INSTALLATION

A. Plumb, align and brace frames securely until permanent anchors are set.

1. Use triangular bracing near each corner on both sides of frames with temporary wood spreaders at midpoint.
2. Use wood spreaders at bottom of frame if the shipping spreader is removed.
3. Protect frame from accidental abuse.
4. Where construction will permit concealment, leave the shipping spreaders in place after installation, otherwise remove the spreaders after the frames are set and anchored.
5. Remove wood spreaders and braces only after the walls are built and jamb anchors are secured.

B. Floor Anchors:

1. Anchor the bottom of door frames to floor with two 6 mm (1/4 inch) diameter expansion bolts. Use 9 mm (3/8 inch) bolts on lead lined frames.
2. Power actuated drive pins may be used to secure frame anchors to concrete floors.

C. Jamb Anchors:

1. Secure anchors to sides of studs with two fasteners through anchor tabs. Use steel drill screws to steel studs.
2. Frames set in prepared openings of concrete: Expansion bolt to wall with 6 mm (1/4 inch) expansion bolts through spacers. Where subframes or rough bucks are used, 6 mm (1/4 inch) expansion bolts on 600 mm (24 inch) centers or power activated drive pins 600 mm (24 inches) on centers. Secure two piece frames to subframe or rough buck with machine screws on both faces.

D. Overhead Bracing (Lead Lined Frames): Where jamb extensions extend to structure above, anchor clip angles with not less than two, 9 mm (3/8 inch) expansion bolts or power actuated drive pins to concrete slab. Weld to steel overhead members.

205 STEEL WINDOWS

205.1 PART 1 - GENERAL

205.1.1 DESCRIPTION:

A. Section Includes:
   1. Steel // single hung // // double hung // windows, type and sizes as shown.
   2. Hardware.
   3. Accessories including, but not limited to, following:
      a. Mullions, closures, trim, weather stripping, covers, insect screens, anchors, clips, fasteners, and other components necessary for fabrication and installation complete of windows as specified.
      b. Provide manufacturer's standard extension pole with hook for opening windows at high window locations. Provide hook receptacle factory attached to ventilators for use with extension poles. //

205.1.2 QUALITY CONTROL

QUALIFICATIONS:
1. Approval is required of products or service of proposed manufacturer, suppliers and installers, and will be based upon submission by Contractor of certification that:
   a. Manufacturer who regularly and presently, manufactures and installs steel window units and related accessories as one of its principal products.
   b. Accessories required for windows shall be manufacturer's standard or those of other manufacturers regularly engaged in making window accessories and acceptable to window manufacturer.
      1) Items shall be of materials which shall be compatible with balance of window unit material, and construction shall be that which shall give desired functional service.
2. Installer: Approved in writing by manufacturer.

205.1.3 PERFORMANCE REQUIREMENTS:

A. Air Infiltration Test at Weather stripped Ventilators:
   1. Operable windows: Provided with weather stripping, such that when tested in closed and locked position in accordance with ASTM E283 before leaving factory, air infiltration shall not exceed 2.06 cubic meter per hour per meter (0.37 cubic foot per minute per foot) of crack length when subjected to a pressure differential across the window of 300 Pa (6.24 psf) equivalent to a wind velocity of 50 miles per hour. Fixed window areas: Maximum air infiltration shall not exceed 0.34 cubic meter per hour per meter (0.06 cubic foot per minute per square foot) of fixed window area.
B. Water Penetration Test at Weather stripped Ventilators:
   1. Operable windows: Provided with weather stripping, such that when tested in closed and locked position in accordance with ASTM E331 no water penetrates for 15 minutes when a window is subjected to a rate of flow of 5 gal./hr./sq. ft. with a pressure differential across the window at 160 Pa (2.86 psf).

205.1.4 SUBMITTALS:

A. Submit SAMPLES AND SHOP DRAWINGS
B. Samples:
   1. Typical sash corner.
   2. Typical mounting section.
   3. For Initial Color Selection: Submit samples of each specified finish on 300 mm (12 inch) long sections of window members.
   4. Hardware.

205.1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver steel window units and related components in protective packaging. Use padded blankets or other approved protective wrapping for glass, decorative metal work, and other exposed elements.
   1. Do not deliver steel window units until work is ready for their installation.
   2. Inspect components for damage upon delivery. Do not install steel window units with dimples or dents. Remove and replace damaged components at no additional cost.
C. Storage: Store steel window units and related components, in positions necessary to prevent twisting, in weathertight and dry storage facility in their original shipping containers with protective wrapping or packaging securely in place, in accordance with manufacturers written instructions.
D. Protect finish from damage from handling, weather and construction operations before, during and after installation.

205.2 PART 2 - PRODUCTS

205.2.1 MATERIALS:

Materials Generally:
   1. Frame: Formed from 2.3 mm (12 gauge) galvanized sheet steel.

   2. Heavy Intermediate Ventilators: Manufactured from solid hot rolled steel shapes.
      a. Sections made from new billet steel with flanges rolled integral at mill.
      b. Ventilator sections shall have glazing rebates providing an unobstructed glazing surface of at least 16 mm (5/8 inch) in height.
      c. Glazing rebate surfaces must be perpendicular to web or stem of section. Applied glazing rebate extensions and tapered rebate surfaces are not acceptable.
   3. Mullions and Transom Bars: Mullions and transom barts shall withstand a uniform wind load of 960 Pa (20 psf) of window area without deflecting more than 1/175 of span.
   4. Weather stripping: Pile weather strip.
   5. Hardware shall be as follows:
      a. Fastener: Standard bronze sweep lock.
      b. Pulls: Standard bronze lift handle.
      c. US 20D: Statuary Bronze. //
      d. U.S. 25D: Polished White Bronze. //
      e. Balance Arm: Spiral and extension spring sash balance.
   6. Paint Finishes:
      a. Prime Coat: After fabrication, steel windows, fins, mullions, cover plates and associated parts shall be cleaned, properly treated, prime painted with manufacturer's standard prime paint.
      b. Factory Finish: After fabrication, for type of factory finish selected, steel windows and associated components shall be cleaned, and given following treatments:
         1) Pretreatment: Zinc phosphate treated.

2) Primer: Manufacturer's special epoxy primer and oven cured.
3) Finish Coat: Manufacturer's standard color coat finish and oven cured.
4) Color: Refer to Section 09050, INTERIOR/EXTERIOR FINISHES, MATERIALS, AND FINISH SCHEDULE.
a) Windows in // boiler house // // ___// shall be given a factory applied finish coat of fume resisting paint. //
b) Color of finish coat is specified in Section 09050, INTERIOR/EXTERIOR FINISHES, MATERIALS, AND FINISH SCHEDULE.
c) Touch-up abraded surfaces with enamel as specified for factory finish coat, except that it shall be Class A (Air-Drying), same as original.

c. Zinc Coated Optional Finish: All steel except screens, shall be cleaned and:
1) Hot dip galvanized (ASTM A123) and/or Electrodeposited (ASTM B633) or equivalent standards.
2) Zinc coated, phosphate treated and prime painted.
3) Zinc coated, phosphate treated, prime painted and factory finished in color as selected, from manufacturer's standard colors.
4) Use galvanize repair compound where galvanized surfaces need field or shop repair. Apply compound in accordance with manufacturer's printed directions.

7. Glass and Glazing: As specified in Section, GLASS AND GLAZING.

a. Windows shall be factory glazed prior to delivery to project site.
b. Do not provide weep holes through glazed areas.

8. Accessories:
a. Insect Screening:
1) Screen Frame: Formed of electro-galvanized steel having minimum thickness of 0.80 mm (0.032 inch), or of formed or extruded aluminum having a minimum thickness of 1 mm (0.040 inch).
a) Screen frames shall be of same material and finish as specified for windows. //
b) Screen frames shall be aluminum with natural finish. //
2) Screens: Shall be re-wirable with 18 x 16 mesh cloth of aluminum, or fiberglass. Nominal wire diameter of the cloth shall not be less than 0.25 mm (0.011 inch) for aluminum. Wire cloth shall be held taught with removable spline. Screens shall be the removable type. Design screens to be rewirable and removable from inside building.

205.2.2 FABRICATION:

A. General: Fabricate steel windows in accordance with approved shop drawings. Form sections in one piece, straight, true and smooth. Prior to fabrication, all hot rolled steel sections shall be cleaned by shot blasting. Provide drips and weep holes in accordance with manufacturer's standard practice.

B. Frame: Members shall be modified channel shapes. Corners of frame and ventilators shall be mitered or coped then solidly welded. Head and jamb members shall have integral screen-stops. Integrally roll continuous flange at jambs and heads to form a caulking stop between facing and backing masonry. Exposed and contact surfaces shall be finished smooth, flush, with adjacent surfaces.

C. Sills: Sills shall have stepped rebates to receive lower sash bottom rail, which shall be kept clear of sill wash. Sills shall not be perforated at any point in their full length. Weld strap anchors to underside of sill, or screw to tapped lugs welded thereto.

D. Sash: Rails shall be tubular. Stiles may be tubular or modified channel shape. Stiles and rails shall be formed in one piece from single strips. Make sash rebates minimum 15 mm (19/32 inch). Make interior horizontal top surfaces of both meeting rails flat and in same plane. Meeting rails shall have tight contact with wedge blocks at jambs when sash is closed. Cope, end-lap and weld all corners of sash.

E. Muntins: Steel tee muntin sections shall be tenoned and welded to perimeter frame. Muntin intersections shall be slotted and cross notched.

F. Glazing: Design windows for interior glazing. Provide continuous removable snap-in metal glazing beads to suit specified glazing.

G. If windows and interior metal window trim are installed as complete units, mullions may be anchored at head by means of 5 mm (3/16 inch) steel plate clip bolted to mullion and welded to lintel, and supported at sill with 2.3 mm (12 gauge) zinc-coated steel bent clips welded to mullion.

H. Closures: Miter or cope closure corners and fit with tightly closed joints. Secure closures to window frames with non-corrosive machine screws or expansion rivets, and to masonry with fasteners specified.

I. Reinforcing: Reinforce window frames for attachment of screens, screen hardware or travel-limit lug. Full or limited length reinforcing plates shall be welded to back of frames, and shall be 3 mm (1/8 inch) thick and of sufficient width to securely hold fasteners.

J. Welding: Dress all exposed welds and joints, flush and smooth.

K. Fasteners for Anchoring: Where type, size or spacing of fasteners for securing windows and accessories to building construction is not shown or specified, use expansion or toggle bolts or screws, recommended by manufacturer for construction material adjacent to window units. Bolts or screws: Minimum 6 mm (1/4 inch) diameter and spaced not over 600 mm (24 inches) on centers.

1. Expansion shield and bolt assemblies shall provide holding power beyond tensile and shearing strength of bolt.
2. Power actuated drive pins may be used for securing anchors to concrete if recommended by manufacturer.

205.2.3 EXTERIOR METAL WINDOW TRIM:

Form window trim of zinc-coated sheet steel. Use 1.2 mm (18 gauge) for heads and jambs, 2.33 mm (12 gauge) for stools and 1.0 mm (20 gauge) for moldings.
Make trim of welded assembly with hairline mitered corners, dressed flush and smooth. Trim to be used for plaster key, shall have flanges expanded or perforated and provided with attachments for anchorage. Slightly round exposed edges. Coat back side of trim to masonry. Make provisions for fastening of metal plastering base.

205.2.4 WEATHERSTRIPS:

Install weather strips, as standard with manufacturer, at head, jambs, sill, and meeting rails of sash and of impost. Weather strip shall be applied to both integral weather strip grooves of aluminum weather strip adapter. Secure weather strip adapter to frame surface.

205.3 PART 3 – EXECUTION

INSPECTION:

A. Window openings shall conform with details, dimensions and tolerances shown on window manufacturer's approved shop drawings.

B. Conditions which may adversely affect window installation shall be brought to Contractors attention, for repair, prior to commencement of window installation. Do not proceed with window installation until unsatisfactory conditions have been corrected.

C. Wash down of adjacent masonry shall be completed prior to erection of windows to prevent damage to window finish by cleaning materials.

INSTALLATION

A. General:
   1. Windows specified under this section shall be installed by experienced window manufacturer.

B. Install windows in strict accordance with approved shop drawings.

   1. Set units plumb, level and true to line, without warp or rack of frames.
   2. Anchor units securely to surrounding construction with a minimum of three adjustable, asphalt coated or galvanized steel anchors with approved fasteners in accordance with manufacturer's recommendations.
   3. Exterior joints between sash, trim and mullions shall be properly sealed watertight with an approved sealant as specified in Section 07920, SEALANTS AND CAULKING, and neatly pointed. Finished work shall have weathertight joints.

C. Protect window equipment during construction.

D. Upon complete installation of all windows and accessories, and before acceptance of work, adjust all movable sash and operating mechanism for free and easy operation, and defects of any nature.

E. Furnish certificate, signed by both contractor and window manufacturer, stating that installation of windows was done by installers approved by manufacturer of windows.

PROTECTION:

Protect windows from damage until final inspection and acceptance.

206 WATER PROOFINGS WORKS

206.1 SBS MEMBRANE

206.1.1 Part 1 – General

1. **Section Includes:**

Surface preparation, supply, and installation of granule surfaced, styrene-butadiene- styrene (SBS) modified-bitumen 2-ply membrane system with self-adhered, heat welded base sheets and heat welded cap sheets over Non-Nailable Substrate, including concrete tiles for protection.

2. **Reference Standards**

a. American National Standards Institute (ANSI)/Single Ply Roofing Industry (SPRI):
   i. ANSI/SPRI FX-1: Standard Field Test Procedure for Determining the Withdrawal Resistance of Roofing Fasteners.

b. American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI):
   i. ASCE/SEI 7: Minimum Design Loads for Buildings and Other Structures.

c. ASTM International:
   i. C36/C36M: Standard Specification for Gypsum Wallboard (withdrawn).
   ii. C67: Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

iii. C140: Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
iv. C208: Standard Specification for Cellulosic Fiber Insulating Board.
v. C578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
vi. C726: Standard Specification for Mineral Wood Roof Insulation Board.
vii. C728: Standard Specification for Perlite Thermal Insulation Board.
viii. C1177/C1177M: Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
ix. C1289: Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
x. D41/D41M: Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
xi. D312: Standard Specification for Asphalt Used in Roofing.
xii. D1668: Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.
xiii. D2178: Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.
xiv. D3617: Standard Practice for Sampling and Analysis of Built-up Roof Systems during Application.
xv. D4263: Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
xvi. D4586: Standard Specification for Asphalt Roof Cement, Asbestos-Free.
xvii. D4601: Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
xviii. D4897/D4897M: Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing.
xix. E108: Standard Test Methods for Fire Tests of Roof Coverings.

d. FM Global:
   i. Class Number 4450: Approval Standard for Class 1 Insulated Steel Deck Roofs.
   ii. Class Number 4470: Approval Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for use in Class 1 and Noncombustible Roof Deck Construction.
   iii. Approval Guide (online resource).
e. National Roofing Contractors Association (NRCA)/ Asphalt Roofing Manufacturers Association (ARMA):
   i. Quality Control Guidelines for Application of Polymer Modified Bitumen Roofing (Quality Control Guidelines).

3. <u>Performance requirements</u>

a) General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
b) Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
c) Roof Assembly must meet the current version of ASHRAE 90.1.

4. <u>Action submittals</u>

a) Product Data: Roofing-system manufacturer's literature, including written instructions for evaluating, preparing, and treating substrate; technical data including tested physical and performance properties; and application instructions

i. For membrane and base flashing materials, and roofing cement, asphalt, primer, mastic sealant, and fasteners.
ii. Include temperature ranges for storage and application of materials, and special cold weather application requirements or limitations.
iii. Include Safety Data Sheets (SDS) for information only; safety restrictions are sole responsibility of Contractor.
iv. Laboratory Test Reports: For installation adhesives indicating compliance with requirements for low-emitting materials.

b) Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work. Include manufacturer's reviewed and approved details that are project specific. Manufacturer's generic details or replication of Architectural drawings will not be accepted.
i. Base flashings and membrane terminations. Draw to scale.
ii. Tapered insulation layout including, crickets, saddles, and tapered edge strips, including amount, direction of slopes, and dimensions.
iii. Dimensions and locations of all field, perimeter, and corners roof areas.
iv. Insulation fastening patterns for field, perimeter, and corners roof areas.
v. Membrane fastening (back-nailing) pattern for roof slopes in excess of 1/2 inch per foot.
vi. Walkway pad plan and details.
vii. Proposed temporary, watertight, tie-off details for each substrate type.
viii. Interfacing details with sheet metal components, including but not limited to:
a. Counterflashing.
b. Stack flashing assemblies.
c. Edge and fascia sections.
d. Interface with coping cap assemblies.
ix. Interfacing details with roofing accessories including but not limited to:
a. Equipment curbs.
b. Roof hatches.
c. Expansion joints assemblies.
d. Penetrations.
e. Crickets, saddles, and tapered edge strips, including slopes.

c) Installer Certificate and Qualifications:
a. Signed by roofing-system manufacturer, certifying that Roofing Installer complies with manufacturer's requirements to install specified, warranted, roofing system.

5. WARRANTY

a) Special No-dollar-limit (NDL) Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
i. Special warranty includes membrane roofing, base flashings, fasteners, stacks, drains, wall flashings, metal flashings and other components of membrane roofing system.
ii. Warranty Period: 10 years from date of Substantial Completion.

b) Special Installer's Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
i. Warranty Period: 10 years from date of Substantial Completion.

c) Maintenance: Along with the issuance of the warranty, a set of instructions shall be included detailing preventative maintenance and noting a list of harmful substances that may damage the roofing membrane.

i. Conspicuously mount laminated or otherwise protected roof assembly letter and warranty at roof hatch upon completion of the Project.

206.1.2 Part 2 – Product

1. GENERAL

a) All products and components for the roofing system shall be supplied by the roofing system manufacturer.

b) Roofing-system manufacturer shall have at least ten years documented experience and FM Global approval for roofing system identical to that specified for Project.

c) Components other than those manufactured or supplied by the roofing system manufacturer shall be submitted for review, prior to ordering. Any product(s) not specifically authorized in writing for the project by the roofing system manufacturer, shall be considered unacceptable and their performance excluded from the warranty.

d) Roofing membranes may be installed over or adhered directly to pre-approved insulation, cover board, decking or composites thereof. Contact manufacturer for additional information regarding compatible substrates.

e) Membranes shall be testes in accordance with ASTM D 5147.

f) Base Flashing Systems: Subject to compliance with requirements, provide products by one of the following, no substitutions:

a. Johns Manville (or equivalent):
- Backer Sheet: DynaLastic 180.
- Flashing Sheet: DynaClad (aluminum-foil-surfaced), heat-welded

b. Siplast (or equivalent):
- Backer Sheet: Paradiene 20 TG.
- Flashing Sheet: Veral **[Aluminum]** **[Stainless Steel]**, heat-welded.

c. Soprema (or equivalent):
- Backer Sheet: Elastophene 180 PS.
- Flashing Sheet: Sopralast **[50 TV ALU]** **[TV Copper]**, heat-welded.

d. Flashing sheet to be coated with granules. Granule color to match color of roofing membrane granules.

2. AUXILIARY ROOFING MEMBRANE MATERIALS

a) General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

i. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

ii. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1) Plastic Foam Adhesives: 50 g/L.
2) Gypsum Board and Panel Adhesives: 50 g/L.
3) Multipurpose Construction Adhesives: 70 g/L.
4) Fiberglass Adhesives: 80 g/L.
5) Contact Adhesive: 80 g/L.
6) Other Adhesives: 250 g/L.
7) Non membrane Roof Sealants: 300 g/L.
8) Sealant Primers for Nonporous Substrates: 250 g/L.
9) Sealant Primers for Porous Substrates: 775 g/L.

b) Asphalt Primer: ASTM D41.
c) Roofing Asphalt: ASTM D312, Type IV.
d) Mastic Sealant: Polyisobutylene, plain or modified bitumen; non hardening, non-migrating, non-skinning, and non-drying.

206.2 BITUMINOUS COAT

206.2.1 Part 1 General

SUMMARY

Section Includes:

- damp-proofing of new structural elements in contact with soil, protecting these structures against water infiltration from the ground.
- damp-proofing of back filled new concrete retaining walls against infiltrated water.
- damp-proofing below slab and over walls of concrete structures retaining aqueous liquids against infiltrated water.
- damp-proofing of cut-off walls in catchment structures.

ACTION SUBMITTALS

1) Product Data: For each type of product indicated.
2) Shop Drawings: Show locations and extent of waterproofing.

INFORMATIONAL SUBMITTALS

1) Product test reports.
2) Sample warranties.

Contractor shall submit for approval prior to ordering all the materials, shop drawings, execution equipments and methods.

206.2.2 Part 2 Product

Damp-Proofing materials

Damp-proofing materials are intended to provide a resistance against water and sometimes against humidity and water vapor.

Bituminous Coating

This material is recommended for use on the exterior wall in contact with soil where water infiltration pressure is low (permeable earth foundation) and where the performation level of protection tolerates some damp patches.

Ground water should be checked previously by the Contractor for chemicals which may have a deleterious effect on the structure or internal finishes.

The Contractor must obtain the previous approval of the Engineer on the support as well on the type of material proposed.
(Type B for reinforced concrete design in accordance with B.S. 8110).

The bitumenous coating for damp-proofing should be cold applied emulsion in two coats (of at least 0.750 kg/m^2 each) and cross applied.

Bitumen primer should be of the same cold bitumen emulsion compound diluated to 50% with water and applied at a minimum rate of 0,400 kg/m^2. The damp-proof bitumenous coat shall be applied around 24 hours after the primer application.

206.3 CEMENTITIOUS WATERPROOFING

206.3.1 Part 1 General

A. SECTION INCLUDES
   1. Surface-applied cementitious waterproofing treatment.
   2. Flexible, 2-component brushable sealing slurry for complete and permanent waterproofing of concrete.

B. American Concrete Institute (ACI). 1. ACI 222R-01(R2010) - Protection of Metals in Concrete Against Corrosion.
C. American Society of the International Association for Testing and Materials (ASTM).
   1. ASTM C109/C109M-16a - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
   2. ASTM C1583/C1583M-13 - Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).
   3. ASTM D1411-09 - Standard Test Methods for Water-Soluble Chlorides Present as Admixtures in Graded Aggregate Road Mixes.
D. British Standard Institution.
   1. BS EN 480-12:1998 - Admixtures for Concrete, Mortar and Grout. Test Methods. Determination of the Alkali Content of Admixtures.
   2. BS EN 12390-8:2009 - Testing Hardened Concrete: Depth of Penetration of Water Under Pressure.
   3. German Institute for Standardization (DIN). 1. DIN 1048 Part 5, Testing Concrete: Testing of Hardened Concrete Water Permeability.
   4. International Concrete Repair Institute (ICRI).
   5. NSF International. 1. NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects.
   6. U.S. Army Corps of Engineers (USACE). 1. CRD C48-92 – Standard Test Method for Water Permeability of Concrete.

PERFORMANCE REQUIREMENTS
A. Permeability:
   1. When tested to BS EN 12390-8 or DIN 1048-5 at 0.5 MPa (72.5 psi) for 72 hours, permeability of treated concrete will be reduced by 51% over untreated concrete. Treated samples were cured for 28 days and treatment was mechanically removed from samples prior to testing.
   2. Passes USACE CRD C48 when tested at 1.38 MPa (200 psi) for 14 days. Permeability of treated concrete will be reduced by 90% over untreated concrete.
   3. When tested versus untreated sample to DIN 1048-5 and following 28 day curing period, depth of water penetration shall be reduced by 75%.

B. Self-Sealing: Autogenous crack sealing of treated concrete for cracks with width of 0.5mm (0.02 inches) or greater when subjected to hydrostatic pressure of 0.44 MPa (65 psi).
C. Chloride Resistance: When tested to ASTM D1411, the waterproofing treatment shall improve concrete resistance to chlorides below limits require by ACI 222R and demonstrate chloride ion reduction of 84% at 15 mm penetration depth and 83% at 10 mm penetration depth; performance shall be verified by independent testing. Treated samples were cured for 28 days and treatment was mechanically removed from samples prior to testing.
D. Sulfate Resistance: The waterproofing treatment shall improve concrete resistance to sulfates by reducing permeability without affecting compressive strength; performance shall be verified by independent testing.
E. Potable Water Containment: Products of this Section shall be certified to NSF/ANSI Standard 61 for use with potable water.

SUBMITTALS FOR REVIEW

A. Product Data: Manufacturer's product data and general recommendations for waterproofing applications.
B. Independent Test Reports: Provide reports certifying compliance of waterproofing products with specified performance requirements.
C. Installation Data: Manufacturer's special installation requirements.
D. Qualification Statements: Written notice from installer confirming project experience.
E. Warranty Documents: Manufacturer's warranty documentation for specified coverage executed in the Owner's name.
F. Environmental requirements: Application should not be made when the surface temperature is below 4 degrees C (40 degrees F).

206.3.2 Part 2 Products

WATERPROOFING MATERIALS

A. cementitious Surface-Applied Waterproofing: dry powder mixed with emulsion.
1. Working Time (-30°C, +80°C) : 30 minutes.
2. Performance Properties:

Temperature resistance: -30 °C to +80 °C

Exposure to rain: after 3 hours

Earth filling: after 3 days

Foot traffic: after 24 hours

Water vapor permeability: Class II

Capillary water absorption: < 0,1 kg/m² $h^{0.5}$

Compressive strength at 28 days: ≥ 19 N/mm²

Flexure strength at 28 days: ≥ 9 N/mm²

Bond strength on concrete after 28 days: ≥ 1,5 N/mm²

Static crack bridging ability 23 °C: EN 1062-7: Class A2

Dynamic crack bridging ability 23 °C : B1 (1000 cycles, *f* =0,03Hz, W_o=0,15mm, W_u=0,10mm, crack change 50µm)

Water penetration under positive hydrostatic pressure: (EN 12390-8, 3 days > 5 bar): No penetration

Water penetration under negative hydrostatic pressure at 1,5 bar): No penetration

B. Emulsion.

MIXES

A. Mix ingredients in clean containers to achieve performance requirements specified.
B. Mix only quantities that can be applied before mixture begins to set, in accordance with manufacturer's written recommendations.

206.3.3 Part 3 Execution

EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that concrete surfaces are sound and clean, and that form release agents and materials used to cure the concrete are removed prior to applying waterproofing treatment.
C. Examine surfaces that are to receive waterproofing treatment for formwork tie holes and structural defects such as honeycombing, rock pockets, faulty construction joints and cracks.

PREPARATION

A. Concrete surfaces must be clean and free of paint, sealers, form release agents, curing compounds, dirt, laitance or any other contaminates.
B. Prepare the surface by high pressure water blasting (minimum 3,000 psi), scarifying, shot blasting or sand blasting to remove loose concrete and surface contaminates.
C. Repair leaking cracks or joints in accordance with manufacturer's written instructions and as follows:
   1. Chase the length of joints and cracks. Provide rectangular-shaped chase that is 40 mm (1.5 inch) deep x 25 mm (1 inch) wide.
   2. Use water stop plug to stop water leakage.
   3. Use repair grout to completely fill the chase flush with adjacent surfaces.

D. Repair form-tie holes, rock pockets, honeycombing, cracks and other concrete defects in accordance with manufacturer's written instructions and as follows:
   1. Rout out defective areas to sound concrete. Leave edges square, do not featheredge.
   2. Remove loose material and saturate with water.
   3. If defect is actively leaking, install water stop plug to a maximum depth of 1/3 of the defect
   4. Fill defect with repair grout.

APPLICATION - WATERPROOFING

A. Saturate the surface by high pressure water blasting. Remove all standing water so the surface is saturated-surface-dry (SSD) condition.
B. Apply waterproofing uniformly at a coverage of 1.2 kg/m2 (2.2 lb/yd2) to concrete surfaces following manufacturers written instructions.
C. Curing:
   1. Wet cure waterproofing treatment for at least three (3) days and in accordance with manufacturer's written instructions.
   2. Cover the waterproofing with tarps or plastic to prevent water loss due to evaporation.
   3. Wet curing should begin when waterproofing has hardened enough not to be damaged by the application of curing water, usually 6-24 hours depending on conditions.
   4. Do not allow water to pool on the surface during the first 24 hours or until the waterproofing is hard.
   5. Keep protective coverings in place during the curing period to retain moisture.
   6. Protect from frost, rain and traffic for at least 24 hours. Heavy traffic must be avoided during the curing period.

CLEANING

Clean spillage and soiling from adjacent surfaces using manufacturer recommended cleaning agents and procedures.

PROTECTION OF FINISHED WORK

A. Protect completed waterproofing from damage after application.
B. Backfill:
   1. Do not backfill for at least thirty-six (36) hours after application of waterproofing.
   2. If backfill occurs within seven (7) days after application of waterproofing, take precautions to prevent dry fill material from absorbing moisture from finished waterproofing.
C. Paints and coatings to be applied over waterproofing must be suitable for use on (new) concrete. Always apply according to the paint manufacturer's instructions, including any recommended primers.
D. Wet cure for a minimum of 3 days, after it has hardened, before water testing treated tanks and reservoirs. For reservoirs that will contain drinking water, cure longer if possible, and then rinse with fresh water several times. Initially, the drinking water may need pH adjustment using citric acid or similar water treatment chemicals.

206.4 THERMAL INSULATION

206.4.1 Part1: GENERAL

SUMMARY

Section Includes:
Foam-plastic board insulation.
Glass-fiber board insulation.
Mineral-wool board insulation.
Glass-fiber blanket insulation.

ACTION SUBMITTALS
Product Data: For each type of product indicated.
LEED Submittals (Projects Authorized for LEED certification only):
Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

INFORMATIONAL SUBMITTALS
Product test reports.
Research/evaluation reports.

206.4.2 PRODUCTS

FOAM-PLASTIC BOARD INSULATION
Extruded-polystyrene board insulation in first paragraph below is also called "XPS insulation."
Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
DiversiFoam Products.
Dow Chemical Company (The).
Owens Corning.
Pactiv Building Products Kingspan Group)

Retain one or more of five subparagraphs below. If retaining more than one, indicate location of each on Drawings or by inserts.
Type IV, 25 psi.

GLASS-FIBER BOARD INSULATION
Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
CertainTeed Corporation.
Johns Manville.
Knauf Insulation.
Owens Corning.
Glass-Fiber Board Insulation: ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
Nominal density of 2.25 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.

MINERAL-WOOL BOARD INSULATION
Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- Fibrex Insulations Inc.
- Isolatek International.
- Owens Corning.
- Roxul Inc.
- Thermafiber.

Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
Retain one or more of three subparagraphs below. If retaining more than one, indicate location of each on Drawings or by inserts.
Nominal density of 6 lb/cu. ft., Type II, thermal resistivity of 4.16 deg F x h x sq. ft./Btu x in. at 75 deg F.

GLASS-FIBER BLANKET INSULATION

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- CertainTeed Corporation.
- Guardian Building Products, Inc.
- Johns Manville.
- Knauf Insulation.
- Owens Corning.

Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

206.4.3EXECUTION

INSTALLATION, GENERAL

- Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

INSTALLATION OF CAVITY-WALL INSULATION

Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

- Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
- Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
- Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

- Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

- Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

- Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
- Show width of cavity on Drawings.
- Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
- After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
- Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

INSTALLATION OF CURTAIN-WALL INSULATION

Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.

- Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
- Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

207 COMMON REQUIREMENTS

All metal sheets shall be 3mm thick minimum. All metal works shall be epoxy painted over a primer.
All hardware shall be water resistant.

Buried walls shall receive a bituminous coating for protection.

208 PAINTING

208.1 PART 1 - GENERAL

208.1.1 DESCRIPTION

A. Section specifies field painting.
B. Section specifies prime coats which may be applied in shop under other sections.
C. Painting includes shellacs, stains, varnishes, coatings specified, and striping or markers and identity markings.

208.1.2 SUBMITTALS

A. Submit SAMPLES AND SHOP DRAWINGS.
B. Manufacturer's Literature and Data:
Before work is started, or sample panels are prepared, submit manufacturer's literature, indicating brand names, product type color, gloss level, coating composition, Federal

Specification Number or manufacturers name or product number where applicable, and certificates as specified.

C. Sample Panels:
   1. After painters' materials have been approved and before work is started submit sample panels showing each type of finish and color specified.

208.1.3 DELIVERY, AND STORAGE

A. Deliver materials to site in manufacturer's sealed container marked to show following:
   1. Name of manufacturer
   2. Product type
   3. Batch number
   4. Instructions for use
   5. Safety precautions

B. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

C. Store materials at site at least 24 hours before using, at a temperature between 18 and 30 °K (65 and 85 °F).

208.1.4 MOCK-UP PANEL

A. Before starting application of water paint mixtures, // cementitious paint // apply paint as specified to an area, not to exceed 9 m^2 (100 sf), selected by Resident Engineer.

B. Finish and texture approved by Resident Engineer will be used as a standard of quality for remainder of work.

208.2 PART 2 - PRODUCTS

208.2 .1 PAINT PROPERTIES

A. Use ready-mixed (including colors), except two component polyesters, paints having metallic powders packaged separately and paints requiring specified additives.

B. Materials finely ground, uniform in consistency and readily dispersed to form a smooth and homogeneous fluid.

C. Where no requirements are given in the referenced specifications for primers, use primers with pigment and vehicle, compatible with substrate and finish coats specified.

208.2 2 REGULATORY REQUIREMENTS

A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
   1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed local, state or district requirements.
   2. Lead-Base Paint:
      a. Comply with Section 410 of the Lead-Based Paint Poisoning Prevention Act, as amended, and with implementing regulations promulgated by Secretary of Housing and Urban Development.
      b. Regulations concerning prohibition against use of lead-based paint in federal and federally assisted construction, or rehabilitation of residential structures are set forth in Subpart F, Title 24, Code of Federal Regulations, Department of Housing and Urban Development.

c. For lead-paint removal, see Section 02090.

3. Asbestos: Materials shall not contain asbestos.
4. Chromate, Cadmium, Mercury, Silica: Materials shall not contain zinc-chromate, strontium-chromate, Cadmium, mercury or mercury compounds or silica sand.
5. Human Carcinogens: Materials shall not contain any of the ACGIH-BKLT and ACGHI-DOC confirmed or suspected human carconigens.

208.3 PART 3 – EXECUTION

208.3 .1 JOB CONDITIONS

A. Safety: Observe required safety regulations and manufacturer's warning and instructions for storage, handling and application of painting materials.
   1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
   2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each days work.

B. Atmospheric and Surface Conditions:
   1. Do no exterior or interior painting in foggy, damp or rainy weather. When building is completely enclosed, interior work may be painted.
   2. Paint exterior and interior surfaces when ambient temperature is between 10 and 32 degrees C (50 and 90 degrees F), except when otherwise designated in manufacturer's printed instructions. Maintain interior temperatures until paint dries hard.
   3. Do no exterior painting when it is windy and dusty.
   4. Do no painting in direct sunlight or on surfaces which will soon be warmed by the sun.
   5. Apply only on clean, dry and frost free surfaces except as follows:
      a. Apply water thinned acrylic and cementitious paints to damp (not wet) surfaces where allowed by manufacturer's printed instructions.
      b. Dampened with a fine mist of water on hot dry days concrete and masonry surfaces to which water thinned acrylic and cementitious paints are applied to prevent excessive suction and to cool surface.
   6. Varnishing:
      a. Apply in clean areas and in still air.
      b. Before varnishing vacuum and dust area.
      c. Immediately before varnishing wipe down surfaces with a tack rag.

208.3 2 SURFACE PREPARATION

A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

B. General:

   1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
   2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
   3. See other sections of specifications for specified surface conditions and prime coat.

4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used. Do not use solvents, acid, or steam on concrete and masonry.

C. Ferrous Metals:

1. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign matter by use of solvents, emulsions, cleaning compounds, or by steam cleaning, as defined in SSPC-SP 1.
2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning, as defined in SSPC-SP 2 and SSPC-SP 3, except where high temperature aluminum paint is used, prepare surface in accordance with paint manufacturer's instructions.
3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of hollow steel doors and frames, access panels, roll-up steel doors and similar items specified to have semi-gloss or gloss finish with metal filler compound. Finish flush with adjacent surfaces.
   a. This includes flat head countersunk screws used for permanent anchors
   b. Do not fill screws of item intended for removal such as glazing beads.
4. Spot prime abraded and damaged areas in shop prime coat which expose bare metal with same type of paint used for prime coat. Feather edge of spot prime to produce smooth finish coat.
5. Spot prime abraded and damaged areas which expose bare metal of factory finished items with paint as recommended by manufacturer of item.

E. Zinc-Coated (Galvanized) Metal, // Zinc, // Aluminum //, // Copper and Copper Alloys // Surfaces Specified Painted:

1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion, with toluene, xylene or similar solvents in accordance with SSPC-SP 1.
2. Spot coat abraded and damaged areas of zinc-coating which expose base metal, using zinc rich paint MIL Spec MIL -P-21035, on hot-dip zinc-coated items and spot prime with zinc dust primer, Fed Spec. TT-P-641.

F. Masonry, Concrete, Cement Board, Cement Plaster and Stucco:

1. Clean and remove dust, dirt, oil, grease efflorescence, form release agents, laitance, and other deterrents to paint adhesion.
2. Use emulsion type cleaning agents to remove oil, grease, paint and similar products. Use of solvents, acid, or steam is not permitted.
3. Remove loose mortar in masonry work.
4. Replace mortar and fill open joints, holes, cracks and depressions with new mortar specified in Section MORTAR AND GROUTS. Do not fill weep holes. Finish to match adjacent surface.
5. Neutralize Concrete floors to be painted by washing with a solution of 1.4 Kg (3 pounds) of zinc sulfate crystals to 3.8 L (1 gallon) of water, allow to dry three days and brush thoroughly free of crystals.
6. Repair broken and spalled concrete edges with concrete patching compound to match adjacent surfaces as specified in CONCRETE Sections. Remove projections to level of adjacent surface by grinding or similar methods.

208.3 3 PAINT PREPARATION

A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of pigment and uniform composition.

B. Do not thin unless necessary for application and when finish paint is used for body and prime coats. Use materials and quantities for thinning as specified in manufacturer's printed instructions.

C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two component and two part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

208.3.4 APPLICATION

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between applications of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by Resident Engineer.

E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.

F. Apply by brush, roller or spray, except as otherwise specified.

H. Do not spray paint in existing occupied spaces unless approved by Resident Engineer, except in spaces sealed from existing occupied spaces.

1. Apply painting materials specifically required by manufacturer to be applied by spraying,
2. In areas, where paint is applied by spray, mask or enclose with polyethylene, or similar air tight material with edges and seams continuously sealed including items specified in WORK NOT PAINTED, motors, controls, telephone, and electrical equipment, fronts of sterilizes and other recessed equipment and similar prefinished items.

I. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

208.3.5 PRIME PAINTING

A. After surface preparation prime surfaces before application of body and finish coats, except as otherwise specified.

B. Spot prime and apply body coat to damaged and abraded painted surfaces before applying succeeding coats.

C. Additional field applied prime coats over shop or factory applied prime coats are not required, except for exterior exposed steel apply an additional prime coat.

D. Prime rebates for stop and face glazing of wood, and for face glazing of steel.

E. Metals except boilers, incinerator stacks, and engine exhaust pipes:

1. Steel and iron: Ferrous metal primer. Use epoxy coating where finish of epoxy coating is specified.

2. Zinc-coated steel and iron: Zinc dust primer.
3. Aluminum scheduled to be painted: Zinc molybdate primer.
4. Terne metal: Ferrous metal primer.
5. Copper and copper alloys scheduled to be painted: Zinc molybdate primer.
6. Machinery not factory finished: Enamel, Alkyd, Gloss Low VOC content.
7. Asphalt coated metal: Aluminum paint.
8. Metal over 94 degrees C. (200 degrees F), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: Heat Resistant Paint, 650 degrees C (1200 degrees F),.

I. Concrete Masonry Units except glazed or integrally colored and decorative units:
   1. Concrete Masonry Unit Filler on interior surfaces.
   2. Prime exterior surface as specified for exterior finishes.

J. Cement Plaster or stucco // Concrete Masonry, Brick Masonry // and Cement board // Interior Surfaces of Ceilings and Walls:
   1. Latex emulsion, except use two coats where substrate has aged less than six months for latex emulsion finish coat.
   2. Use acrylic emulsion finish coats of cementitions paint or epoxy or water paint as scheduled.

K. Concrete Floors: Floor Enamel.

L. Barrier coat to separate epoxy paint from existing oil or alkyd paint:
Two coats latex emulsion or rubber paint.

M. Rubber paint when rubber paint finish is specified over prime coats to surfaces.

208.3.6 EXTERIOR FINISHES

A. Steel and Ferrous Metal, // Including Tern //.
   1. Two coat of exterior oil paint on exposed surfaces, except on surfaces over 94 degrees C (200 degrees F).
   2. One coat of heat resistant paint on surfaces over 94 degrees K (200 degrees F) and on surfaces of boiler // incinerator // stacks // engine exhaust pipes.

B. Machinery without factory finish except for primer: One coat Enamel, Alkyd, Gloss Low VOC content.
   1. Use water paint without additions only interior surfaces.

C. Concrete Masonry Units // Brick // Cement Plaster // Concrete //:
   1. General:
      a. Where specified in Section 09050 or shown.
      b. Mix as specified in manufacturer's printed directions.
      c. Do not mix more paint at one time than can be used within four hours after mixing. Discard paint that has started to set.
      d. Dampened warm surfaces above 24 degrees C (75 degrees F) with fine mist of water before application of paint. Do not leave free water on surface.
      e. Cure paint with a fine mist of water as specified in manufacturer's printed instructions.
   2. Use one of the following unless specified otherwise.
      a. Two coats of water paint mixed with additives specified (CEP).
         1) Water paint mixed with water and liquid acrylic resin.
            a) Allow 24 hours minimum drying time between coats.
            b) Apply paint with stiff fiber brush and thoroughly work into surface with rubbing motion to seal pores, cracks and voids.
            c) Apply first coat with brush strokes horizontal or vertical, and second coat brush strokes perpendicular to first.

d) After the second coat has set so it will not roll or lift, float surface to uniform texture with a sponge float to match finish of mock-up panel.

2) Water paint mixed with water, liquid acrylic resin and sand aggregate grades for application by plasterer's type spray gun.

a) Prepare paint powder for spraying by mixing with a liquid consisting of one part of liquid acrylic resin to three parts of water unless specified otherwise in manufacturer's printed instructions.
b) Spray first coat evenly distributed.
c) Float or brush out first spray coat before starting second spray application to fill holes, pores, and imperfections.
d) Spray second coat after first coat has set, and air and water bubbles have broken, double back over surface with an even spray application, or additional applications to provide a uniform texture and to match finish of mock-up panel.

b. Two coats of cementitious paint.

208.3 .7 INTERIOR FINISHES

A. Metal Work:
1. Apply to exposed surfaces.
2. Omit body and finish coats on surfaces concealed after installation except electrical conduit containing conductors over 600 volts.
3. Ferrous Metal, Galvanized Metal, and Other Metals Scheduled:
   a. Apply two coats of Alkyd Semigloss (SG) unless specified otherwise.
   b. Two coats of // alkyd flat or (AK) // alkyd gloss (G) //.
   c. One coat of enamel undercoat plus one coat of alkyd semigloss on exposed interior surfaces of alkyd-amine enamel prime finished windows.
   d. Two coats of rubber paint (RP) on exposed surfaces in // battery rooms // pool area // chlorinator room //.
   e. Machinery: One coat Enamel, Alkyd Gloss, Low VOC content.
   f. Asphalt Coated Metal: One coat Aluminum paint (AP).
   g. Ferrous Metal over 94 degrees K (200 degrees F:), Boilers, Incinerator Stacks, and Engine Exhaust Pipes: One coat Heat Resisting Paint, 650 degrees K (1200 degrees F). (HR).

B. Masonry and Concrete Walls:
1. Over filler on CMU surfaces.
2. Two coats of latex emulsion (LE).
3. Two coats of latex flat (AK), low-luster (LL), latex semigloss (SG), or latex gloss (LG).
4. One coat rubber paint. (RP).
5. Two coats water paint (WPC).

208.3 .8 PROTECTION CLEAN UP, AND TOUCH-UP

A. Protect work from paint droppings and spattering by use of masking, drop cloths, removal of items or by other approved methods.
B. Upon completion, clean paint from hardware, glass and other surfaces and items not required to be painted of paint drops or smears.
C. Before final inspection, touch-up or refinished in a manner to produce solid even color and finish texture, free from defects in work which was damaged or discolored.

209 PIPELINES AND PIPEWORK

209.1 TRENCH EXCAVATION

Excavation for pipelines shall be carried out in accordance with Sub-Section 201.3.2 of the General Specifications. During the pipe laying, jointing, testing of pipes and backfilling, the trench shall be completely dry.

The trench shall be as per trench details included in the contract drawings.

The Contractor shall excavate the trenches without damaging existing pipes, cables and any other structure. In this respect, the Contractor shall excavate the necessary depth or change the route in order to avoid damaging the pipes, cables and culverts that cross the roads.

In case the modification of the pipe depth or route is impossible, the Contractor shall, after the approval of the Engineer, undertake all the necessary works including excavation, fill and concrete works, etc... to modify the culvert in a way to maintain the passing section of the culvert, the cost of these works, after getting the approval of the Engineer should be measured as a concrete works (according to concrete works item).

The Contractor shall clear away within the same day, all excavated material arising from trenches and headings on asphalted roads as the work proceeds, and shall keep these roads free from any accumulations and clear in a good condition, to the satisfaction of the Engineer.

In addition to Sub-Section 201.3.2 of the General Specifications, Earthwork shall not be classified in accordance with the hardness of the excavated material, all excavation should be classified as common excavation and the Contractor shall take the sole responsibility for his assessment of excavated material and conditions. He should also use all suitable materials in the permanent construction required under the contract.

In addition to all the above, the excavated material arising from trenches executed on main roads should be removed from site, transported to environmentally approved disposal areas accepted by the Engineer, all that at the contractor expenses without any extra cost, and the trenches on main roads should be backfilled with imported clean granular material.

209.2 BACKFILLING OF PIPE TRENCHES

Backfilling shall be carried out in accordance with the Ministry of Public Works decree No. 13495 dated 5/11/98 (Refer to Annex 1 of this volume) and in accordance with related general specifications of Volume 3.

In case of ambiguities or discrepancies between the content of the above-mentioned decree and the general specifications, the decree shall prevail.

All pipes shall be placed in granular material (fine, coarse) bedding and surround if the pipeline is above water table, and in gravel bedding and surround if the pipeline is below water table.

Backfilling of pipes trenches on main roads should be executed using imported clean granular material and should be compacted by layers of 30cm thick each.

a) Material unsuitable for filling:

Shall mean material other than suitable material and unless accepted by the Engineer shall include:

- Material from swamp, marshes, or bogs and solid containing more than 12% organic matter when tested in accordance with Test 8 of BS 1377, and which occurs below the top soil layer.
- Clay-based materials of liquid limit exceeding 40 and/or plasticity index exceeding 10 as and if directed by the Engineer,
- Boulders.
- Maximum granular diameter > 5 cm.

209.3 PIPELINES AND MATERIALS

As specified in the BOQ, Preferred C-class ductile iron pipes and HDPE pipes shall be used.

Moreover, the materials used shall comply with the requirements of Section 101.9 of the General Specifications. Any unsuitable material not satisfying the specifications shall be rejected by the Engineer, removed from the Site and replaced by the Contractor at his own expense.

209.3.1 SPECIAL REQUIREMENTS

MANUFACTURER'S CERTIFICATE

Materials shall be supplied with certificates, in respect of each delivery, stating that products comply with and have been factory tested in accordance with the specified Standards.

SPECIAL TESTS

Whenever required by the Engineer, the Contractor shall supply and transport to an approved testing laboratory samples of materials selected by the Engineer. The number of samples shall not be less than 0.5% of total supplied, with at least one from each class, diameter and manufacturer. Failure of any sample shall be followed by a second and if necessary, a third test from the same batch. A third test failure will result in all material from that manufacturer being rejected and replaced by material from a different manufacturer, subject to approval by the Engineer, after satisfactory testing. Laboratory test reports in an approved form shall be provided.

MANUFACTURER'S INSTRUCTIONS

The Contractor shall observe the manufacturer's written instructions and recommendation in respect of handling, protection, stacking, storage, laying, fitting, cutting, repair of the products and materials as applicable.

MARKING

Unless otherwise specified in the relevant Standard, products shall have legibly cast, stamped or indelibly painted on, the following marks, as appropriate:

- The manufacturer's name, initials and identification mark.
- Nominal diameter.
- Class designation.
- Initials and number of relevant Standard.
- Length of pipe if shorter than the standard length.
- Angle of bends in degrees.
- The date of manufacture.

SAMPLES AND STORAGE OF MATERIALS

Where required by the Engineer, the Contractor shall submit to the Engineer for approval samples of pipes, fittings and materials prior to procurement.

The Contractor shall store pipes, fittings and other materials only at places approved by the Engineer and shall at all times provide adequate supervision and watchmen to prevent theft or damage. Any loss or damage incurred will be the Contractor's responsibility.

Pipes shall not be stacked higher than recommended by the manufacturer. The area on which the pipes are to be stacked shall be free draining, the grass or other vegetation shall be kept cut and suitable timber or cradles shall be provided on which the pipes shall be laid. End stops to all stacks shall be provided.

Fittings and valves shall not be stacked more than one tier high and they shall be supported off the ground by suitable timbers.

Air valves, rubber joint rings, gaskets, bolts and similar fittings and materials shall be kept in approved locked premises and such fittings and materials shall not be distributed to the trench side until immediately prior to laying, fitting, jointing or assembly thereof. All rubber joint rings and gaskets must be stored in a cool damp location and all fittings and materials shall at all times be stored in the shade under cover and protected from the weather to the satisfaction of the Engineer.

FLANGES

Unless otherwise specified, flanges shall be faced and drilled to conform to the dimensions specified in BS EN 1092-2:1997. Flanges shall be compatible with the pressure rating of the adjacent pipework but not less than 16 bars. Bolts, nuts, and washers (two washers per bolt) shall be to BS 4504 Clause 5 or ISO 898-2:1999

and ISO 4032:2001. No bolt shall project more than two full threads beyond its nut after tightening. In no circumstances shall be shortening of excessively long bolts but cutting be allowed.

Gaskets shall comply with BS EN1514-4:1997, ISO 4633:2015 or BS 2494 Type W.

Flanges shall be painted with two coats of epoxy resin paint or with the same coating as fittings: an epoxy coating in accordance with EN 14901:2014.

MECHANICAL COUPLINGS

Unless otherwise specified or shown on the Drawings pipes and fittings shall be supplied with flexible joints. Mechanical couplings shall be of the Dresser, Viking Johnson type without a center register.

MATERIALS FOR THE ASSEMBLY OF FLEXIBLE JOINTS

Lubricant shall be of a kind not conductive to the growth of bacteria and shall have no deleterious effects on either the joint rings or pipes. Lubricants for water supply shall not impart to water taste, colour, or any effect known to be injurious to health.

209.3.2 WORKMANSHIP: OPERATIONS

1) Manufacturer's recommendations on handling, repairing, laying, jointing, anchoring, testing and other works for pipes and fittings shall be strictly followed.
2) The Contractor shall use cranes, hoists or forklifts as directed by the Engineer. The Contractor shall use hooks, spreader beams, ropes, band or wire slings etc. as recommended by the manufacturer for each type of pipe and as approved by the Engineer.
3) The Contractor shall stack pipes on a level surface. Pipes shall not rest on sockets or flanges and end pipes in the bottom row shall be securely chocked. Heights of stacks shall be in accordance with the manufacturer's instructions.
4) The Contractor shall handle material with care to avoid damage whenever moved by hand, forklifts or hoists.
5) The Contractor shall provide safe storage for all material. The interior of pipes, fittings etc. shall be kept free from dirt and foreign matter. The Contractor shall provide shade for materials as required by manufacturers' instructions and recommendations and to the Engineer's approval.
6) Pipe Cutting: The Contractor shall use hacksaws, manually operated wheel cutter or pipe cutting machine in accordance with manufacturers' instructions. If, in the opinion of the Engineer, special precautions are required to eliminate airborne particles, the Contractor shall use methods and equipment as directed by the Engineer. The Contractor shall prepare ends according to type of joint used and follow manufacturers' recommendations. The Contractor shall take care not to damage linings. The Contractor shall repair on site minor damage if so permitted by the Engineer.
7) The Contractor shall repair damaged coatings, sheathings or linings in accordance with the Specification and the manufacturer's instructions. The Contractor shall use material compatible with that originally used. Repairs shall be approved by the Engineer before incorporating the materials into the works.

209.3.3 SEQUENCE OF CONSTRUCTION

The Contractor shall adhere to the sequence of construction as set out below unless a justified request for modification is approved by the Engineer at least two weeks prior to commencement of work on the affected section of the network:

1) Stake out pipe alignments

2) Clear and grade the right of way (wherever required)

3) Carry out surveys, including trial pits if necessary, along the alignments to verify the location, depth, size and type of existing utilities.

4) Prepare and submit for approval composite Shop Drawings for all utilities showing alignment, ground elevation, trench invert elevation, pipe size, class and length, station and size of fittings, valves as applicable manholes, inlets, appurtenances and structures to be demolished and reinstated (curbstone, rails, culverts, etc.). Cross sections showing location and inverts of existing pipes and those proposed shall be prepared. Pipes, structures and other utilities to be removed or relocated shall be indicated on the Shop Drawings.

5) Relocate, demolish and reinstate existing services and utilities interfering with pipeline alignments.

6) Remove pavement layers, excavate trenches and place bedding as required

7) Lay and join pipes, fittings, appurtenances, manholes, etc.

8) Place primary backfill material

9) Perform hydrostatic testing

10) Complete connections to existing services and curb/gutter inlets as required

11) Place final backfill

12) Restore or reinstate surfaces and structures as required

13) Carry out final surface works road surfacing curb stone, backing walls, sidewalk paving, etc.

14) Dispose of surplus materials.

209.3.4 DUCTILE IRON PIPES

GENERAL

1) Ductile iron pipes for raw and potable water pipelines shall be of Preferred C-Class unless otherwise specified pipes in conformance to BS EN 545-2010 and ISO 2531:2009. Pipes shall be to pressure rating suitable for the condition of service as denoted on the drawings and according to the allowable operating pressure of C Class. All ductile iron pipes and fittings to be supplied under this Specification shall be obtained from an approved manufacturer having an ISO9001-2015 TOTAL QUALITY ASSURANCE system based on the latest version of the ISO9001 standard.

2) Spigot and socket ended pipe joints shall be used for straight runs and adjacent to elbows or fittings. These joints shall be provided with rubber gaskets, and external thrust blocks at elbows or fittings. Anchored joints shall be the push-in, self anchored type. Concrete thrust blocks are not required for anchored joints. The Contractor shall submit calculations verifying the number of restrained joints required noting that pipe pressure testing will be made when pipes are partially backfilled.

3) Prior to the ordering of pipe and fittings materials, the Contractor shall carry out his own calculations of the surge, the maximum allowable pressure and the Test Pressures, using approved parameters to ensure safety of the proposed system under worst working conditions, all to the approval of the Engineer. If the Contractor's approved calculations show that the resulting pipe classes needed are higher than the original Contract Documents, then the Engineer shall instruct the Contractor to adopt them; but if lower classes are needed, then the Contract classes shall prevail.

4) Flanges shall be provided in accordance with BS EN 1092-1:2002 and BS EN 1092- 2:1997.

   - Internally: cement lined to BS EN 545:2010 with ordinary Portland or sulphate resisting cement (for potable water) to BS EN 197-1:2011 and ISO 4179:2005.
   - Externally: 200g/m^2 metallic zinc shall be applied in accordance with BS EN 545:2010 and ISO 8179:2017 And a finishing layer (a bituminous varnish or equivalent anticorrosive paint) shall be uniformly covering the whole surface of the metallic zinc layer, with a minimum thickness not less than 70micron.

5) Factory protection for fittings shall be as follows:

   Coated internally and externally by dipping, or other method, using hot applied coal tar based material to BS 4164:2002 or hot applied bitumen to BS 3416:1991, Type 1, grade D, minimum thickness 250 microns or with a hot applied epoxy powder coating, minimum thickness 250 microns, over a shot blasted surface. In accordance with EN545:2010 and EN 14901:2006.

JOINTS

Joints of Ductile Iron Pipes and Fittings shall be of the Push in automatic standard type and any axial forces shall be taken by thrust and anchor blocks, where necessary and as shown on drawings.

LUBRICANT PASTE

The lubricant paste shall be a mixing of Vaseline, non-soluble in accordance with French standard AFNOR T90 M DOC8. The quantities used in the assembly joints shall be as per manufacturer recommendation. The pipes and fittings manufacturer shall supply it.

CONNECTING PIECES

All connecting pieces i.e. flexible coupling, flange adaptors, dismantling joint shall be made of ductile iron and shall be supplied from the same pipes and fittings manufacturer.

PIPES INTERNAL PROTECTION (INCLUDING WELDED FLANGED PIPES)

Pipes shall be internally lined with sulphate resisting blast furnace slag cement applied by a centrifugal process. The cement mortar lining shall be in accordance with the European Standard EN 545-2010 & with the International Standard ISO 4179-2005 with the thickness given in the following table:

	Thickness of mortar	
	Nominal mean value (mm)	Tolerance (mm)
80 – 300	4	-1.5
350 – 600	5	-2
700 – 1200	6	-2.5
1400 – 2000	9	-3

PIPES EXTERNAL PROTECTION (INCLUDING WELDED FLANGED PIPES)

Pipes shall be externally coated with:

- A metallic zinc coating in accordance with the European Standard EN545 – 2010 and the International Standard ISO 8179:2017. The quantity of zinc shall not be less than 200 g/m2.
- A bituminous varnish or equivalent anticorrosive paint which shall be applied over the zinc coating in accordance with the European Standard EN545-2010 and the International Standard ISO 8179:2017, with a minimum thickness of 150 microns.

CONNECTING PIECES INTERNAL AND EXTERNAL PROTECTION

The connecting pieces (flexible couplings, flange adaptors, dismantling joint) shall be internally and externally protected with a powder epoxy coating having a minimum thickness of 150 microns or with a Rilsan nylon coating having a minimum thickness of 200 microns.

209.3.5 POLYETHYLENE PIPE FOR POTABLE WATER

1- Pipes and fittings shall be manufactured in accordance with DIN 8074/8075 or AWWA C906-99. Pipes shall be supplied straight with straight ends suitable for heat fusion, class 16 kg/cm2.

2- Materials used shall have a minimum hydrostatic design basis of 1600 psi according to AWWA C906-99 Table 1.

3- Manufacturers shall provide certification that stress regression testing has been performed on the pipe products. Materials shall also meet elevated temperature requirements as given in Table 2 AWWA C906:99.

4- Fittings shall be manufactured in accordance with AWWA C906-99, extruded or injection moulded suitable for the class of pipe required.

5- Joints for pipes and fittings shall be made by heat fusion and in strict accordance with the pipe manufacturer's recommendations. Joints shall have a tensile strength equal to that of the pipe. Fusion temperature, interface pressure, alignment and cooling time, shall be according to the manufacturer's recommendations.

6- PE compounds in pipes and fittings shall contain no toxic chemicals that can migrate into the water. PE compounds shall be tested and certified suitable for potable water by an accredited testing agency as approved by the Engineer and certificates from an accredited testing agency proving, that the material compounds used during manufacturing of pipes are suitable for potable water, should be submitted to the Engineer before placing order of purchase. Tests shall be undertaken in accordance with requirements no less restrictive than those in NSF Standard No. 14 (1976), Sections 3 and 4. The seal and mark of the testing laboratory shall be included on pipes and fittings.

209.4 WARNING TAPES

Warning tapes shall be placed on well compacted backfill at 450mm below the finished level and directly above the center-line of the pipeline.

Warning tapes shall be made of pigmented low density polyethylene and aluminum foil in a bright color or other approved material not less than 250 mm wide and 0.15 mm thick. When laid, the tapes shall provide a continuous band detectable with a metal detector if the pipe itself is not detectable. The tapes shall be continuously and alternatively labeled in Arabic and English.

Where possible, tapes shall also be laid above ducts and concrete protection slabs as directed by the Engineer.

209.5 MANHOLES

Manholes shall be constructed as specified in Sub-Sections 202.11.2, 202.14.2 and 202.14.5 of the General Specifications and according to the dimensions specified in the BOQ and the related drawings.

Steel Ladders shall be manufactured in accordance with BS 4211:2005, mild steel, galvanized to BS EN ISO 1461:1999 with 200 grams of zinc per square meter.

All concrete faces in contact with the soil shall receive a waterproofing treatment consisting of two layers of brush-applied bituminous paint, in accordance with Sub-Section 213.2.1 of the General Specifications.

209.6 CHAMBER COVERS AND SURFACE BOXES

Covers and frames shall be manufactured from ductile iron in accordance with BS EN 124:1994, non-rock, locking and solid tops. The wording on covers shall indicate the nature of the network (water supply). Grades of covers shall be Grade A, heavy duty test load 40 tons.

Manhole covers shall be of a circular pattern unless otherwise indicated on the Drawings. Frames shall be provided with openings for fixing bolts for solid frame embedment into manhole concrete necks. Covers and frames shall be coated with a bitumen based compound to BS 3416:1991 with a minimum thickness of 200 microns.

209.7 STEP IRONS FOR VALVE CHAMBERS

Step Irons shall be manufactured in accordance with BS EN 13101: 2002.

209.8 TEMPORARY AND/OR PERMANENT RESTORATION OF PAVED ROADS

In all paved roads, trenches shall be refilled and compacted to the underside of the original road surface.

A sub-base and base layers shall be laid and compacted and shall be carried out in accordance with the Ministry of Public Works decree No. 13495 dated 5/11/98 (Refer to Annex 1 of this volume) and in accordance with related general specifications of Volume 3.

In case of ambiguities or discrepancies between the content of the above mentioned decree and the general specifications, the decree shall prevail.

For main roads subject to a permit from the Ministry of Public Works and Transport, the Contractor, at his own expenses and sole responsibility, should deal to obtain and receive this permit, and the asphalt reinstatement works should be carried out in accordance with the specifications and conditions (if any) of the permit.

As for narrow roads not exceeding 3m width, asphalt reinstatement should be executed to cover the entire width of the road.

209.9 REMARKS

The Contractor shall lay pipes on one side of the streams and on one side of the roads (even if this is not shown of the drawings) and if possible outside the carriageway in order to avoid damaging the roads. The Contractor shall coordinate with the Administration and the Engineer and the relevant Authorities in order to obtain official authorization prior to any construction work.

HYDRAULIC ACCESSORIES

209.10 ELECTRO-MAGNETIC FLOW METERS

The flowmeters shall be of electro-magnetic inductive type having a DC pulsed field with automatic zero error averaging and low power consumption. They shall have no moving or protruding parts nor cause any restriction in the flow path (Insertion type are not allowed) and be capable of setting adjustments without the need to stop the flow.

Each metering system shall comply with the latest international standard and comprise a flow sensor mounted in the pipework line and a transmitter which degree of protection is IP68; either integrally mounted or remotely located preferably within the main control panel.

Electro-magnetic system shall comply with the latest international standards at least with:

- 2014/35/EU- EN 61010-1:2013 (LVD)
- 2014/30/EU- EN 61326-1:2013 (EMC)
- OIML R49- 1:2013
- European directive 2014/32/EU (MID)
- 2014/34/UE – IEC 60079- 0, IEC 60079- 18 (ATEX- IECEx) Separate version
- EN ISO 15609-1 and EN ISO 15614-1
- UNI EN ISO 12944-2, painting for C4 class environments (on request)
- Ebonite conform to the norms WRAS, FDA e DM174
- BS 5792

The flowmeter shall have a maximum accuracy at normal operating conditions.

The Flowmeter should be equipped with a MODBUS comunication module RS485 with 4-20mA.

The power supply should be 220V AC and a 10-36V DC compatible with a built-in battery.

The uncertainty of the calibration shall be equal to 0.2% +- 2 mm/s. The repeatibility of the measure shall be about 0.1%. Bi-directional measure. The sensors shall be certified under MID01 norms. Every meter shall be delivered with its calibration certificate.

Error range no larger than +/- 0.2% of the reading operating at 30% or less than the meter range, error range shall not exceed +/- 0.5%

The maximum permissible error shall be within the limits indicated in the following graph, for each sensor diameter.

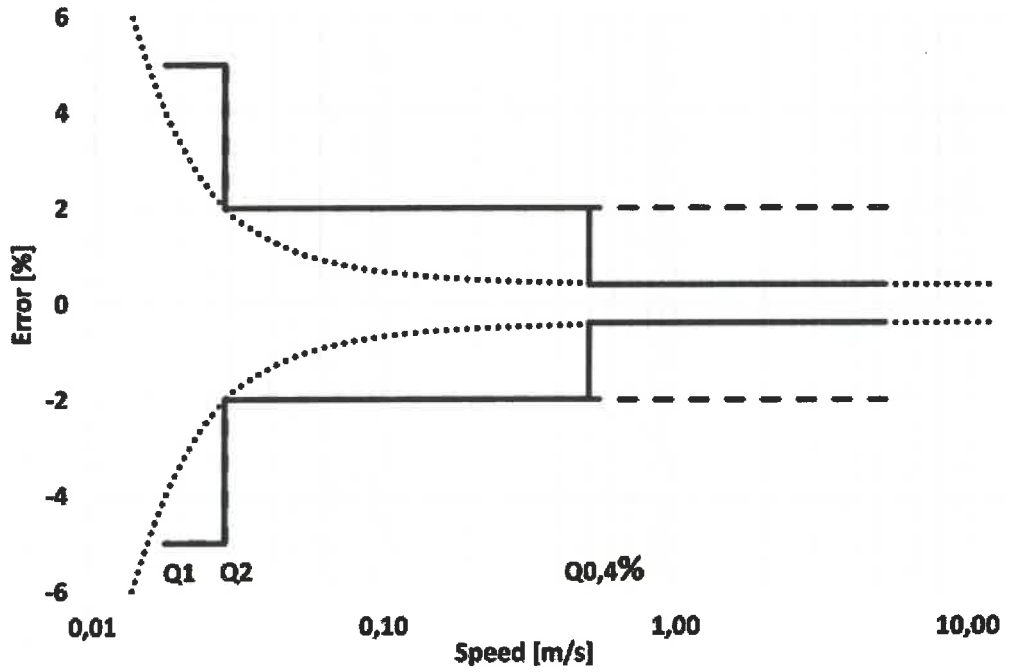


Figure 1: Graph indicating the Maximum Permissible Error

Sensor diameter	Flow [m3/h]					Ratio Q3/Q1
	Min Q1	Trans. Q2	Q0,4%	Perm. Q3	Overl. Q4	
DN50 - 2"	0,125	0,20	3,50	25,00	31,25	200
DN65 - 2"1/2	0,20	0,32	6,00	40,00	50,00	200
DN80 - 3"	0,315	0,50	9,00	63,00	78,75	200
DN100 - 4"	0,50	0,80	14,00	100,00	125,00	200
DN125 - 5"	0,80	1,28	22,00	160,00	200,00	200
DN150 - 6"	1,25	2,00	32,00	250,00	312,50	200
DN200 - 8"	3,15	5,04	57,00	630,00	787,50	200
DN250 - 10"	5,00	8,00	90,00	1000,00	1250,00	200
DN300 - 12"	8,00	12,50	128,00	1000,00	1250,00	125

Table 1: Flow rates table

a) **Flow sensors** These shall comprise electrodes located in a meter tube which shall be made of watertight construction, suitable for operation without loss of accuracy when totally submerged to a depth of 3 metres or even burried into the ground together with the water pipe. Its degree of protection shall be IP68. They shall not contain any active components such as amplifiers or memory modules. The flowmeter shall be flanged type and the lining shall cover the external parts of both flanges

The flow tube shall be made of stainless steel AISI 304 or AISI 316, where two coils are installed on its top and lower side. The interior of the flow tube shall be electrically insulated, thus the process liquid shall no longer be in contact neither with the material of the flow tube nor with that of the flanged.

The standard internal insulating lining shall be in compliance with WRAS, FDA and DM174 standards. The flanged materials shall be made of Carbon steel (S235 JR-1.0037), AISI 304 optional, and or AISI 316 optional and shall comply with at least EN 1092-1 and ANSI 150 Standards.

The measuring electrodes shall be continuously cleaned by means which do not interrupt the process flow or the measurement. A sensing electrode shall also be provided to detect when the flow meter is not fully charged with liquid.

Electrodes shall be supplied in Hastelloy B, C, Titanium, Tantalum or Platinium. A partially empty tube detection (fourth electrode) shall be installed and should be enabled or disabled through the software.

The electromagnetic flowmeters shall guarantee a pressure drop less than 250 mbar at velocity of 8 m/s. The pressure drop shall always be less than 10 mbar at velocities lower than 1 m/s.

b) Transmitter

The converter shall be able to generate the current supplying the coils, aquire the electrodes potential difference, process the signal to calculate the flowrate and manage all the communication.

The transmitter shall have an LCD display with facility to show live flow rate. The display shall be programed to show readings.

The transmitter shall provide the following minimum functions:

- Conversion of its supply voltage 90 to 264 Vac or 12/24 Vac/dc,battery powered supply or 12/24 Vac/dc or battery powered-2 xD Cell 3.6V (Lithium) , Lithium battery life shall be up to 10 years with the possibilty of changing the batteries in order to prolong the lifetime of the pressure sensor and the transmitter.

- Supervision of the flow sensor: the transmitter shall be able to generate an alarm signal when the following conditions occur:

  - water conductivity below a preset level
  - flow meter empty
  - reverse flow direction
  - Excitation failure
  - Empty pipe on the 4th electrode
  - Empty pipe on measuring electrodes
  - High temperature

- High voltage supply
- Pulse overlapped
- Wet electronic board

Status icon for alarm shall be displayed and alarm shall be logged in the datalogger.

– Output signals to inform the control/display equipment. Thus, the transmitter shall have as a minimum the following independent output signals:

  - Standard analogue current signal 4-20 mA fully isolated from input and other outputs, and where the zero and full scale mA - value are configurable as well as the measuring range. The range adjustment shall be continuous, and the units shall be configurable in flow engineering units.
  - 2 pulses passive outputs (MOS), individual galvanically isolated-clean contact, with a maximum load +/- 35V DC, 100 mA short circuit protected

The Transmitter shall have an LCD display-Index menu, and symbols icon for dedicated information, it shall bear at least 4 Push bottons to access all functions and the totalizer informations shall be displayed with 5 decimal digits. The minimum information displayed shall be as follow:

- Live Flowrate
- Total positive Totalizer (t+)
- Total negative Totalizer (T-)
- Partial positive Totalizer (P+)
- Partial negative totalizer (P-)
- Time & date
- Converter temperature
- Parameters corresponding code and value

The convertor shall have an excellent data security given by the internal memory. It shall have a built in datalogger with over 100 000 data lines capacity with a frequency of log betwwn 1 minute and 120 minutes (default 15 minutes).When ful capacity is reached; cycle memory, old data shall be overwritten by new ones. Software shall be supplied with the unit to allow users to communicate with the convertor via port to any pc, laptop, windows tablet. Downloading the data, managing and programming shall be easy.

– Data shall be protected with a password, in addition, automatic firmware check and recovery during the update must be possible. As for the external verification, field verificator shall be available for calibration verification and electronic status.

– The instrument shall have at least 4 totalizers (2 positive and 2 negative)

– Software for communication and programming: Commisionning (equal settings of meters)-Data print for documentation- Data export (CSV file)- Firmware update -Read instant flowrate- Read and write all non volatile parameters- Download internal datalogger- View instrument event logger.

c) Flowmeter Cabling

Where remote mounted converters are specified, cables shall be provided, installed and terminated between the sensor and converter/ pulse power unit for the following purposes:

- flow signal;
- reference signal;
- coil supply;

Such cables and sealing glands shall be suitable for submersible operation (IP68) of the sensor to the depth specified. The cable length depends on the liquid conductivity.Cable entries shall be 4X PG9 Glands I/O -2X PG20 Glands junction box in remote version.

d) Spool Piece

A flanged steel pipe spool piece shall be provided of the same diameter and length as the respective flowmeter and flanged for insertion in the pipe should it be necessary to remove the flowmeter.

e) Accuracy

The accuracy of the flowmeter shall be independent of the range which has been selected for the analogue signal and shall be better than 0.2% +/- 2 mm/s, in addition, insertion sensors accuracy shall be 2% of rate +/- 2 mm/s. The uncertainty of the calibration shall be equal to 0.2% +/- 2 mm/s. The repeatibility of the measure shall be about 0.1%. Bi-directional measure. The sensors shall be certified under MID01 norms.

Note : the flow test shall be made on a recognised test bench which is traceable to international standards.

209.11 WATER METER ACCESSORIES

A typical arrangement for water meters installation consists of a Quarter turn valve followed by an air valve before distributing into the different house pipes. All house pipes shall be equipped with two ball valves and a subscriber meter.

The pipe arrangement shall force air trapped in the service pipe to exit from the air valve. Therefore the air valve must be located at a high point that provides at least 5 cm head room above the air valve. Supply pipes may need to be re-arranged to allow for the installation of all fittings and valves required for the installation of subscriber meters in a given location. All pipes above ground until the new water meters shall be executed with galvanized iron pipes.

Where water meters are installed above 700m, contractor must proceed to insulation for protection against frost. Thermal insulating materials should be of the closed cell type complying with BS 5422 and be installed in accordance with BS 5970.

The Contractor shall provide and install all pipes, fittings, bends, reducers and materials required for the installation of the new pipe arrangement.

209.11.1 STRAINERS AND NON-RETURN VALVES

Contractor shall ensure that water meter bodies are fitted with a tubular strainer made of stainless steel in addition to a non-return valve for Multi-jet type meters. The strainer shall have at least at least 18 holes/cm² and is to be fitted at the inlet and both the strainer and non-return valve are to be fitted in such a way that they can be removed but cannot fall of the meter inlet or outlet.

209.11.2 UNION JOINTS AND WASHERS

Contractor is required to supply transport and install union joints and washers. The joints are to be used for the installation of the water meters. The union joints shall be of brass, stainless steel or composite material (for plastic bodies) and shall be supplied in separate packaging than the meters.
The nut of the union joint shall have two 1 mm diameter holes drilled on its side diagonally and opposite to each other. This will allow a 0.8 mm seal wire to pass through it while the meter is being installed.

209.11.3 AIR VALVES

The contractor shall install one air valve before every individual water meter. The air valve is to be installed on the upper part of the pipe arrangement prior to the entry of the water meter. The pipe arrangement shall be designed in such a way to force any trapped air to exit from the air valve. The air valve shall therefore be located at a high point that provides a minimum of 5 cm of headroom above the air valve.

209.11.4 QUARTER TURN VALVES

The contractor is required to supply, transport, and install one quarter turn valve before the water meter. The quarter turn valve must allow locking/plumbing.

209.11.5 METER PROTECTION BOXES

The contractor is required to supply transport and install meter protection boxes. The meter boxes are installed in order to prevent and mitigate the risk of vandalism and tampering and therefore should be solid and are to be secured with locks in order to avoid unwanted access to water meters. A sample of water meter boxes is to be provided to the Supervising engineer for approval.

CABINET MATERIAL AND DIMENSIONS

The meter protection boxes are to be made of steel; the box shall be of off-white color and the profile of the boxes' door should be at least 1 cm curved (90 degrees), to prevent the entrance of heavy waste or rain water.

The contractor is required to ensure that the box is tested for:

- High temperature resistivity
- Electrical insulation (paint)
- Dust and weather
- Impact resistance

The box should be designed in such a way to allow for easy mounting on walls and surfaces: it should have a minimum of 4 wall mounting holes at the back, each one to be located in one of the corners.

There should be at least three sizes of water meter protection boxes:

- Box able to fit 1 water meter (15, 20, or 25 mm)
- Box able to fit 2 water meters (15, 20, or 25 mm)

- Box able to fit 3 water meters (15, 20, or 25 mm)

In these two latter cases, a collector linked to the downstream end of the service line shall distribute water to each house connection. For pricing purposes, this collector shall be considered an integral part of the water meter boxes it is supplying. The dimensions of the boxes will vary based on the water meter dimensions, and should allow for a minimum of 5 cm space in between water meters themselves and in between the water meter and the walls of the box.

The contractor shall ensure that the water meter cabinets have built-in 20 mm incoming/outgoing water pipes opening. The number of outgoing openings will vary on the number of water meters the cabinet holds.

Boxes must be insulated with rigid polyurethane foam or equivalent, box openings to be sealed with water proof glands and injected with polyurethane materials.

Boxes must be equipped with built-in locks that can be locked with a triangular Allen key.

These locks shall be identical for a given number of boxes. For each group of similar locks, shall be provided a corresponding set of 5 identical keys.

209.11.6 INSTALLATION OF WATER METERS

The contractor is to follow the instructions of the manufacturer when installing the new water meters and related accessories. In particular, for mechanical domestic meters, the orientation of installation has to be horizontal because any tilting will affect the accuracy. The contractor needs to ensure that the water meters are installed in such a way as to allow easy legibility of water meter reading.

When installing a new water meter in place of an already existing domestic connection, the contractor is required to dismantle the existing water meter/gauge and hand them over to the water establishment. The contractor is to ensure that the subscriber's access to water is not interrupted for more than 6 hours when dismantling old water meters/gauges and installing new water meters and water meter cabinets.
The contractor is required to modify the supply pipe after installing the water meters in order to fit the available space conditions.

The contractor is to strive to carry out works carefully in order to avoid sand or dirt entering water meters and water meter boxes. For aesthetic reasons, pipes shall either be installed horizontally or vertically. Inclined pipes will not be accepted.

209.12 VALVES & PENSTOCKS

209.12 .1 General Requirements for Valves

General

Small valves of ND less than or equal to 40 mm shall be provided with self locking handles or handwheels to prevent accidental operation.

Emergency isolation valves shall be gate, ball or plug valves.

Drain and vent valves shall be provided with a plug or blind on the discharge side.

Flangeless valves shall not be used as the first block valves against storage tank.

Unless otherwise specified, valves shall be epoxy coated internally and externally. The coating shall have a minimum thickness of 150 µm.

Threaded ends shall not be used for valve sizes larger than 50 mm ND.

All handwheels, headstock, foot brackets, guide bracket and thrust tubes shall be of cast iron.

Fixing nuts and bolts supplied by the manufacturer shall be as specified in the general requirements for fastners.

Valves shall be sized such that the velocity through the valve when fully open does not exceed 2.50 metres per second at the rated throughput. They shall have flanges to not less than BS.4504 NP.16 and shall be capable of withstanding the same test pressures as the pipeline on which they operate. All nuts and studs subject to vibration shall be fitted with spring washer or locking tabs.

Types and Operating Conditions

Valves shall be designed to meet the operational and environmental conditions specified for the types indicated in the specific valve schedule.

The closure rates of all valves shall be designed to prevent the effects of surge. Where necessary, valves with a varying closure rate shall be used.

Valve flanges or couplings shall be as specified in the valve schedule and match those specified for the pipework installation.

Working and tests pressures shall equal respectively 16 and 20 bars.

Identification

Each valve shall be identified by a unique reference as approved which shall identify the medium/plant controlled and be numbered in a logical sequence.

The reference shall be either engraved on a 3mm thick laminated white/black/white traffolyte disc or stamped on a 1.0mm (19g) thick brass disc. The discs shall be at least 35mm dia. with reference letters and numerals not less than 4mm and 8mm high respectively.

The discs shall be mounted on the hub of the handwheel or where this is impractical, they shall be attached to the valve stem by means of suitable brass 'S' hooks and/or jack chain through a hole at the top of the disc.

Access

All valves, spindles and handwheels shall be positioned to give good access for operational personnel. It shall be possible either to remove and replace or to recondition seats, gates or gland packings which shall be accessible without removal of the valve from the pipework or, in the case of power operated valves, without removal of the actuator from the valve.

Extension spindles shall be supplied wherever necessary to achieve the specified operating requirements.

Hand Operation

All handwheels shall be arranged to turn in a clockwise direction to close the valve or penstock, the direction of rotation for opening and closing being indicated on the handwheels.

The handwheels shall be coated with black plastic and incorporate facilities for padlocking in either the open or closed position.

Bituminous paints shall not be applied to any valve handwheel.

The operating gear of all valves and penstocks shall be such that they can be opened and closed by one man against an unbalanced head 15% in excess of the maximum specified service value and any gearing shall be such as to permit manual operation in a reasonable time and not exceed a required rim pull of 55kgf.

Power operated valves shall include equipment for manual operation by means of a handwheel or other suitable device which shall be interlocked with, and fixed to, the power unit.

Headstocks and valves of 125mm nominal bore and above shall be fitted with mechanical position indicators to show the amount which the valve is open or closed in relation to its full travel, i.e. 0.25, 0.50, 0.75, 1 etc.

209.12 .2 Valve Materials

Valve bodies and other components shall be of corrosion resistant materials, compatible with the medium and of robust industrial design.

For water applications and where specified, valve bodies, discs and wedges shall be of cast iron, with facing rings, seating rings, wedge nut and other trim of corrosion resistant bronze or gun metal.

The valve stem, thrust washers, screws, nuts and other components exposed to the water shall be of a corrosion resistant grade of bronze or stainless steel.

For water works applications, wedge gate, metal seated valve materials shall be in accordance with BS 5163 Table 6A, fitted with a stuffing box and gland seal on the stem. Oil or grease shall not be used on any bearing or seal that may be in contact with the water being controlled.

The type and size of valve to be used to any particular location shall be as indicated on the contract drawings. Valve materials shall comply with the following minimum requirements.

ENVIRONMENT	BODY	TRIM**	REMARKS
Air	Carbon Steel or Bronze	410 SS Bronze	Blower discharge valves can be supplied to blower manufacturer standard.
Cl_2 Gas	Carbon Steel	410 SS	
Cl_2 Water	PVC	PVC	
Diesel Oil	Carbon Steel	410 SS	
Sewage	Ductile Iron Cast Iron	Bronze* Bronze*	Zinc free.

	PVC	PVC	
Potable Water	Bronze PVC Ductile Iron Cast Iron	Bronze* PVC Bronze* Bronze*	Less than 1000 mg/l total dissolved solids. Zinc free.

* Alternate acceptable materials for stem is aluminum bronze, or nickel aluminum bronze

** Trim material includes stem, body and closure seating surface, seat rings, bushings, springs, or any small parts in contact with service fluid.

209.12 .3 Butterfly Valves

Butterfly valves shall have a resilient disc seating and be designed for a positive leak-proof shut off at a minimum pressure of 16 bar. Non-wafer types are preferred.

Butterfly valves shall conform to BS 5155

The disc shall be in grey or ductile cast iron unless otherwise specified with a resilient seating ring in moulded rubber, or other material to the approval of the Engineer.

For valves of 350 mm ND and above, a suitably lubricated axial thrust bearing shall be fitted.

A stuffing box and gland shall be fitted on the operation shalft extension to seal the pressure side of the valve. The design shall be such as to facilitate packing replacement without removal of the valve from the pipeline.

A valve position indicator, to show the position of the disc, shall be provided on the valve operating gear.

Suitable stops shall be incorporated to prevent movement beyond the disc "fully open" and "fully closed" positions.

Valves for flow regulation shall be of all metal construction.

209.12 .4 Air Valves

Air valves shall be of two types:

c) Single (small) orifice valves (SOV), for the discharge of air during the normal operation of the pipeline.
d) Double orifice valves (DOV), consisting of a large orifice and a small orifice. These shall permit the bulk discharge of air from the main during filling and air inflow when emptying in addition to the discharge of small quantities of air during normal operating conditions.

Air valves shall be supplied with an independent isolating butterfly valve (DOV) or cook (SOV) which permits the complete removal of the air valve from the main, without affecting the flow of water in the main.

The sizing of the air valve and isolating assembly shall be such that the pressure drop at design flow capacity does not exceed 0.5 bar.

Each air valve assembly shall be suitable for connection to a flange on the pipeline.

At the connection between the air valve and its isolating valve a BSP tapping shall be made suitable for fitting of a pressure gauge. All tappings shall be sealed by a brass plug and copper compression ring gasket.

Air valves shall operate automatically and be constructed so that the operating mechanism will not jam in either the open or closed positions.

209.12.5 Pressure / flow control valves (reducing/regulating)

Control valves shall function efficiently of line pressure or flow without human intervention. They shall be hydraulically or electrically operated depending on the availability of a power source. The basic valve shall be heavy duty globe type to BS 5152 & 5160. It shall have no packing glands or stuffing boxes and shall be maintained with ease without removal from the pipeline.

The valve shall be coated internally and externally with epoxy 150 μm minimum thickness. The material of the valve and its elements shall be selected to suit the fluid in the line and the environmental factors such as abrasion, corrosion, pressure and temperature.

210 SHOP DRAWINGS, AS-BUILT DRAWINGS

Shop Drawings and all necessary material technical specification shall be submitted to the Engineer for approval at least 21 days before starting the work.

As built drawings shall be prepared after completion of the work, and shall be also submitted to the Engineer for approval.

It is the duty of the Contractor to undertake all the Engineer's recommendations, modifications and corrections at his own expense until complete satisfaction of the Engineer.

All the modifications to the design drawings coming out during execution of the works, or after ordering the relating materials (especially for pumping stations building dimensions) should be done by the contractor and approved by the Engineer.

VOLUME 3
BILL OF QUANTITIES

Part 1 – General Requirements
Part 2 – Civil works

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INTRODUCTION

1.10 GENERAL

The Bill of Quantities is not and does not purport to be either exhaustive or explanatory of all the obligations and duties of the Contractor who shall be deemed to have satisfied himself as to the correctness and sufficiency of the rates and prices entered by him in the Bill of Quantities all of which shall cover all his obligations under the Contract (including those in respect of the supply of goods, materials, plant or services or of contingencies) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein and which

may reasonably be inferred to be necessary for the Works as described in the Contract whether expressly mentioned therein or not.

1.11 ITEMS DESCRIPTION

A detailed description of the items and of the conditions under which and the manner in which the work is to be done and measured is not set out in each item of the Bill of Quantities. Reference should be made to this Preamble and all other documents forming the Contract.

1.12 DEFINITIONS OF BILL OF QUANTITY CATEGORIES

The Works shall include, but not be limited to, concrete works, plastering, waterproofing, thermal insulation, metal works, plastering, painting, and all necessary works not mentioned above and needed for a good finishing and exploitation of the different structures. Also, this category shall include, but not limited to, the prices to supply and install all necessary hydraulic accessories needed for the equipment of the reservoir and related valve chamber.

1.13 RATES AND PRICES

The Contractor shall be deemed to have inserted against each item in the Bills such rates and prices as he may deem necessary to cover the requirements of the Contract. Where neither price nor rate is entered against an item or if the term "included' or any such similar term is used it shall be deemed to have been included in the other priced items in the BOQ and measured accordingly. All rates and prices entered against any item in the BOQ shall be deemed to include all the detailed requirements of the General and Particular Specifications.
Rates and prices shall be inserted in the unit rate column of the Bill of Quantities. Each part of the Bill of Quantities shall be totaled and the totals carried to the Summary and Grand Summary.

1.14 MEASUREMENT

The Bill of Quantities includes items as lump sum and others as measured quantities.

1.14.1 Lump Sum

The lump sum items shall not be subject to re-measurement, and shall include the prices for all necessary equipment, construction, installation, testing and commissioning among others. The lump sum entered in the Bills shall include the price for a complete installation as described in the specifications.

The prices shall include all work necessary for completion of the Works and shall include the prices for all necessary building work and all necessary safety and access works including guards, handrails, firefighting equipment and the like.

1.14.2 Measured Quantities

All measurements in the Bill of Quantities are taken strictly net. The principle of net measurements shall apply to all Works executed. All quantities measured for payment shall be measured by the Contractor and checked and approved by the Supervisor on the basis of actual net quantities of Work fixed in position.
The quantities given in the Bill are the estimated quantities. In no sense shall such quantities be considered as limiting or extending the amount of the work to be done by the Contractor and of the materials to be supplied by him. The Contractor shall be responsible for checking quantities and for making any necessary surveys and investigations prior to placing any order for materials.

1.15 DEALING WITH WATER

Items in the Bills of Quantities shall be deemed to include the prices for dealing with water flows and keeping the Works free of water.

1.16 WATER AND POWER

Unless otherwise explicitly stated in the Contract, water and power for the purpose of constructing, cleaning, and testing the Works shall be provided by the Contractor at his own expense, and shall not be measured separately.

1.17 TRAFFIC REGULATION CONTROL AND SAFETY PROVISION

The provision of traffic control, safety equipment, signs, diversions, control systems including obtaining approvals and liaison with third parties for work in public roads and streets or in private sector will not be measured separately but shall be included in pipes rates, and shall include but not by way of limitation:

- Preparing all necessary plans, details and schedules and submission to the contracting authority/supervisor to obtain all necessary approvals.
- Liaison with third parties.
- Erecting, maintaining, moving and removal of safety barriers, signs and traffic control equipment.
- Establishment and management of road diversions.
- Watching and lighting.
- Maintaining roads and streets clean and free from construction debris.

2.000 RESERVOIR WORKS

2.10 SITE CLEARANCE

The lump sum price shall include cleaning the entire surface of the site and clearing it from any obstacle (material or equipment) located within the area of works, it shall also include the demolition of existing unused structures, labor, necessary equipment, transport of soil or wastes to environmentally approved public dumps (permit from the concerned authorities) and all tasks to deliver the site for excavation.

2.11 SCREED

The price per square meter of screed above the reservoir shall include material, equipment, transport, supply, placing, mixing, labor… Formwork and scaffolding are included and shall be measured according to geometric shapes determined by written instructions of the engineer. All tasks necessary for the completion of the work are deemed to be included in the price.

2.12 INTERNAL WATERPROOFING

The price per square meter of internal surface waterproofing coating for reservoirs shall include preparation of the surface (sand blasting, water blasting), treatment of singular points (contraction or expansion joints, pipe penetration, ...) material, transport, scaffolding, application in several layers, labor, expenses in conformity with the technical sheet of approved material, quality tests, structures test, before and after application and warranty. Cementitious waterproofing products shall be applied on reservoirs walls, bottom and upper slabs. All products used shall be non-toxic.

2.13 WATERPROOFING OF ROOF SLABS and other structures WITH THERMAL INSULATION

The price per square meter of cover slab waterproofing shall include material, transport, equipment, labor, supply, installation, preparation of support, treatment of singular points (rain outlets, ventilations, openings). Roof slab waterproofing shall be composed of a thermal insulation with minimum thickness of 50 mm and a thermal conductivity $\alpha = 0.037$ Kcal/h.m2/oC, and a double layer waterproofing membrane (SBS) 2x4mm thick minimum. Vertical up stands shall be aluminum self-protected. The price shall also include the supply and installation of a nonwoven polyester sheet 200 g/m2. Supply and installation work of necessary roof drains are deemed to be included in this item and shall not be paid for separately.

The membranes shall be measured only for horizontal surfaces and no measurements or excess shall be paid for vertical surfaces.

2.14 BITUMINOUS COATING

As for the protection of underground concrete elements, the price per square meter of bituminous waterproofing paint shall include material, transport, equipment, labor, supply, installation, preparation of support, treatment of singular point, scaffolding and shall be composed of two layers of bituminous paint including 1 coat of water-based primer in order to assure a protective coating for underground structures.

2.15 GEOTEXTILE

The price per square meter of geotextile placed shall include material, equipment, transport, supply, placing, mixing, labor… Formwork and scaffolding are included and shall be measured according to geometric shapes determined by written instructions of the engineer. All tasks necessary for the completion of the work are deemed to be included in the price.

2.16 GRAVEL

The price per square meter of gravel placed above the geotextile on the roof of the electrical room shall include material, equipment, transport, supply, placing, labor… and shall be measured according to geometric shapes determined by written instructions of the engineer. All tasks necessary for the completion of the work are deemed to be included in the price.

2.17 WATER TESTING AND DESINFECTION OF RESERVOIRS

The lump sum price of water testing of reservoirs per site shall include:

- Supply, transport and filling of reservoir with water, and checking for leaks. This operation shall be repeated to the Engineer's satisfaction.
- Water sampling for analysis and transport in an adequate packing to the laboratory
- Bacteriological analysis type B2 (2 per reservoir)
- Cleaning and disinfection including all material, scaffolding, labor, expenses and all tasks necessary to accomplish the work.

2.18 GALVANIZED STEEL DOORS INCLUDING PAINTING

The price per unit of exterior steel doors shall include all material, equipment, transport, labor, expenses, water-resistant hardware, ventilation, mechanical protections, approved minimum two coat protective paint system after grit blasting and shop priming, louvers, openings, locking system, supply, installation, anchoring, reinstatement of support, finishing and all tasks and accessories, necessary to a perfect execution. Metal sheets shall be 3mm thick minimum.

2.19 GALVANIZED STEEL LOUVERS

The price per unit shall include supply and installation of colored galvanized steel louvers and including frame, subframe transoms, sills, stainless steel fixing, accessories ironmongery sealants anchors, sand insect screens trap filter and protective coating.

2.20 METAL WORKS

The price per kilogram of metalwork (protection bars, louvers, ventilation, ladders type Saf-T-Climb or similar, grating, railings, trap doors, ...) shall include all material, equipment, transport, labor, expenses, hardware, painting with approved minimum two coat protective (anti-corrosion), supply, installation, anchoring, locking system, reinstatement of support, finishing and all tasks and accessories necessary to a perfect execution.

2.20.1 Metal ladder

The price per unit of internal and external ladder inside the reservoir shall include all material, equipment, transport, labor, expenses, hardware, painting with approved minimum two coat of resin, supply, installation, anchoring, locking system, reinstatement of support, finishing and all tasks and accessories necessary to a perfect execution.

2.21 STEEL COVERS

The price per square meter of steel plates shall include the supply and installation of steel plates with all supporting steel structures and with embedded steel angles installation, including welding, bolts, hinge, primer, 2 coats of oil-based paint, and all necessary material and accessories as per drawings. Steel covers for water tanks access at the roof slab and for valve chamber shall be galvanized.

Steel covers: (removable or not) and frames shall include for all assembling and jointing components parts and accessories, fixing in position and removal of all protective coverings.

All components shall be shop primed prior to shipment to site.

Rates shall include (but not be limited to) the following:

- All materials and accessories, gutter.
- All cuttings, notches and making holes, anchors and lugs including fixing and building in, sawn grounds, blockings and backings,
- Auxiliary materials and accessories as required,
- Factory anti-rust primer before fixing as specified, touch-up at installation,
- Fabrication and working to all shapes,
- Compliance with designed and required shapes, straight and curved,
- Specific coordination with related works,
- Assembling and jointing components parts and accessories,
- Anti-corrosion priming and finishing as required,
- Generally, all materials, accessories and workmanship.
- All cuttings and reservations for hardware and ironmongery,
- Finishing as required,
- Hardware only where indicated,
- Fixing of hardware supplied by owner where indicated,
- Work in all shapes, securely fixing in position.

2.22 FINISHES

2.22.1 Portland Cement Plaster

The price per square meter shall include all materials and accessories. Surfaces are measured net, as the effective executed quantity. All openings shall be entirely deducted.

The price per square meter shall include (by way of indication and not limitation) the following:

- Preparation of substrates,
- Placing embedded items, such as metal lath, reference spots, and the like,
- Any additives needed to improve workability and/or waterproofing and/or other property of plaster, subject to Consultant's approval, such as fiber reinforcement product, waterproofing admixture, and the like,
- Waterproofing admixtures (for external plaster and plaster in wet areas) and any other material needed,
- Control joints,

- Application to any surface indicated, as per required number of coats and tolerances,
- Making good around inserts, recesses and the like,
- Finishing surfaces, curing,
- Cutting and patching, protection in general,
- all materials, accessories and workmanship.

2.22.2 Painting

Works shall be measured net, according to an "Engineering measurement", as per the layout and units of the Bills of Quantities; no other method of measurement or applicable custom shall be allowed or considered.

The price per square meter shall include all materials and accessories, workmanship, surface preparation, and quantities will be measured as the effective executed quantity in contact with the substrate.

Rates for painting include (but are not limited to) the following:

- Preparation of paint or varnish including rubbing down of surfaces to be painted, cleaning and dusting-off, rubbing down between coats, priming and putty filling as necessary,
- Plastering repair where required with non-shrink grout and painting for maintenance of exterior elements.
- Epoxy painting on cementitious surfaces shall include acid etching and cleaning,
- Cutting in edges and cutting to line and work on additional surfaces exposed by such open edges, pipe clips, saddle and holder bats and the like and rubbing down between coats,
- Washable painting for internal walls, including one undercoat and two coats of enamel paint with semi-gloss finish, all as specified as recommended by manufacturer.
- Attendance, protection and making good after all works.

2.23 INDUSTRIAL FLOORING

The price per square meter of industrial flooring shall include all material, equipment, transport, labor, expenses, application, preparation of support, scaffolding, curing, finishing, cleaning, singular points, screed if necessary. It shall be composed of heavy-duty chemical and abrasion resistant epoxy resin floor (5mm thick). For walls skirting, 2mm thick of epoxy resin will be sufficient (the number of layers should be in compliance with the manufacturer's recommendations and the Engineer's instructions).

The surfaces shall be measured according to geometric shapes of painted area (floor), no measurement and no excess shall be paid for re-entrant or salient angles of openings or wall skirting.

2.24 RESERVOIRS HYDRAULIC ACCESSORIES

2.24.1 Supply and installation of pipes

Pipes shall be classified for payment according to diameter and material and shall be measured in linear meters of pipeline in place measured along the crown of the pipeline.
The length measured for payment shall include the lengths of all fittings, valves and specials installed in the line.
The price shall cover all fittings, bends, joints, reducers, flanges, holderbats, supports, puddle flanges, inserts, bolts, nuts, brackets, bell mouths, as well as hauling, transport, unloading, staking and all necessary labour and accessories to provide a complete installation.

2.24.2 Supply and installation of gate valves

Gate valves shall be classified for payment by nominal diameter and nominal pressure class and shall be measured by number.

Price shall include for all fittings necessary to join the assembly to the pipeline (either new or existing), including thrust flanges, flexible joints, dismantling joints, supports and all items necessary to make a complete installation.

2.24.3 Floor drain

Floor drains shall be measured by number, and shall include for floor drain pipe DN 80mm, excavation, backfilling, reinstatement of the concrete surface level, flap valve, bends and all components necessary to provide a complete installation.

2.24.4 Supply and installation of float control valve

Float valves shall be classified for payment by nominal diameter and nominal pressure class and shall be measured by number. Price shall include all the requirements for the proper functioning of the valve.

2.24.5 Supply and installation of suction strainers

Suction strainers shall be measured by number according to nominal diameter. Material shall be stainless steel, coated cast iron or bronze.

Price shall include for all fittings necessary to install the suction strainer inside the reservoir on the outlet pipe including flanges, joints, bolts, nuts and all accessories to make a complete installation.

2.24.6 Supply and installation of level indicator

Level indicators shall be measured by number, and the price shall include for all necessary fittings to install the level indicator, civil works, concrete drilling, grouting with suitable material, level indicator, testing, bolts, nuts, etc.

2.24.7 Supply and installation of double air release valves

Air valves shall be measured by number for each air valve size and nominal pressure, and shall include for tees, ARV, gate valves, riser pipes, flanges, bolts, nuts, supports and all components necessary to provide a complete installation.

2.24.8 Supply and installation of electromagnetic flow meters

Water meters shall be measured by number for each nominal diameter and nominal pressure class, and shall include for **filters/Y strainers, flow straighteners** (both having same DN and PN as water meters. Moreover, flow straighteners should be of the type which eliminate the need for any straight length of pipe before and after the water meter), flanges, dismantling joints, supports, bolts, nuts and all components necessary to provide a complete installation.

2.24.9 Supply and installation of manometers

Manometers shall be measured by number regardless of the caliber of the pressure gauge and the diameter of the tapping collar. Price shall include for manometers (case 10 cm, glycerin filled), isolating valves (DN = 15 mm, PN as required), tapping collars, bolts, nuts and all components necessary to provide a complete installation.

2.24.10 Supply and installation of pressure regulating valves (PRV)

Pressure regulating valves shall be measured by number for each diameter of pipeline and pressure class and shall include for thrust flanges, dismantling joints, filters/Y strainers, manometers, supports, and all components necessary to provide a complete installation.

2.24.11 Supply and installation of inserts

Inserts shall be classified for payment by nominal diameters, and shall be measured by number, price shall include for material, inserts, installation, grouting, bolts, nuts, flanges, etc.

2- BILL OF QUANTITIES

ITEM Nb.	DESCRIPTION	UNIT	QTTY	Unit RATE USD	Total Amount USD
	CIVIL WORKS				
1.0000	**GENERAL**				
1.0010	Site clearance	L.S.	1		
	TOTAL GENERAL REQUIREMENTS				
2.0000	**CONCRETE WORKS**				
2.1000	**Screed** Reinforced Concrete Strength Class C25/30 dosing 250kg/m3 including formwork and slope, steel reinforced (1 layer 1Ø6@15cm on each direction) and all needed materials for the execution of the works.				
2.1010	Screed to slope for drainage and waterproofing preparation average 6 cm thick - water tanks	sq.m	142		
2.1011	Screed to slope for drainage and waterproofing preparation average 6 cm thick - valves chamber	sq.m	15		
	Sub-Total 2.1000				
2.2000	**Concrete works around valve chamber and reservoir**				
2.2010	Mass Concrete Strength Class C20/25 around reservoir and valve chamber 10 cm thick	cu.m	10		
	Sub-Total 2.2000				
	TOTAL OF CONCRETE WORKS				
3.0000	**METAL WORKS**				
3.1000	**Galvanized Steel Louvers** Supply and installation of colored galvanized steel louvers and frames installed complete including frame, subframe transoms, sills, stainless steel fixing, accessories ironmongery sealants anchors, sand insect screens trap filter and protective coating				
3.1010	Steel louvers for valves chamber (100x60ht)	u	1		

	Sub-Total 3.1000				
3.2000	**<u>Galvanized Steel Doors</u>** Supply and installation of galvanized steel doors with protective coating and adequate support , including all necessary fixing devices, accessories, fasteners as specified and shown on drawings.				
3.2010	Steel doors for valves chamber (100x210ht)	u	1		
	Sub-Total 3.2000				
3.3000	**<u>Metal Ladders</u>** Supply and installation of epoxy coated metal ladder with epoxy coating steel adequate support, including all necessary fixing devices, accessories, fasteners .				
3.3010	External galvanised steel ladder for ground tank including guardrail protection.	u	1		
3.3011	Internal galvanised steel ladder for ground tank	u	1		
	Sub-Total 3.3000				
3.4000	**<u>Steel Cover</u>** Supply and installation galvanized steel cover with all supporting steel structures and with embedded steel angles installation, including welding, bolts, hinge, primer, 2 coats of oil-based paint, and all necessary materials and accessories as per the drawings.				
3.4010	Galvanized steel cover for the ground tank	u	1		
	Sub-Total 3.4000				
	TOTAL OF METAL WORKS				
4.0000	**WATERPROOFING AND THERMAL INSULATION**				
4.1000	**<u>Water Tanks</u>**				
4.1010	<u>Waterproofing membrane</u>				

	Application of 2 layers of SBS polymer modified bitumen membrane 4mm thick to be placed on top of concrete roof. After application of bituminous membrane, dressing up 150mm high against parapets along anodized aluminum flashing for waterproofing system, with mastic sealants and anchors including the flood test.	sq.m	142		
4.1011	Thermal insulation				
	Insulation extruted polystyrene pannels	sq.m.	142		
4.1012	Geotextile				
	Geotextile - Supply and installation of nonwoven polyester sheet, filter fabric, minimum density of 200 g/m² between waterproofing and precast concrete protective tiles	sq.m.	142		
4.1013	Roof drains				
	Roof drains to evacuate rain water	u	1		
4.1014	Ventilation pipes	u	1		
	Cementitous waterproofing				
4.1015	Internal cementitious waterproofing of floor, walls, and upper slab	sq.m	160		
4.2000	**Valves Chamber**				
4.2010	Bituminous coat on all underground structures in contact with soil				
	Bituminous waterproofing paint to all exterior concrete surfaces of the control room in contact with soil including surface preparation as required per specifications	sq.m	38		
4.2011	Waterproofing membrane				
	Application of 2 layers of SBS polymer modified bitumen membrane 4mm thick to be placed on top of concrete roof. After application of bituminous membrane, dressing up 150mm high against parapets along anodized aluminum flashing for waterproofing system, with mastic sealants and anchors including the flood test.	sq.m	15		
4.2012	Thermal insulation				
	Insulation extruted polystyrene pannels	sq.m	15		
4.2013	Geotextile				
	Geotextile - Supply and installation of nonwoven polyester sheet, filter fabric, minimum density of 200 g/m² between waterproofing and precast concrete protective tiles	sq.m	15		

4.2014	Waterproofing protection Application of gravel layer for waterproofing protection	cu.m	8		
4.2015	Aluminum Flashing Anodized aluminum flashing installed, anchored and well sealed and turned into strips, sealants, anchors and protective coating, all including performed reglet as specified at roof slabs drawings. Aluminum flashing 200mm	lm	15		
4.2016	Roof drain Roof rain water drain	u	1		
	TOTAL OF MOISTURE AND WATERPROOFING WORKS				
5.0000	**FINISHING WORKS**				
5.1000	**Plastering** Sand cement plastering on internal walls and ceiling of valve chamber including hollow bloc repair and fill, corner beads, casing beads and plastering repair where required with non shrink grout and painting including upper roof parapet				
5.1010	Plastering on internal and external side of walls for Valve Chamber	sq.m	75		
	Sub-Total 5.1000				
5.2000	**Internal painting** Interior painting finish including preparation of surfaces, rubbing with sealer, sanding, cleaning, application of thin putty filler as required, under coat and two enamel final painting coats with semi-gloss finish, complete all as specified and shown on drawings and as recommended by manufacturer.				
5.2010	Enamel paint on internal valves chamber walls	sq.m	37.5		
5.2011	Ceiling painting of Valves Chamber	sq.m	37.5		
	Sub-Total 5.2000				
5.4000	**Industrial resin - Epoxy floor coating**				

	Supply and application of Epoxy floor coating, heavy duty, excellent chemical and water resistance, including surface preparation, epoxy resin (base) and a co-reactant hardener (curing agent), applied in compliance with supplier recommendation and data sheet.				
5.4010	Floor into Valves Chamber	sq.m	15		
	Sub-Total 5.4000				
	TOTAL OF FINISHING WORKS				
6.0000	**WATER TESTING AND DISINFECTION OF RESERVOIRS**				
6.1010	Water testing and disinfection of the reservoir	L.S	1		
	TOTAL OF WATER TESTING AND DISINFECTION OF RESERVOIRS				
7.0000	**PIPING WORKS**				
7.1010	Supply and installation of connections to existing pipes.	L.S	1		
	TOTAL OF PIPING WORKS				
TOTAL CIVIL WORKS					
	VALVE CHAMBER HYDRAULIC ACCESSORIES				
K 1.0000	**PIPING AND ACCESSORIES**				
K 1.1001	Y-Strainer DN 150 PN16	nb	1		
K 1.1002	Y-Strainer DN 200 PN16	nb	1		
K 1.1003	Flow Straighteners DN 150 PN16	nb	2		
K 1.1004	Flow Straighteners DN 200 PN16	nb	1		
K 1.1005	Double Air release valve DN50, PN16 with isolating valve	nb	1		
K 1.1006	Double Air release valve DN80, PN16 with isolating valve	nb	1		
K 1.1007	Dismantling Joints DN150 PN16	nb	2		
K 1.1008	Dismantling Joints DN200 PN16	nb	1		
K 1.1009	Butterfly Valve DN150 PN16	nb	7		
K 1.1010	Butterfly Valve DN200 PN16	nb	1		

K 1.1011	Pressure regulating valve PN16, for pipe DN 150 mm DI	nb	1		
K 1.1012	Flow control Valve DN150 PN16	nb	1		
K 1.1013	Insert DN 150 mm	nb	7		
K 1.1014	Insert DN 200 mm	nb	2		
K 1.1015	Float Control Valve DN150 PN16	nb	1		
	Sub-Total K1.1000				
K 1.2000	**Supply and installation of ductile iron class C40 pipes including all necessary fittings (bends, tees, reducers, flanges, dismantling joints, support, etc…)**				
K 1.2001	DI pipes, DN 150 (for inlet and outlet)	lin.m	40		
K 1.2002	DI pipes, DN 200 (for inlet and outlet)	lin.m	20		
K 1.2003	DI pipe DN 150 (Overflow and Washout pipe) This item shall also include excavation, backfilling and all necessary works to convey water to the nearest stream.	lin.m	100		
	Sub-Total K1.2000				
K 1.3000	**Supply and installation of valves chamber floor drain**				
K 1.3001	Valves chamber floor drain, including pipe DN 100 and flap valve to be connected to drain pipe	nb	1		
	Sub-Total K1.3000				
	TOTAL OF PIPING AND ACCESSORIES				
K 2.0000	**INSTRUMENTATION AND CONTROL**				
K 2.1001	Piezoresistive level measurement at reservoir	nb	1		
K 2.1002	Piezoresistive pressure measurement	nb	1		
K 2.1003	Electromagnetic Flow Measurement DN 150 PN 16 with 1 analogue output 4-20mA Pulse output	nb	2		

K 2.1004	Electromagnetic Flow Measurement DN 200 PN 16 with 1 analogue output 4-20mA Pulse output	nb	1		
	TOTAL OF INSTRUMENTATION AND CONTROL				
TOTAL ELECTRO-MECHANICAL WORKS					
TOTAL BILL C1 - GHINEH RESERVOIR WORKS					

TOTAL BILL:
VAT 11%:
Grand Total:

Total in letters:
VAT 11% in letters:
Grand Total in letters:

العارض :

التوقيع :

تاريخ :

طابع أميري :

3- تصريح / تعهد

للإشتراك في مناقصة إعادة تأهيل خزان الغينة وربطه بالشبكة الموجودة

أنا الموقع أدناه .....

الممثل بالتوقيع عن مؤسسة/شركة .....

المتخذ لي محل اقامة ..... منطقة ..... حي .....

شارع ..... ملك .....

رقم الهاتف ..... مكتب ..... فاكس .....

البريد الالكتروني .....

اعترف بانني اطلعت على دفتر الشروط المتضمن التعهد، الشروط الادارية والفنية الخاصة للاشتراك في هذا التلزيم التي تسلمت نسخة عنها.

واصرح انني وبعد الاطلاع على هذه المستندات التي لا يمكن باي حال الادعاء بتجاهلها وعلى تفاصيل الاعمال المطلوبة، اتعهد بقبول كافة الشروط المبينة فيها وبالتقيد بها وتنفيذها كاملة دون أي نوع من انواع التحفظ او الاستدراك.

وأنني تقدمت لهذا الإلتزام للإشتراك ب:

.....

كما اصرح بانني وضعت الاسعار وقبلت الاحكام المدرجة في دفتر الشروط هذا آخذاً بعين الاعتبار كل شروط التلزيم ومصاعب تنفيذه في حال وجوده.

كما أتعهد برفع السرية المصرفية عن الحساب المصرفي الذي يودع فيه أو ينتقل إليه أي مبلغ من المال العام، وذلك لمصلحة الإدارة في كل عقد من أيٍ نوعٍ كان، يتناول مالاً عامًا.

التاريخ _____

ختم وتوقيع العارض

طوابع بقيمة
مليون ليرة لبنانية

4- تصريح النزاهة

عنوان الصفقة: **إعادة تأهيل خزان الغينة وربطه بالشبكة الموجودة**

مؤسسة مياه بيروت وجبل لبنان

اسم العارض / المفوض بالتوقيع عن الشركة .....

إسم الشركة: .....

نحن الموقعون أدناه نؤكد ما يلي:

1- ليس لنا، أو لموظفينا، أو شركائنا، أو وكلائنا، أو المساهمين، أو المستشارين، أو أقاربهم، أي علاقات قد تؤدي إلى تضارب في المصالح بموضوع هذه الصفقة.

2- سنقوم بإبلاغ هيئة الشراء العام والجهة المتعاقدة في حال حصول أو اكتشاف تضارب في المصالح.

3- لم ولن نقوم، ولا أيّ من موظفينا، أو شركائنا، أو وكلائنا، أو المساهمين، أو المستشارين، أو أقاربهم، بممارسات احتيالية أو فاسدة، أو قسرية أو مُعرقلة في ما يخص عرضنا أو اقتراحنا.

4- لم نقدم، ولا أيّ من شركائنا، أو وكلائنا، أو المساهمين، أو المستشارين، أو أقاربهم، على دفع أي مبالغ للعاملين، أو الشركاء، أو للموظفين المشاركين بعملية الشراء بالنيابة عن الجهة المتعاقدة، أو لأي كان.

5- في حال مخالفتنا لهذا التصريح والتعهد، لن نكون مؤهلين للمشاركة في أي صفقة عمومية أياً كان موضوعها ونقبل سلفاً بأي تدبير إقصاء يُؤخذ بحقنا ونتعهد بملء إرادتنا بعدم المنازعة بشأنه.

إن أي معلومات كاذبة تُعرضنا للملاحقة القضائية من قبل المراجع المختصة.

التاريخ: _____

الختم والتوقيع

5- تعهـد برفع السرّية عن الحسابات المصرفية المتعلقة بهذا الإلتزام

أنا الموقع أدناه .....

المتخذ محل إقامة في .....

محل معترفاً باطلاعي على جدول الأسعار وتقدير الكميات ودفتر الشروط ومرفقاته العائد لـ **إعادة تأهيل**

خزان الغينة وربطه بالشبكة الموجودة

أتعهد، بالاستناد إلى ملف الإلتزام الذي اطلعت عليه، وعملاً بالقرار رقم 4 تاريخ 2020/4/28 الصادر عن مجلس الوزراء اللبناني المتعلق بتطبيق المادة الخامسة من قانون السرّية المصرفية التي تجيز رفع السرية عن الحسابات المصرفية المتعلقة بهذا الإلتزام لصالح مؤسسة مياه بيروت وجبل لبنان، بأن أرفع السرية عن الحسابات المصرفية المتعلقة بهذا الإلتزام لصالح مؤسسة مياه بيروت وجبل لبنان، فور تبلغي قرار إسناد الإلتزام إليّ.

ربطاً

مستندات العرض المطلوبة

المتعهّد

رقم الهاتف:

طابع أميري /1.000.000/ل.ل.

نُظّم في

6- تصريح بمعاينة مواقع العمل نافي للجهالة للإشتراك بمناقصة إعادة تأهيل خزان الغينة وربطه بالشبكة الموجودة

أنا الموقع أدناه .....

بصفتي .....

ومفوضًا بالتوقيع من قبل .....

أصرح باسم .....

بأنني قد عاينت مواقع العمل الخاصة بالتلزيم المذكور أعلاه ولن أتذرع فيما بعد بالجهل أو بأي عذر آخر متعلق بحالة المواقع المذكورة.

إن المعلومات التي تقدمها سلطة التعاقد (سواء في دفتر الشروط هذا أو في غيره) هي لإرشاد العارضين المحتملين في تحضير عروضهم. على كل عارض بذل جهده الخاص للتحقق من المخاطر التجارية المرتبطة بتنفيذ الالتزام ولا تتحمل سلطة التعاقد أية مسؤولية عن أية معلومات غير صحيحة قد يحصل عليها أي عارض.

إن أية مصاريف أو تكاليف تكبدها أي عارض من أجل معاينة مواقع العمل وتقديم عرضه هي على مسؤوليته الكاملة وليس على سلطة التعاقد أي مسؤولية من أي نوع كانت مرتبطة بذلك.

توقيع وختم العارض التاريخ

تفيد مؤسسة مياه بيروت وجبل لبنان بأن العارض الموقع أعلاه قد عاين مواقع العمل المُحددة في دفتر الشروط الخاص بالصفقة برفقة مندوب من قبل الإدارة.

توقيع وختم سلطة التعاقد التاريخ

إعادة تأهيل خزان الغينة وربطه بالشبكة الموجودة

- **General Maintenance and Contracting**

العنوان: بعبدا – الشياح – شارع الفرير – مبنى السلام

الهاتف: 03/249609

البريد الالكتروني: ekhoury67@gmail.com

- **مؤسسة يامن للتجارة العامة والمقاولات**

العنوان:

الهاتف: 76/559000

البريد الالكتروني: yamen@yamenest.com

- **مؤسسة حطاب إخوان للهندسة**

العنوان: بيروت – بئر حسن – شارع السلطان ابراهيم – مبنى الروان

الهاتف: 03/608806

البريد الالكتروني: hattab@hattabbros.com