

## **Section IV.                      Technical Specifications**

# **TECHNICAL SPECIFICATION FOR PIPE WORKS**

## **1. PRELIMINARIES**

### **1.1 GENERAL**

The Conditions of Contract and Bill of Quantities shall be read in conjunction with the specifications and matters referred to shown or described in the former are not necessarily repeated in the latter.

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### **1.2 STANDARD AND CODES**

The Contractor shall, perform the Works in compliance with all regulations, standard specifications or statutes of the Government of Maldives unless otherwise conform to this specification.

The current British Standard Specifications and Codes of Practice shall apply to and form part of these specifications unless otherwise specified in respect of all materials and works to which they have application.

In various places throughout this specification and the Bills of Quantities reference is made to the Standards, Specifications and By-Laws issued by the British Standards Institution and other similar organizations. These references shall in every case be deemed to include the latest edition or issue of such Standards. Specifications and By Laws including all revisions, amendments and addenda subsequently issued. Where materials are not specified to be to a particular British Standards and a British Standard exists in respect of such materials, and then the materials shall in all respects comply with the relevant and current British Standards. In such cases where British Standards do not exist, the materials used shall be of the best type available and shall generally be to the Employer's satisfaction.

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### **1.3 DRAWINGS AND SPECIFICATIONS**

Drawings ,BOQ and Specifications are intended to complement each other, so that if anything is shown on the Drawings, but not mentioned in the specifications or vice versa, it is to be furnished and built as though specifically set forth in all three. If any discrepancies, errors, ambiguities or omissions occur in the Drawings or BOQ or Specifications, the same shall be referred to the Employer before proceeding with the Works, and the Employer decision on such discrepancies, errors, ambiguities or omissions shall be final.

In addition to the Drawings, BOQ and Specifications attached hereto, the Employer will during the progress of the Works furnish additional Drawings, Specifications, and instructions as may be necessary, in the opinion of the Employer for the

Purpose of the proper and adequate execution and maintenance of the Works, and the Contractor shall make his work conform. Such drawings and instructions shall be deemed to be part of the Contract Documents.

#### **1.4 TRANSPORTATION TO THE SITE**

The Contractor shall provide all necessary transport, handling and storage of all materials, components and the like to their points of installation on site including transport to and from storage. The Contractor shall provide all necessary transport of labour to and from the site.

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#### **1.5 MATERIALS, GOODS AND WORKMANSHIP**

Materials, goods and workmanship shall be of the best quality of their respective kinds and, as far as applicable, shall comply in every respect with the requirements of the quoted Standards, Codes of Practice and Specifications or any other National Standard approved by the Employers. Preambles and descriptions of materials, goods and workmanship given in any one section of the specifications shall apply throughout the whole of these specifications unless otherwise described. The substitution of materials, goods, workmanship and the like from that specified shall only be permitted with the written approval of the Employer.

The Contractor shall submit for the approval of the Employer a list of names and addresses of the manufacturers and trademarks or names of all the various types of materials and goods he proposes to use the Works. This list shall include reference to the specifications Clause or Article to which the materials and goods apply.

All materials used in the Works shall be new and of the appropriate quality all to the Employer's approval.

Materials shall be obtained from approved sources and used in accordance with the manufacturer's printed instructions. In the absence of a specification all materials shall comply with a relevant standard. The Employer shall order the removal of any materials, which he has not approved.

No orders for materials and goods shall be placed until approval has been obtained for the materials and goods from the Employers.

The Contractor shall note that it is his responsibility to include in his price for the cost of the materials and products as specified and no adjustment will be allowed should the alternatives be rejected by the Employer.

All workmanship shall be of the best standard. All goods and materials to be incorporated in the Works must be new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the contract.

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## **1.6 MANUFACTURE'S INSTRUCTIONS**

All items or materials shall be assembled, mixed, fixed, applied, or otherwise incorporated in the Works in accordance with the printed instructions of the manufacturer of the items or materials unless specifically instructed otherwise by the Engineer.

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## **1.7 SAMPLES**

The Contractor shall furnish for approval with reasonable promptness, all samples as directed by the Engineer. The Engineer shall check and approve such samples with reasonable promptness only for conformance with the design concept of the Works and for compliance with the information given in Contract Documents. The work shall be in accordance with the approved samples.

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## **1.8 ORDERING MATERIALS**

The Bills of Quantities shall not be used as a basis for ordering materials and the Contractor is entirely responsible for assessing the quantities of materials to be ordered.

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## **1.9 DEFECTIVE WORK**

Any defective work materials and also deviations from the working details in respect of setting out, correct lines and levels, verticality, sizes thickness of members and/or any other dimensional variation of any kind whatsoever, shall be removed and reconstructed or otherwise rectified without undue delay to the approval of the Employer and the Contractor shall be responsible for all additional costs incurred due to rectification of any defective work or material.

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## **1.10 DISPOSITION OF EXISTING UTILITIES**

Before commencing any construction work the Contractor shall obtain from the various utilities departments, companies or Employer the location of any existing utilities on the Site. Active utilities on the site shall be carefully protected from damage, relocated or removed as required by the work.

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## **1.11 SITE CLEANING**

The Contractor shall tidy up and leave the Site in a clean and sanitary condition at all times during the execution of the Works.

The contractor shall clean up the site and dispose all unwanted materials from the site on completion of works to the satisfaction of the Employer.

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## **1.12 SCAFFOLDING**

The Contractor at his own expense shall provide, erect, maintain, dismantle, and clear away at completion proper and adequate scaffolding for the proper execution and completion of works.

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### **1.13 PROTECTION OF WORKS**

The Contractor shall cover up and protect the Works from the weather and from damage by his own or other workmen performing subsequent operations. He shall provide all necessary dustsheets, barriers and guard rails and clear away same at completion.

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### **1.14 CUTTING AND PATCHING**

The Contractor shall be responsible for all cutting and patching and making good required for all trades for all work and his prices will be deemed to include for all such cutting and patching and making good.

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### **1.15 WATER FOR THE WORKS**

The Contractor shall make all necessary arrangements and provide all water for the proper execution of the Works, together with all transport, temporary plumbing, storage and distribution, pay all charges and alter, adapt and maintain temporary work as necessary and remove and make good at completion.

Water for execution of works such as Construction works, Concreting, Curing, Pressure testing, Leak testing, cleaning and for other construction activities shall be portable fresh water and shall not contain any harmful impurities which may affect quality of works.. Saline water shall not be allowed for above purposes. Cost of water shall be borne by contractor.

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### **1.16 ELECTRICITY FOR THE WORKS**

The Contractor shall make arrangements to provide all necessary lighting and power for the proper execution and security of the Works and its protection, with all meters, temporary wiring and fittings, pay all charges and alter adapt and maintain the temporary work as necessary and remove and make good at completion.

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### **1.17 SAFETY OF ADJOINING EXISTING BUILDINGS**

The Contractor shall take all necessary precautions during the excavation for the Works particularly those excavation which are adjoining existing buildings, Curb Stones, pavements and shall protect such structures from the damage or collapse by means of temporary or permanent shoring, strutting, sheet piling or underpinning or excavation in short lengths and/or other methods as he deems fit also he shall properly support all foundations, trenches, walls, floors, etc affecting the safety of the adjoining existing buildings

The Contractor shall alter, adopt and maintain all such works described above for the whole period of the Contract and shall finally clear away and make good all damages done

The construction and efficiency of the shoring, underpinning, strutting and the like for the purpose for which it is erected shall be the responsibility of the Contractor, should any subsidence or any other damage occur due to the

inefficiency of the shoring, underpinning, strutting and the like or any other support provided. The damage shall be made good by the Contractor at his own expense and responsibility.

The shoring, strutting, piling and the like, shall be executed in such a manner as to cause as little inconvenience as possible to adjoining owners or the public and the Contractor shall be responsible for negotiating with the adjoining owners the means to safeguard their property and for the use of any portion of their land for the purpose of executing the excavations and no claims submitted on this ground will be entertained

The Contractor shall be held solely responsible for the safety of the adjoining existing buildings, the sufficiency of all temporary or permanent shoring, underpinning, piling, and the like. The Contractor shall keep the Employer informed as to manner in which he intends to proceed with the execution of the excavations and obtain his approval. Such approval if given shall not absolve the Contractor of his responsibility under this Clause

The Contractor shall save harmless and indemnify the Employer in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever arising out of or in relation to any such matters in so far as the Contractor is responsible under this Clause

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## **1.18 DEMOLITIONS**

Demolition includes the complete demolition including grubbing up of foundations and the proper termination of all services as required by the Drawings including the removal and disposal of all demolished materials. The demolition work shall be executed in a systematic manner.

Demolition operations and the removal of debris shall be carried out to ensure minimum interference with roads, streets, footpaths and other adjacent occupied or used facilities

The Contractor at his own expense shall repair damage caused to adjacent facilities by demolition operations. The Contractor shall arrange and pay for the disconnecting, removing and capping of utility services, notify the affected utility agency in advance and obtain written approval before commencing work.

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## **1.19 LEVELS AND REFERENCE POINTS**

The Contractor shall satisfy himself that the existing ground levels as indicated in Contract are correct. Should there be any dispute regarding any levels, Contractor shall submit to the Employer a schedule of the levels considered to be in error, together with the values he believes to be correct. The ground relevant to the disputed levels shall not be disturbed until the Engineer's decision as to the correct levels is given.

The Contractor shall supply to the Engineer details of the value and location of the temporary benchmarks and reference points he proposes to use.

## **1.20 INTERFERENCE WITH ACCESS TO PROPERTIES AND APPARATUS**

Before interfering with access to any property, the Contractor shall make adequate alternative arrangements for the occupiers.

The Contractor shall not obstruct access to any apparatus or utilities of any service or utility.

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### **1.21 CONTRACTOR'S SITE AREA**

Throughout the period of the Contract the Contractor shall maintain the area of his operation within the limits of the Site in a clean, tidy and safe condition by arranging materials and the like in an orderly manner. All rubbish, debris, waste materials and the like shall be systematically cleared from the Site as it accumulates.

The Contractor shall take all steps necessary as directed by the Employer to minimise or eliminate dust, noise or any other nuisance, which may occur. Plant emitting dust, smoke, excessive noise or other nuisance shall not be permitted.

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### **1.22 SAFETY**

The Contractor shall comply with industrial normal safety practices for working in or around the site.

Contractor's workers should be provided with safety equipment in compliance with the acceptable industrial safety.

When working at Site the contractors should comply with Occupational Health and Safety (OH & S) standards to meet OHSAS18001:2007. OH & S refers to the conditions and factors that affect or could affect the health and safety of employees or other workers (including temporary workers and contractors personnel), visitors, or any other person in the workplace. This includes,

- Wearing of Proper Site clothing.
- Wearing of hard hats, gloves at working site.
- Wearing Safety Shoes at working sites.
- Maintaining a "First aid Kit" to attend to minor injuries that may occur during Site works.
- Providing Safety Sign boards near areas where a danger or public related health issue may occur.
- Providing Proper Barricading and Warning lights when an area such as an "excavated area is left open".
- Wearing of Safety Mask/Gas Protection Mask when working with Hazardous chemicals.
- And any other related safety precautions as per the site condition that may affect the health and safety of the workers or people involved in the workplace.

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### **1.23 ENVIRONMENTAL PROTECTION**

The Contractor shall take all necessary precautionary measures to ensure carrying out the works in accordance to acceptable environment norms.

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### **1.24 SECURITY**

The contractor shall ensure that the site is secure during the period of work and shall be liable for any loss or damage sustained as a result of their failure to comply with this condition.

The Contractor shall provide and maintain, night lights, road sign boards, warning tapes etc.

Where the works are in close proximity to buildings, walls or other existing structures, the contractor shall take adequate measures to prevent any damage to such structures. In addition before commencing work the Contractor shall submit details in writing to the Engineer's Representative of his proposed method of carrying out these measures and shall not commence operations until these are approved in writing.

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## **2. EARTH WORKS**

### **2.1 Excavation**

Trench excavation work shall be carried out in a safe and proper manner with appropriate precautions being taken to safe guard workmen and existing structures and utilities against all hazards. Notwithstanding these provisions, if damage to existing utilities results from the contractor's operations, such damage shall be repaired without delay by the contractor or some other agency approved by the engineer, and the cost of such repairs shall be borne by the contractor.

Trenches shall be excavated to the lines and levels shown on the drawing or as directed by the engineer.

Trenches shall be excavated to a width, which will provide adequate working spaces and sidewall clearances for proper pipe installation, jointing and embedment.

All trench excavation shall be open cut from the surface unless authorized by the engineer and shall be excavated so as that pipes can be laid straight at uniform grade without dips or humps between terminal elevations.

Mechanical equipment shall not be used in locations where its operation would cause damages to trees, buildings, culverts or other existing property, utilities or structures above or below ground. In all such locations hand-excavating methods



shall be used.

Where necessary contractor shall use hand tools to excavate test pits prior to excavation to determine the exact location of existing utilities. Test pits shall be refilled by hand as soon as practicable after the necessary information has been obtained. No extra payment will be made for the excavation of test pits.

The trench shall be excavated to the necessary depth to meet the requirement for preparation of trench bottom for pipe laying. Any part of the trench below grade shall be backfilled to grade with thoroughly compacted materials approved by the engineer. When an unsuitable sub grade condition is encountered and in the opinion of the engineer, it cannot support the pipe, an additional depth as directed by the engineer shall be excavated and refilled to pipe foundation grade with approved suitable material to achieve a satisfactory trench bottom.

All excavated materials shall be piled in a manner that will not endanger the work or obstruct side ways or drive ways. Gutters shall be kept clear or other satisfactory provisions made for street and other drainage. Location will be as given in the drawing or as directed by engineer

The Contractor should take all measures to warn the traffic and people using the stretch of the road where the pipes are being laid. Acceptable road signs and night- lights should be maintained during the work period.

The contractor should keep the de-watering pumps operated and the pumped water should be diverted to suitable point as directed by the engineer.

Where soil is not suitable for laying pipes, the selected fill material should be placed 400 mm deeper than the specified inverted level and the bedding should be placed in 100 mm thick layers under the pipe. Each layer should be compacted to the satisfaction of the engineer. The thickness of layers for compaction above the pipe should not be more than 150 mm. The engineer will decide if the excavated material is suitable for backfill and in which case the contractor should sieve the excavated material.

Trenches shall be excavated to the minimum width necessary to suit the outside diameter of the pipe plus the clearance either side to the trench walls. For smaller diameter pipes this will be less than the minimum width necessary for the work of installing pipes in the trench, particularly in deep excavations. A minimum trench width of 600 mm shall be used and the maximum width under normal conditions should be as follows:

| <b>Pipe Size</b>                               | <b>Min Trench Width</b> | <b>Max Trench Width</b> |
|--|-------------------------|-------------------------|
| Less than 150 mm ( inclusive) nominal diameter | 450 mm                  | 750 mm                  |
| 200 mm nominal diameter                        | 500 mm                  | 800 mm                  |
| 300 mm nominal diameter                        | 600 mm                  | 900 mm                  |

However for deeper depth, and/or larger diameter of pipe, and where required excavation width, will be more than above specified, so that to have sufficient working space while laying. Excavation width should be more than above specified where Valves, hydrants and other specials and fittings to be laid or

installed and sufficient working space should be provided or made where required.

Stepped trenches may be excavated to provide adequate working space over the pipeline, whilst still permitting pipes to be laid in minimum width trenches.

Trenches shall be carefully excavated to the width specified in the design and any soft spots removed from the bottom. All voids, whether due to the removal of soft spots or over-excavation shall be refilled along with any natural material on which the pipes will be bedded.

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## **2.2 Sheet piling and Shoring**

Excavation for trenches shall be sheeted, braced and shored as necessary to prevent caving or sliding.

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## **2.3 De-watering**

The contractor shall provide and maintain adequate de-watering equipment to remove and dispose of all surface and ground water entering excavations, trenches or other parts of the work as approved by the Government Authorities and copies of such approvals shall be submitted to Employer. The trench shall be kept dry during sub-grade preparation and continually thereafter until the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, floatation, or other cause will result.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damages to the adjacent property.

Dewatering shall be carried out with liaising to relevant Government authority and as per the government regulations. A copy of approval letter / certificate shall be submitted to Employer.

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## **2.4 Backfilling of Trenches**

Backfilling shall be undertaken as soon as practicable after the specified operations preceding it, have been completed. Backfilling should not be commenced until the works to be covered have been completed to the extent required by the Employer.

Compacted backfilling will be required for the full depth of the trenches. The backfill shall consist of uniform, readily compatible materials and shall not contain materials deemed unsuitable as directed by the engineer. At least up to 300mm above the top of the pipe only selected soil or fill materials shall be deposited in 150mm layers and thoroughly compacted using an appropriate mechanical compactor. Particular care shall be taken to avoid damages to the pipe. The remainder of the refilling may consist of coarse materials, which shall be spread in layers of not more than 250mm and compacted as above.

Where the excavations have been supported and the supports shall be removed these shall be withdrawn progressively as backfilling proceeds in such a manner so as to minimize the danger of collapse. All voids behind the supports shall be filled and compacted.

Backfilling shall commence as soon as the work of constructing the pipeline has been completed, but not before the work has achieved sufficient strength to withstand all loads imposed by backfilling. All excavation and backfilling shall be co-ordinate with construction of the pipeline so as to expedite completion with minimum disruption. Backfilling of a trench shall be carried out after inspection of the trench by the Engineer (Employer)

For pipes bedded on the trench bottom, or on a sand or granular bed, selected backfill material free from vegetable matter, building rubbish, stones, etc. shall be placed in unconsolidated layers of 150 mm thickness, and then uniformly compacted.

Backfill used above the selected backfill layer shall be to the approval of the Employer, or others responsible for the upkeep of roads, and will usually be the excavated material.

Contractor should arrange local sand in case of insufficient sand in the excavated area. Well compacted back filling should reach at least 95% of Maximum Dry Density.

Backfilling around manholes and inspection chambers shall be undertaken in such a manner that will avoid damage or uneven loading.

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## **2.5 DISPOSITION OF EXCAVATED MATERIALS**

Subject to any specific requirements of the Contract, the disposition of excavated material shall be at the Contractor's discretion but shall be so arranged as to suit the overall requirements for the construction of the Works.

The Contractor shall ensure that no excavated material which is suitable for or is required for re-use in the Works is disposed of outside of the site.

Temporary spoil tips may be used to store excavated material as required, and shall be arranged by the Contractor.

Excavated material which is surplus to requirements or is unsuitable for re-use in the Works shall be disposed off-site either to locations to be found by the Contractor (Contractor's tip) or to locations designated by the Engineer (Engineer's tip). Materials ordered to be disposed of to the Contractor's tip shall become the Contractor's property and he shall be entirely responsible for its disposal. Material ordered to be disposed of to the Engineer's tip shall remain the property of the Employer.

### **3. CONSTRUCTION OF SEWER PIPE LINES**

#### **3.1 General**

##### **3.1.1 Bedding**

The bedding for pipes shall be constructed by spreading and properly compacting suitable granular bedding materials over the full width of the trench. For normal bedding the trench bottom shall be given a final trim and shape so that the pipe will be uniformly bedded on the required grade. Any stones or flints likely to damage the pipe or its coating shall be picked out of the pipe bed, and any hole so formed shall be filled with soft material and trimmed to the correct level.

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##### **3.1.2 Pipe Laying**

All laying shall be carried out according to the standard code of practice.

The pipe shall be laid directly on the selected bedding materials properly compacted to the satisfaction of the Engineer.

Pipes shall be accurately laid + in perfectly straight lines and true gradients in accordance with the plans and sections shown on the drawings or as otherwise directed by the engineer.

Pipes shall be embedded properly by placing embedment materials and shall be protected from lateral displacement during embedment operations.

Bricks or other hard materials shall not be placed under the pipes for temporary support except where a concrete bed is to be provided.

After backfilling 300 mm above crown of the pipe, contractor shall lay acceptable warning tape above all pipes.

Wherever pipe laying is stopped, the open end of the pipe shall be closed with an end board closely fitting the end of the pipe, to keep sand and earth out of the pipe. The end board shall have several small holes near the centre to permit water to enter the pipe and prevent flotation in the event of flooding of the trench.

Whenever pipes are laid directly on the trench bottom or on a sand or granular bed, depressions shall be formed in the bedding at the pipe joints to ensure that the pipe is uniformly supported throughout the length of its barrel.

While laying pipes, no tensile stress shall be applied to pipes previously laid.

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##### **3.1.3 Pipe Installation**

Pipes and fittings shall be carefully examined for cracks and other defects immediately before installation.

The interior of all pipes and fittings shall be thoroughly cleaned of foreign matters before being installed and shall be kept clean until the work has been accepted.

Precautions shall be taken to prevent foreign materials from entering the pipe during installation.

Water shall not be permitted to accumulate in any part of the trench during installation and testing.

The Contractor shall strictly follow manufacturer's instructions in laying and jointing pipes and fittings.

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#### **3.1.4 Reaction Anchorage and Blocking**

All exposed piping with mechanical couplings, push-on or mechanical joints, or similar joints subject to internal pressure shall be blocked, anchored, or harnessed to preclude separation of joints. All un-lugged bell and spigot or all bell tees, Y-branches, bends deflecting 1 1/4 degree or more, and plugs or caps, which are installed in buried piping subjected to high internal hydrostatic head, shall be provided with suitable reaction blocking, anchors joint harness, or other acceptable means for preventing movement of the pipe caused by internal pressure.

Reaction blocking shall extend from the fitting to solid undisturbed earth and shall be installed so that all joints are accessible for repair.

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### **3.2 Installation of UPVC Sewer Pipes**

UPVC pipes and fittings shall be installed strictly in accordance with the Manufacturer's instruction. UPVC pipes shall not be bent to accommodate changes of direction.

Pipe shall be cut from measurements taken at the site and shall be cut in a neat manner, without damage to the pipe or to the lining. Cuts shall be smooth, straight and at right angles to the pipe axis. All pipe cutting shall be done with a fine toothed hacksaw or a portable power driven saw with a steel blade or abrasive discs. Cut end shall be beveled using a plastic pipe-bevelling tool, which cuts the correct taper automatically. Methods of cutting and bevelling the pipe shall be acceptable to the Engineer.

Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed.

Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying except when reverse laying is permitted by the Employer.

Socket pipes shall be laid singly with the sockets uphill unless shown otherwise on the drawing and each spigot end shall be pushed into the next socket so that the space between the surfaces of the joint is one thirtieth of the internal diameter of the pipe or 10mm whichever is less. This space shall be established by marking the spigots or by other approved means.

Joint preparations and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are

pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe. The position and condition of each rubber gasket (unbounded gaskets) shall be checked with a feeler after the joint is completed.

### **3.3 Connection of new works with existing works.**

Connection between new work and existing pipes and junctions or manholes shall be made under conditions which will least interfere with service to users. Where pipe has to be connected to the existing manholes or junctions the opening, if required, for pipe connection shall be made as directed by the engineer. Approved leak proof cement shall be used for such installation or connection of pipes and shall be carried out as directed by the engineer.

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### **3.4 Pipe works to concrete fixings**

Pipes and fittings passing through or into concrete shall be grip bonded in order to get a satisfactory bond with the concrete. This is achieved by painting the surface with solvent cement and whilst it is wet, sprinkling with dry course sand or grit. Once the surface is dry, it is ready to bond directly to concrete.

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### **3.5 Pipe Flexibility**

Unless noted otherwise on the drawings pipes passing out of or into manholes, and under or from under structures, shall have their first flexible joint at a position not greater than one pipe diameter from the manhole or vertical line through the face of the overlying structure.

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### **3.6 Junction and drain Connections**

All junctions are to be oblique and unless the connection is to be laid at the time the junction is laid, are to be fitted with suitable stoppers obtained from the manufacturer of the pipe.

No saddles shall be used except with the prior approval of the engineer, which will only be given exceptional circumstances. If the contractor omits to lay a junction as directed, then the engineer may require the necessary pipe or pipes to be taken out and replaced with the proper junction all at the Contractor's expenses.

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### **3.7 Testing**

#### **3.7.1 General**

A gravity sewerage system shall be tested in separate sections, each section being the complete sewer length between manholes. Testing may be either by the application of air or water pressure.

Each section shall be tested progressively by the Contractor during construction, each time two pipes are laid. An air test is the most convenient for this. No backfilling of trenches shall be carried out until a successful test has been completed on the pipes to be backfilled.

After backfilling, complete sections between manholes shall be tested under the

inspection of the Engineer.

### **3.7.2 PRECAUTIONS PRIOR TO TESTING**

All open ends and connecting branches in gravity sewers shall be stopped with suitable plugs or caps, before testing commences.

Prior to testing of sewers, the internal surfaces of pipes and inspection chambers shall be thoroughly cleansed. Previously cleansed and tested sewers, or existing live sewerage systems, shall not be used to drain water and matter from sewers being cleansed.

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### **3.7.3 Acceptance tests**

Each reach of sewer shall meet the requirements of the following acceptance tests which shall be carried out by the Contractor before backfilling.

- a) Leak tests (Manholes / Inspection chambers/Catch pits)
- b) Alignment (Pipe line)
- c) Levels (Manholes/Inspection chambers & Pipe line)
- d) Conditions and stability of bed.

Testing of sewer pipe line shall be carried out from manhole to manhole

After back filling appropriate tests shall be made, if required by the Employer, to determine whether the finished work meets the specified requirements.

If the test is unsatisfactory, the contractor shall make good any defects and shall retest the pipes until a satisfactory test has been carried out.

The contractor shall provide water, apparatus and materials for testing and subsequent detection of leaks. The water used for testing shall not be saline.

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### **3.7.4 Exfiltration**

After completing the installation of a sewer line or section of the line, and before backfilling of the line, an exfiltration test shall be carried out on each reach of sewer between manholes. Individual or multiple reaches may be tested at one time as approved by the engineer.

Exfiltration shall be conducted by blocking off all manhole and Y branch openings, except those connecting with the reach being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Each manholes shall be subjected to at least one exfiltration test.

During the exfiltration test, the average water depth above the pipe invert shall be 2000 mm or the full depth of the upper manhole.

The total exfiltration shall not exceed 30 litres per mm of nominal diameter per km of pipe per day for each reach tested. For purposes of determining maximum allowable leakage, manholes shall be considered sections of 1200 mm pipe. The exfiltration tests shall be maintained on each reach for at least 2 hours and as much longer as necessary, in the opinion of the Engineer to locate all leaks.

The contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, together with equipment

and materials required for the tests. The methods used and the time of conducting exfiltration tests shall be acceptable to the Engineer.

All water required for cleaning and for flushing shall be furnished by the contractor at his own expenses.

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### **3.7.5 AIR TEST FOR GRAVITY SEWERS**

Air testing shall be carried out using a U -tube connected to the pipeline. A pressure of 100 mm head of water shall be applied for a period of five minutes and the line shall be accepted if the air pressure remains above 75 mm head of water after this time.

Failure to pass the air test shall not preclude acceptance of the pipeline if a successful water test can subsequently be carried out in accordance with the specification.

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## **3.8 Cleaning of Pipelines, Manholes & Inspection Chambers**

Immediately before pipelines and manholes and other works are taken over by the Employer the contractor shall, at his own expense, rod out and flush all sewers and manholes, and wash out all rising mains and other pipe work to ensure that there are no obstructions. The contractor shall make good any defects located to the satisfaction of the engineer. The contractor shall also, in presence of the Engineer's representative, pass a loose plug through the whole of the pipelines in order to ensure that they are entirely clear of obstruction and that the invert is smooth. The loose plug shall be in the form of a cylinder, made of timber not less than 25 mm thick or any other material approved by the engineer, and the outside diameter shall be 25 mm less than the pipe diameter or one tenth of pipe diameter whichever is the lesser and its length shall not be less than its diameter. The whole cost of providing the plugs and carrying out this work shall be borne by the contractor.

All pipelines conveying water or wastewater installed under this contract, including all valves and fittings installed therein, shall be flushed or cleaned to the satisfaction of the engineer. Flushing shall precede disinfection for potable water piping and valves.

Potable water shall be used on the potable water system only. No cross-Connection condition shall be allowed on the potable water system at any time.

Small pipelines shall be flushed with water at the maximum velocity which can be practically developed. The flushing velocity shall be at least one meter per second, unless otherwise permitted by the engineer.

Booster pump shall be used if required to obtain the necessary volume or velocity of water.

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## **3.9 MANHOLES AND INSPECTION CHAMBERS**

### **3.9.1 Installation of HDPE Plastic Manholes and Inspection Chambers.**



HDPE manholes and inspection chambers shall be installed strictly in accordance with the Manufacturer's instructions.

The bedding for HDPE manholes and inspection chambers shall be of 75 mm thick lean concrete of mix ratio 1:2:6 by volume.

The backfilling of earth around the PVC Inspection chambers / Catch pits or HDP manholes shall be in 150mm thick layers properly compacted with a mechanical vibrator.

Contractor shall make necessary drilling and making holes in Manholes and Inspection chambers and Catch pits to connect sewer pipe line.

All catch pits, inspection chambers and Manholes shall be confirmed as leak proof structure by performing leak test. Contractor shall bear the cost of performing such successful leak test. Water Proofing Compound shall be applied after performing successful leak test.

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### **3.9.2 HANDLING**

The Contractor shall exercise care in handling pipes so as to avoid damage, particularly to pipe ends. The loading and unloading of loose pipes shall be carried out by hand, avoiding the use of skids. Metal slings, hooks and chains shall not come into direct contact with the pipes, and they shall not be dropped onto hard surfaces or dragged along rough ground.

When pipes have fixed sockets at one end, the socket ends shall be placed at alternate ends of the stack with the sockets protruding so that the pipes are evenly supported along their entire length.

UPVC pipes and fittings shall be stored under cover out of direct sunlight,

### **3.10 CONCRETE WORKS**

#### **3.10.1 Cement**

All cement used for Sump well shall be **sulphate resistant cement**. Cement shall be Ordinary Portland Cement confirming to B.S. 12 for all works. Other kinds of cements shall not be used unless otherwise approved by the Employer in writing.

#### **3.10.2 Aggregate**

Course aggregates shall be clean well graded imported granite chips ranging in average size from 5mm to 20mm. Fine aggregate shall imported river sand or quarry sand.

#### **3.10.3 Water**

Water shall not contain injurious amounts of impurities which may adversely affect concrete and reinforcement. Portable fresh water shall be used for all

concrete works and curing. Saline Water Shall not be allowed for any Construction Work or Curing Purpose.

#### **3.10.4 Specified Design Strength.**

The specified design strength of concrete shall be not less than 20N/mm<sup>2</sup> unless otherwise specified.

#### **3.10.5 Water Cement Ratio.**

Water-Cement Ratio of all concrete shall be 0.4 to 0.5 by weight.

#### **3.10.6 Mix and Mix Ratio**

All mixes shall be by concrete mixer.

Fine and course aggregate shall be measured by volume unless otherwise specified. The mix ratio for all concrete shall be as instructed by Employer

#### **3.10.7 Quality Inspection of Concrete**

The contractor shall conduct tests on concrete to ensure its quality. In this respect contractor is required to make three test cubes of standard sizes and make arrangements for testing the strength in 7 days, 14 days and 21 days and approve the results from Employer.

#### **3.10.8 Consolidation**

The concrete shall be properly vibrated immediately after placing by means of a mechanical vibrator designed for continuous operation to ensure proper consolidation.

#### **3.10.9 Concrete curing**

After concrete has been placed the concrete surface shall be kept moist by spraying with water and shall be protected from the direct sunlight and rapid drying. The curing period shall not be less than 7 days.

#### **3.10.10 Construction of Form works**

Form work shall be sufficiently rigid and tight to prevent loss of mortar from the concrete and to maintain the correct position, shape and dimensions of the finished work. It shall be so constructed as to be removable from the cast concrete without shock or damage.

The form shall be capable of producing a consistent quality of surface as required and a neat finish shall be obtained.

Where holes are required to accommodate, fixing devices or other built-in items, precautions shall be taken to prevent loss of mortar matrix.

The interior of all forms shall be thoroughly cleaned out before any concrete is placed. The faces of the forms in contact with the concrete shall be cleaned and treated with a suitable agent where applicable.

Formwork shall be removed without shock to, or disturbance of the concrete.

## **. MASONRY AND RENDERING**

### **4.1 MATERIALS**

#### **4.1.1 Cement**

Ordinary Portland Cement shall be used as described under concrete work. White or coloured cement shall comply with the physical requirements of B.S 12.

#### **4.1.2 Water**

Water shall be as described under Concrete Works.

#### **4.1.3 Sand**

Sand shall be imported river sand, free from silt, quality to be approved by the Employer. For use in plastering, sand is to comply with the requirements of BS1198 Table 1.

#### **4.1.4 Blocks**

Blocks shall be solid blocks manufactured with cement and sand with no defects. The average compressive strength for the gross area of hollow blocks shall be not less than 25 kg/cm<sup>2</sup> and the minimum block shall be 20 kg/cm<sup>2</sup>.

### **4.2 MORTAR**

Mortar shall consist 1 part cement to 4 parts of sand by volume. For work not in contact with earth or sand, one part lime may be added to the mix. Mortar for pointing facing concrete blocks shall be prepared using white cement. When block work is constructed below ground level sulphate resisting cement shall be used.

Mixing shall be carried out by means of an approved mechanical mixer. The mortar shall be mixed dry until a uniform mix is obtained. Sufficient water shall then be added and the mixing continued until a homogenous mix is obtained. Excess water shall not be used in the mix.

All mortar shall be used before the initial set has taken place and on no account shall mortar which has commenced to set be remixed with water or new batches and used.

### **4.3 WORKMANSHIP**

Generally in accordance to BS 8000.

Block work shall be set out and built to the respective dimensions, thicknesses and heights shown on the Drawings and/ or as instructed in writing by the Employer

Blocks shall be laid in true and regular courses on a full bed of mortar of 10 mm average thickness, exclusive of any key in the jointing surfaces of the blocks. Sufficient mortar shall be used in bedding and jointing to ensure that all keys are solidly filled. Where blocks abut against

concrete each third course shall be tied thereto by means of approved galvanised steel ties. All horizontal joints shall be properly level. The Vertical joints shall be properly lined and quoins, jambs and other angles plumbed as the work proceeds. All walls shall be plumbed vertical.

#### **4.4 PROTECTION OF FINISHED BLOCKWORK**

The Contractor shall ensure that the finished block work walling is not damaged by subsequent operations.

The Contractor is to protect newly or partially built walling against it being dried out too rapidly by the sun's heat or from any other adverse climatic effects and is to follow the Employer's instructions in this matter.

#### **4.5 LINTELS**

Prefabricated lintels shall comply with the requirements of B.S 5977, Part 2. All lintels shall be bedded on cement and sand mortar and the Contractor shall allow for a minimum bearing at each end of 150 mm.

#### **4.6 PREPARATION OF SURFACES FOR PLASTERING**

Surfaces to receive plastering, beds and the like are to be dry brushed to remove all loose particles, dust, laitance, efflorescence and the like, any projecting fins on concrete surfaces shall be hacked off. All traces of mould oil shall be removed from concrete surfaces by scrubbing with water containing detergents and rinsing with fresh water.

#### **4.7 PLASTERING**

Internal plastering is to comply with BS 5492.

The plaster for use masonry wall is to be composed of 1 part cement, and 4 parts of sand, and is to be applied the finished stated thickness.

Plaster or render is to be mixed in clean buckets and gauge boxes. All tools are to be kept clean and fresh plaster or render is not to be contaminated with set plaster or render.

The working time permissible after the addition of water to the plaster or render mix is to be 30 minutes. Mixed plaster or render that has exceeded this limit is to be removed from the site and not re-tempered and used in the works.

The Contractor is to ensure that before plastering or rendering commences the junctions between differing base materials are reinforced with a strip of galvanised expanding metal lath secured at both edges. All angle beads and the like shall also have been fixed.

All Plastering shall be executed in a neat workmanlike manner and made good to wood frames, skirting, pipes, fittings and the like.

Plasterwork is to be finished with a smooth, trowelled face, free from blemishes and fit to receive decoration. Render is to be finished with a wood float.

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### **5. ALUMINUM DOOR AND WINDOWS**

#### **5.1 General**

All windows and doors are to be constructed by approved specialist suppliers of light, medium or heavy section to suit location, local building regulations, and particular requirements noted on the drawing as to weight and profile.

All frames should be made to fit the actual openings with a 5mm clearance all round.

Discrepancies in overall width or height exceeding 5mm will not be allowed and the frames will be rejected in such cases. Any small discrepancies shall have the gaps suitably backed and then filled with gun-applied water repellent mastic sealant.

All nuts, bolts, washers and screws used for assembly and fixing shall be of adequate strength for their purpose within the design and shall be stainless steel grade 18/8.

All sealants used in the assembly of, and in the fixing of cladding and window framing, shall be non-setting to allow thermal movement without detriment to those joint sealants used for peripheral caulking and shall be one part silicone sealant and shall conform to BS 4245 or ASTM C920. All spliced joints between mullions will be sealed with an approved silicone product, compatible with other sealants and packings used.

All ironmongery shall have the same finish as the frames and shall be approved by the Consultant.

## **5.2 Side hung windows, doors and ventilators**

All Windows and doors should be weather-stripped. The weather protection should be achieved by a positive compressive action against the section and should not depend on external contact. At every contact between two profiles two weather-stripping sections should be provided to complete weather protection.

The bottom sections for hinged doors must be capable of being adjusted vertically if necessary. The gap between the bottom section and the floor should be covered with a pair of special splay-type sections.

The shutters of the windows and doors should be assembled with concealed corners of high rigidity. Hinges should be concealed within the sections.

Hinges shall be anodised aluminium with stainless steel pins and nylon washers. Handles shall be anodised aluminium finished to match the aluminium sections and mounted with self-lubricating nylon washers.

Windows shall have anodised aluminium handles, colour as framing and a latching mechanism securing the shutter to the frame both at the top and bottom.

## **5.3 Workmanship**

Take site dimensions and submit Drawings as detailed elsewhere in these documents, showing elevations, plans and full size sections, proposed methods of fixing, proposed methods of forming joints, any proposals for fabricating large components in more than one piece.

Mechanical joints shall be tight with no visible gaps. Where screw heads will be visible after component is fixed, or raised screw heads would interfere with any moving part of component, use countersunk machine screws unless specified otherwise. Mechanical joints of components which will be located externally shall be bedded in bedding compound, including all mating surfaces, cleats and other fixings.

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# **6. METALWORK**

## **6.1 GENERAL**

### **6.1.1 Material**

Shape of steel shall be precise and straight and free of injurious scratches and rust.

All steel sections shall be of strength class 43 A.

Dimensions of steel section and tolerance of dimension shall confirm to standard dimensions of steel regulated in ASTM or BS standard.

## 6.2 FABRICATION

Section of each material shall be cut perpendicular to axis unless otherwise specified in the drawing or by the Consultant.

Cut section shall be free of any noticeable defect.

Deformation caused by cutting shall be corrected.

Those directed in the drawing shall be chiseled finish and completely attached.

Material shall be checked for bend, distortion, warp, etc. before fabrication.

## 6.3 QUALITY OF WORK

Metal work shall be fabricated carefully and accurately to ensure compliance with design and performance requirements, using types and grades of metal as specified for the purpose. The finished work must be free from distortion and cracks. Proprietary products shall be used to the recommendations of the manufactures.

Steelwork shall be fabricated and erected by competent, experienced persons and shall generally conform to B.S. 449: Part 2 - "Specification for the use off structural steel in buildings."

## 6.4 SHOP ASSEMBLY

The components parts shall be assembled in such manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers if any are provided.

All tubular members shall be sealed so as to prevent the access of moisture to the inside of the members.

## 6.5 BOLTING

Bolts shall be of sufficient length to have at least one complete thread projecting beyond the outer face of the nut when tightened up. Washers shall be provided in all cases.

Shape of bolts, nuts and washers shall be in accordance with the requirement of BS4190 and BS 3692.

Quality of bolt shall be SC 34 A

Spacing of bolt holes shall be as directed in the following table.

| <b>Diameter of Bolt</b> | <b>Standard pitch</b> | <b>Minimum Pitch</b> | <b>End Distance</b> | <b>Edge Distance</b> |
|-------------------------|-----------------------|----------------------|---------------------|----------------------|
| 12                      | 50                    | 50                   | 30                  | 25                   |
| 16                      | 50                    | 40                   | 40                  | 30                   |

Minimum pitch and end distance for light weight steel shall be more than 3 times and 2.5 times a bolt diameter respectively.

Diameter of hole shall not be over 0.5 mm larger than bolt diameter. However, for anchor bolt 5mm clearance shall be allowed between bolt diameter and diameter of hole unless otherwise specified.

Bolt hole shall either be drilled open or reamed after subpunching. Punching can only be permitted for a material thickness less than 13 mm.

Rolled edge around a hole shall be removed.

Position of a bolt hole shall be precise so that the center of all holes aligns.

Nuts shall be protected against loosing by concrete covering, double nuts or other proper means.

Shear bolt shall be provided with washers to keep the nut out side of grip.

## **6.6 WELDING**

### **6.6.1 General**

Arc welding rod shall conform to materials to be welded, and position.

Steel shall normally be welded by the metal arc process conforming to B.S. 5135. Other methods shall be subject to the approval of the Employer.

Welding of stainless steel, aluminium alloys, copper alloys, bronze etc. and brazing shall conform to the appropriate British Standard where specified, approval and testing of welders and welding procedures shall be as B.S. 4870, B.S 4871 and B.S. 4872. Surfaces to be welded shall be dry. When rain is falling or during periods of high wind, necessary precautions shall be taken to protect outdoor welding areas.

Welding shall be so carried out as to ensure that:

1. Welds will be of good clean metal deposited by a procedure, which will ensure uniformity and continuity of work.
2. The surfaces of the weld will have an even contour and regular finish and will indicate proper fusion with the parent metal.

Welder shall have an authorize qualification in Maldives and approved by the Consultant.

### **6.6.2 Welding Machine**

Arc welding machine shall be alternate or direct current type which provides sufficient and adequate current.

The field arc welding machine shall be provided with remote control for easy control of current.

### **6.6.3 Preparation**

Welding shall be done as much down wards as possible using a jig such as rotary frame.

Welding rod shall be always kept in a dry area and if necessary dried by drying equipment.

Welding surface shall be free of water, scale or others injurious to welding work. Slag appeared on the created surface in the middle of welding shall be cleaned before starting again.

### **6.6.4 Fabrication.**

Welding edge shall be smoothed by automatic gas cutting or other proper finishes.

### **6.6.5 Built-up**

Jig shall be used to keep mutual position of materials in assembly.

Temporary bolt hole for assembly shall be bored with approval of the Consultant.

Proper amount of construction, predistortion or restrain shall be added to welding parts to attain precise finish dimensions and shape.

Welding materials shall be properly met in fillet welds.

### **6.6.6 Tack**

Short bead shall be avoided for tack welding. The minimum length of tack welding shall be as follows. Plate thickness under 3.2mm Bead length over 30mm, from 3.2 to 25mm-40mm.

The end of joint, corner angle, beginning and ending point of final welding shall be avoided for tack welding.

#### **6.6.7 Work**

Type of welding rod, rod diameter, current, voltage and welding speed shall be selected in accordance with type of welding work.

Order of welding and movement of rod shall be determined so as that there shall be no deformation after welds.

Welding shall be carefully done in concealment in raining and strong wind.

#### **6.6.8 Finishes**

Surface of welds shall be as smooth as possible and size and length of welds shall not be less than designed dimensions.

Reinforcement of weld shall not exceed  $0.1s + 1\text{mm}$  (s: Designated size) in filled welds.

Welded parts shall be free of undercut, overlap, crack, blow hole, lack of welds, and lack of weld settlement, rolled up slag or other defects.

Crater at the end of bead shall be carefully heaped up and slag, sputter, etc. shall be completely removed after welds.

#### **6.6.9 Safety**

Safe scaffoldings shall be provided for the field welds work.

Welding facilities shall be such that there shall be no electric leakage or electric shock. There also shall be sufficient protection for fire.

Electric shock protection device shall be used and also care shall be taken not to get suffocated or intoxicated by gas when welding in small area.

#### **6.6.10 Inspection**

Welding parts shall be inspected before, during and after welding in accordance with work schedule.

#### **6.6.11 Correction**

Welding parts having injurious defects shall be removed and re-welded.

When deposited metals get cracked, at least 50mm from the edge of crack shall be cut off and re-welded.

When base metals get cracked, it shall be replaced.

Under cut parts shall be corrected by attaching deposited metal.

Injurious deformation left on welding materials shall be corrected or reinforced.

#### **6.6.12 Transportation**

While transporting materials, care shall be taken for preventing from defect.



### **6.6.13 Erection and Field Painting**

Material shall be stored on flat surface in order not to get distortion, twist or other defects. Correction shall be made to those distortion or twisted before erection.

Connection of materials by bolts, etc. shall be made after distortion on plumb is thoroughly corrected.

Temporary bracing or other reinforcement shall be placed to resist wind pressure or other loads erection.

Care shall be taken on all facilities so that there is no accident.

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## **7. PAINTING**

### **7.1 GENERAL**

The painting materials shall be obtained from an approved manufacturer and shall be supplied ready mixed in the manufacturer's sealed and branded containers. Each container shall bear the maker's brand name, identification of contents and directions for its proper use. All material must be thoroughly stirred before use. All painting work must be carried out according to paint manufacturer's instructions unless otherwise directed by the consultant. Appropriate primers and under coats shall be used on all surfaces to be painted.

All sealers, primers, undercoats and thinners shall be the products recommended by the manufacturers of paint used for the finishing coat.

The paint type shall be 'Nippon' or equivalent brand and the Consultant shall approve the colour before placing the order.

### **7.2 PAINT SPECIFICATION**

For interior apply Acrylic or similar alkali resisting primer sealer, apply putty grind by sanding to level uneven surfaces, finish with two coats of matt finish with acrylic copolymer emulsion paints.

For exterior apply Acrylic or similar waterproofing quality primer sealer, apply texture coat, and apply two coats of finish as per manufacturer's specifications. The exterior shall have textured paints finished appearance as granite finish.

Marine grade timber varnish for all timber doors, cupboard doors and other exposed timber members.

### **7.3 MATERIALS**

#### **7.3.1 Priming Paints**

Priming paints shall be the primer recommended by the manufacturer of the finishing paint or:

- ◆ For woodwork -lead-based or priming paint to comply with B.S 2521 and 2523.
- ◆ For steel work-red oxide priming paint to comply with B.S 2524.
- ◆ For galvanized, zinc or aluminium work- grey zinc chromate priming paint.
- ◆ For concrete, block work, plaster, plasterboard and the like- alkali priming paint.

#### **7.3.2 Undercoating**

Undercoating shall be:

- ◆ Zinc oxide based undercoating paint.
- ◆ White lead based undercoating paint in accordance with B.S 2525-7. Colours shall approximately match the finishing paint.

- ◆ Synthetic alkyd based undercoating in accordance with the recommendations of the paint manufacturer.

### **7.3.3 Finishing Paints**

Finishing paints shall be as otherwise specified.

## **7.4 WORKMANSHIP**

### **7.4.1 General**

The Contractor shall carry out all tests necessary for determining the colours and shades of the finishes and the appropriate methods of application. Sample panels shall be completed in accordance with Consultant's instructions.

All work shall be performed in accordance with the manufacturer's written instructions.

Before application of any paint or finish all surfaces shall be cleaned, dried and prepared as specified hereinafter, all to the Consultant's approval, no work shall commence until this approval is given in writing to the Contractor.

No exterior or exposed painting shall be carried out under adverse weather conditions such as rain , extreme humidity, dust storms, high temperature of surface etc.

All coating shall be well applied, leaving no sags, laps, brush or other defects. Each coat must thoroughly dry before next coat is applied. All work must be carefully cut into a true line and left smooth and clean.

### **7.4.2 Painting to Concrete, Block or Plaster**

Concrete, block work and plaster surfaces to be painted or decorated shall have all cracks cut out and made good to the satisfaction of the Consultant.

Plasterboard surfaces shall have taped joints and the surface puttied to the satisfaction of the Consultant. The surfaces shall be completely dry and shall be brushed free of impurities immediately prior to the commencement of the painting work.

Efflorescence shall be completely removed by rubbing down with dry coarse cloths followed by wiping down with damp cloths and allowed to dry. All surfaces shall be rubbed down with fine glass paper and brushed free of dust before applying any form of decoration.

Concrete block work and plastered surfaces which are to receive paint shall be given one thin coat of oil putty and allowed to dry for at least two days. The surfaces shall then be rubbed down with fine glass paper and given a second thin coat of oil putty and when completely set shall be rubbed down again with fine glass paper before applying the painting system.

Emulsion paint shall be applied by brush or roller and shall consist of primer and two full coats of paint.

Oil paint shall be applied by brush or roller and shall consist of a priming coat, two undercoats and one finishing coat of paint.

### **7.4.3 Painting to Metal work**

Steelwork delivered to the Site unprimed shall be cleaned of impurities, scrapped and wire brushed to remove rust and painted with one coat of priming paint applied by brush.

Steelwork delivered to Site primed shall be cleaned of impurities and damage to the priming paint and made good with priming paint.

Galvanized metalwork to be painted shall be cleaned of impurities. Where rusting has occurred the rust shall be removed by wire brushing and made good with an approved rust inhibitor. The

surfaces shall be coated with a mordant solution, washed with clean water and painted with two coats of priming paint applied by brush.

Metal which is concealed shall be prepared and primed as above and shall be painted with two priming coats and one finishing coat of paint applied by brush.

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## 8. FIBRE GLASS LINING

### 8.1 GENERAL

All fibre glassing works shall be done according to manufacture's instructions.

During the entire operation the sump shall be kept completely dry by taking appropriate measures.

### 8.2 Methodology

- \*Prepare the area for accepting the fiber coat with dry, clean and remove all the loose particles, dust etc.
- \*Prepare and mix the resin with harder
- \*immediately apply the resin to the prepared surface
- \*Before hardening the resin, fix the fiber mat to the surface (two layers)
- \*Apply the resin over the mat
- \* Roll the steel roller (thread faced small roller) above the resin
- \*After drying the resin prepare for Gelcoat (It is required to avoid the losing of fiber strips and make smooth surface)
- \*Prepare and mix the Gelcoat with harder
- \*Apply the Gelcoat and finished smooth.

**Note: Contractor should submit the methodology and take prior approval for material and methodology before commence the work.**

Fiberglass material specifications are as below.

| Material                   | Brand                          |
|----------------------------|--------------------------------|
| Gel Coat                   | Cylanolup or Any reputed brand |
| Polyester Resin            | Any reputed brand              |
| Hardener                   | MEKP or Any reputed brand      |
| Acetone                    | Any reputed brand              |
| Chopped Strand Mat – 450 g | Any reputed brand              |