**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

### 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.

**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.

**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.

**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.

**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

**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.

**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.

### 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.

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.

**1.23 ENVIORENMENTAL PROTECTION**

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

**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.

**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:

|  |  |  |
| --- | --- | --- |
| **Pipe Size** | **Min Trench Width** | **Max Trench Width** |
| Less than 150 mm ( inclusive) nominal diameter | 450 mm | 750 mm |
| 300 mm nominal diameter | 500 mm | 800 mm |
| 400 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.

**2.2 Sheeting and Shoring**

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

**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.

**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 reminder of the refilling may consist of course 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.

**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 it's disposal. Material ordered to be disposed of to the Engineer's tip shall remain the property of the Employer.

**3 CONSTRUCTION OF PIPE LINES**

* 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.

* 1. **PIPE LAYING**

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

Pipes shall be laid directly on the selected bedding materials properly compacted to the satisfaction of the Employer.

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

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 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.

* 1. **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.

* 1. **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 11 ¼ 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.

**3.5 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,

**4 STORM WATER PE PIPELINE**

**4.1 LAYING AND INSTALLATION WATER PIPELINES**

All laying and installations shall be carried out as specified in Clause 3.

**4.2 PIPE JOINTING AND WELDING**

All pipe jointing and welding and pipes will have to be laid by the Contractor.

**4.3 PRESSURE TESTING WATER NETWORKS (PIPELINES)**

The Water mains shall be tested after laying and before backfilling by carefully filling the main with clean water, taking care that all air is expelled from the main. An accurate clearly readable pressure gauge shall then be connected to the main together with a pump and the pressure in the main shall be raised to 60m head of water or 1.5 times the working pressure in the main, whichever is the greater. The Pump shall be then disconnected for a period of at least two hours, after which the pump should be reconnected, its container filled with water to a specified mark and pumping carried out until the pressure rises again to the test pressure. Valves shall be tested by applying a pressure not less than working pressure to one side of the closed valve to prove that the valve is sealing properly.

The amount of water used from the pump container must be measured and the test shall be considered unsatisfactory if the amount of water consumed is more than specified below.

An objective for apparent loss due to such factors is 2 liters per meter of nominal bore, per kilometer length, per meter head per 24 hours of test pressurization.

Q = 2(liters) x diameter (m) x length (km) x head (m) per day.

Where Q equals to measured volume of make up water in liters.

|  |  |
| --- | --- |
| Nominal Dia. Of Pipe (mm) | Loss in liter/km length/head(in m)/day |
| 200 | 0.25 |
| 350 | 0.35 |
| 400 | 0.45 |

Allowable loss in water line is as follows.

If the test is unsatisfactory, the Contractor shall examine the pipe joints and fittings and make good any defects and shall re-test the pipes in the same way until a satisfactory test, witnessed by the Employer, has been carried out. Any pipes, fittings or joints broken under pressure shall be taken out and replaced at the Contractor’s expense.

The Contractor must provide for the testing and subsequent detection of leaks, if any, all necessary stoppers, caps, pumps, accurate gauges, supports, water and other necessary apparatus and materials which must be of a type approved by the Employer.

Before any test is carried out all changes of direction in the pipelines, junctions, stopped ends and the like shall be securely anchored so that no moment can take place under the test pressure.

**5. CONSTRUCTION OF uPVC PIPE LINES**

* 1. **General**

**5.1.1 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.

**5.1.2 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 it's barrel.

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

**5.1.3 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.

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

**5.1.4 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 11 ¼ 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.

# 5.2 Installation of UPVC Pipes

UPVC pipes and fittings shall be installed strictly in accordance with the Manufacture’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.

**5.3 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.

**5.4 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.

**5.5 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.

**5.6 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.

**6. COLLECTING TANKS AND CATCH PITS,**

**6.1 Construction of RCC Collecting tanks and RCC Catch pits,**

Steel Grating Cover for catch pits shall be installed strictly in accordance with the Manufacturer’s instructions.

The backfilling of earth around the tanks / Catch shall be in 150mm thick layers properly compacted with a mechanical vibrator.

Contractor shall make necessary drilling and making holes in tanks and Catch pits to connect gravity 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.

Testing and commissioning of above works

**6.2 Construction of BIOSWALE,**

Bio swales must be excavated during dry weather and install the overflow outlet pipes and the fill with the media up to the proposed final elevation. A non -woven geotextile screen shall be loosely placed overlaying sand slope surface with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Care must be taken during installation so as to avoid damage occurring to the geotextile as a result of the installation process. Atmospheric exposure of geotextiles to the elements following lay down shall not exceed 7 days. Successive sheets of geotextiles shall be overlapped a minimum of 350 mm (unless stated otherwise in the drawings), with the upstream sheet overlapping the downstream sheet.

During construction contractor must be cautious to keep the sediments out from the infiltration as much as practicable. As soon as the grading is complete, slopes should be stabilized to reduce erosion of native soils. Local vegetation such as sea lettuce ( magoo), Ironwood ( kuredhi) or Octopus bush ( Boashi) must be vegetated as soon as possible following the completion of grading.

Preventing and alleviating compaction are crucial during construction of the infiltration practices, as compaction can reduce the infiltration rates in sandy soils. Contractor must keep heavy construction equipment away from excavation bottom to avoid compaction. Tracked vehicles should be used to reduce the pressure applied to the soil. Drivable mats can be used for backfill and grading to minimize the compaction. During the final pass with the excavator bucket ( i.e bottom of excavation ) , it is highly recommended to rake the soil with the teeth of the bucket to loosen any compaction.

**7. Concrete works**

**7.1 Cement**

##### Cement shall be Ordinary Portland Cement Grade 52 confirming to B.S. 12 for all works. Other kinds of cements shall not be used unless otherwise approved by the Employer in writing.

**7.2 Aggregate**

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

**7.3 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.

**7.4 Specified Design Strength.**

The specified design strength of concrete shall be not less than 40N/mm2 unless otherwise specified.

**7.5 Water Cement Ratio.**

Water-Cement Ratio of all concrete shall be 0.4 to 0.5 by weight and concrete mix design must be approved by the project consultant.

**7.6 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

**7.7 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 and 28 days and approve the results from Employer.

**7.8 Consolidation**

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

**7.9 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.

**7.10 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.