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ARAB ENGINEERING BUREAU

12 GRIT REMOVAL EQUIPMENT

12.1 GENERAL

12.1.1 Scope

- 1 This part specifies the requirement for the design, manufacture, construction, installation, testing and commissioning of grit removal equipment.
- 2 Related Sections and Parts are as follows:

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| Section 1 | General |
| Section 8 | Drainage Works |
| Section 10 | Instrumentation, Control and Automation |
| Section 13 | Building Electrical Works |
| Section 21 | Electrical Works |

12.1.2 References

- BS 970 (ISO 683) Specification for wrought steels for mechanical and allied engineering purposes; (ISO 683-1 Heat-treatable steels, alloy steels and free-cutting steels — Part 1: Non-alloy steels for quenching and tempering; ISO 683-2 Heat-treatable steels, alloy steels and free-cutting steels — Part 2: Alloy steels for quenching and tempering; ISO 683-3 Heat-treatable steels, alloy steels and free-cutting steels — Part 3: Case-hardening steels; ISO 683-4 Heat-treatable steels, alloy steels and free-cutting steels — Part 4: Free-cutting steels; ISO 683-5 Heat treatable steels, alloy steels and free-cutting steels — Part 5: Nitriding steels; EN 10250-4: Open die steel forgings for general engineering purposes - Stainless steels; EN 10095 Heat resisting steels and nickel alloys; BS PD 970 Wrought steels for mechanical and allied engineering purposes. Requirements for carbon, carbon manganese and alloy hot worked or cold finished steels; EN 10089 Hot rolled steels for quenched and tempered springs. Technical delivery conditions; EN 10277 Bright steel products. Technical delivery conditions; EN 10278 Dimensions and tolerances of bright steel products; EN 10088-1 Stainless steels - List of stainless steels; EN 10088-3 Stainless steels - Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes)
- EN 10084Case hardening steels - Technical delivery conditions; (ISO 683-3 Heat-treatable steels, alloy steels and free-cutting steels — Part 3: Case-hardening steels)

List of 'Approved Suppliers' prepared by the Public Works Authority

12.1.3 Submittals

- 1 In addition to the requirements of Part 1 of this Section, the Contractor shall reconfirm the information provided in the Technical Submission Schedules submitted with his Tender.

12.2 PRODUCTS

12.2.1 General

- 1 Grit removal equipment shall comprise vortex grit separators, sized to achieve the specified operating criteria and each shall operate in conjunction with a grit classifier.

- 2 The Contractor shall make his own assessment of the amount of grit which will be produced by his equipment and the design of the grit handling systems shall be sized accordingly.
- 3 Grit separators shall be complete with all necessary ancillary equipment and controls.
- 4 The plant shall be controlled by PLC suitable for SCADA and telemetry connection and shall incorporate a Human Machine Interface (HMI) within a dedicated Motor Control Centre (MCC).
- 5 An interlock shall be provided between the grit removal device and the grit classifier.

12.2.2 Hydro Dynamic Separator

- 1 The grit separator shall be designed to efficiently remove grit from waste water inflows to protect downstream components of the Treatment Plant. They shall utilise the special characteristics of controlled hydro dynamic flow, to separate settleable solids and operate at high hydraulic loadings to minimise facility space requirements.
- 2 The separator shall have no moving parts and require no maintenance. Grit separation shall be accomplished entirely by the unit geometry and hydraulic flow regime. The tangential inlet and overflow design shall ensure that vortex flow develops and that no short circuiting through the unit can take place.
- 3 The flow shall enter through the tangential bottom inlet pipe, spiral and rise through the separator, flows through the annular opening created by the conical section and the overflow floor, over the overflow weir and out through the de-gritted overflow pipe or channel.
- 4 Grit and other settleable solids shall drop to the sloped bottom and be concentrated into the unit sump. The concentrated grit shall be removed from the sump using a grit pump or airlift pump.
- 5 A tangential inlet shall induce a vortex flow pattern within the separator hence creating ideal conditions for the potential currents of a vortex funnel. The resulting flow patterns shall be well defined and low in turbulence leading to favourable conditions for grit settling.
- 6 A conical section extending into the interior of the vessel shall be used to stabilise the secondary currents and increased the boundary surfaces to induce further grit settling.
- 7 The collected and concentrated grit in the sump shall be pumped to a screw classifier which shall be used to wash and classify the grit in order to minimise organic solids concentrations in the grit discharge.
- 8 All internal parts and weirs shall be stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084).

12.2.3 Vortex Grit Separator

- 1 The circular tank grit trap shall be supplied complete with geared motor, gearhead assembly, impeller drive tube, impeller, air blower and airwash/airlift assemblies.
- 2 The grit trap shall be designed such that the headloss is less than 7mm. The design shall be capable of removing grit from screened sewage and depositing grit into the grit classifier.
- 3 The grit removal chamber shall have inlet and outlet separated by greater than 270° of the tank periphery. There shall be a sloping floor connecting the upper and lower sections.
- 4 The grit removal device shall be fitted with a rotating impeller. The impeller shall be manufactured in two halves and shall be clamped to the drive tube when fully assembled. The stub shaft should not have any supporting bearings under the water and should be hanging from the gear head assembly.

- 5 The impeller shall be fitted with four fixed blades set at an angle of 30° and provide sufficient washing action to prevent lighter solids entering the classification gap between impeller and grit hopper whilst allowing settled grits through for collection.
- 6 The impeller blades shall create a slight upward flow in the central zone of the upper chamber whilst leaving the outer annulus of the upper chamber quiescent to allow grit settlement.
- 7 The impeller shall be driven by a helical geared motor with a service factor of 2.0 or greater. The geared motor shall be fully weatherproofed and shall be oil lubricated and the drive shall incorporate a slewing ring bearing and helical spur gearing transmission. Torque limiter to be provided for protecting the drive unit.
- 8 An airwash/airlift assembly shall be provided to facilitate grit washing and removal. The assembly shall consist of an airlift pump discharge pipe, minimum 100mm diameter, with airwash and airlift headers. Separate air supply lines consisting of minimum 38mm diameter pipe shall connect to the airwash and airlift header. The airwash header shall discharge an adequate quantity of air for air washing of the collected grit. Each air delivery line shall terminate above the drive gear head and connected to a three way ball valve, minimum 38mm diameter, with automatic operation.
- 9 The Contractor shall supply a displacement blower and pipework to provide air for the airwash/airlift operation. The blower shall have the capacity to provide sufficient quantities of air at the required pressure to ensure efficient operation of the airwash/airlift system.
- 10 All internal parts and weirs shall be stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084).

12.2.4 Cross Flow Grit Removal

- 1 Cross Flow Grit Removal Equipment shall be designed to achieve an optimum sewage velocity to enable the complete satisfactory settlement of the specified fine grit particles.
- 2 Each arm assembly shall be equipped with a sufficient number of scraper flights such that they will be capable of removing up to 50 mm of grit from the floor of the grit settlement tank into a grit sump.
- 3 The Contractor shall supply and install all the equipment necessary for its operation inclusive of bridge, scraper arms, drive assembly, inlet guide vanes, tubes, pipes, grit pump and fixings etc.
- 4 The plant shall be designed for installation in a circular flat-bottomed tank.
- 5 The approach velocity into the detritor shall be 1.2m/s with a maximum horizontal velocity across the tank not exceeding 0.3m/s unless stated otherwise in the Contract Documents.
- 6 The inlet shall span the diameter of the tank and be equipped with inlet deflectors which shall evenly distribute the flow across the whole width of the tank. The deflector support channels, spindles and sleeves complete with concrete guide vanes shall be supplied and installed by the Contractor.
- 7 The bridge structure shall be constructed from stainless steel section braced together. The beams shall be designed to withstand the total loadings imposed by the bridge and its associated equipment plus a super-imposed load of 250kg/m² (equivalent to two men) without exceeding a total deflection of 1/360 of the bridge span.
- 8 The access walkway shall comprise stainless steel non-slip floor plates fixed to the bridge structure and supporting double row handrailing which shall comply with Section 8 Part 6.
- 9 The centre bearing assembly shall be designed to withstand the total loading of the rotating scraper arms and other forces associated with the plant in operation.

- 10 The scrapers shall be driven by a motor/gearbox unit, directly or via a chain drive. In both cases a torque limiting device shall be supplied to initiate safe plant shut down should a blockage occur.
- 11 The peripheral speed of the scraper arm shall not exceed 5m/min.
- 12 The scraper arms, blades and shaft shall be fabricated from stainless steel and shall incorporate a scoop at the extreme end to assist in the sweeping of the deposited grit into a grit sump, or into the classifier hopper, depending on the system design.
- 13 Duty and standby grit pumps shall lift the grit into the classifier hopper.

12.2.5 Screw Grit Classifier

- 1 Each grit separator shall have an individual grit classifier. However, the grit delivery pipework shall be arranged such that if one classifier is out of operation, e.g. for maintenance, its associated separator can be connected to another classifier.
- 2 The grit classifiers shall be capable of handling the water and grit removed from the grit separators at the rate discharged by the grit air lift or grit pump.
- 3 The grit classifiers shall be a free standing units of the helical screw type which shall efficiently deposit dry organic free grit to a skip positioned beneath the discharge chute.
- 4 A wash water supply shall be connected into the classifier to assist with washing the grit. The units shall be provided with a valved washout drain at the lowest point which shall be piped, together with the wash water overflow, to a local drain point.
- 5 The screw drive unit shall be mounted at the upper end of the screw trough. The whole of the unit shall be guarded over its whole length.
- 6 The screw conveyor shall use a shaft-less screw resting on wearing surfaces. The screw device shall not have a submerged end bearing.
- 7 The screw shall be formed in stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084) plate of 8mm minimum thickness and the trough of a similar metal in 6mm plate.
- 8 The wearing surfaces in the screw trough shall be easily replaceable and formed of high density polyethylene (HDPE).
- 9 The screw shall be fitted on one bearing placed in the drive unit. The bearing shall be a combined thrust and radial type sufficient to accommodate the total axial and thrust loading.
- 10 The screw conveyor shall have adequate accessibility for maintenance.

12.2.6 Reciprocating Rake Grit Classifier

- 1 Reciprocating rake grit classifiers and cleaning mechanisms shall comprise a multiple-rake reciprocating mechanism mounted within the cleaning channel constructed parallel to the direction of flow and integral with one side of the cross flow grit settlement tank. The mechanism shall be inclined and deposit clean grit into the collecting skip positioned below the grit discharge. The discharge point shall be above Top Water Level. The grit shall be separated from the organic matter by the washing action of the reciprocating rake and suitable means of returning organic matter to the collecting tank shall be provided, together with the necessary built in pipework, screen and washwater pump.
- 2 The rake and blades shall be fabricated from stainless steel section and shall be suspended from the drive unit by connecting rods and bell cranks.

- 3 The classifier shall be driven by a motor/gearbox unit with torque unit switch via a crank mounted on the output shaft; balance weight arms, secondary output shaft; bellcrank and rake hangers.
- 4 The entire reciprocating mechanism shall be totally enclosed to prevent accidental contact and release of odours.

12.3 INSTALLATION AND COMMISSIONING

12.3.1 Installation and Commissioning

- 1 The equipment delivered to Site shall be examined by the Engineer to determine that it is in good condition and in conformance with the approved working drawings and certification. All equipment shall be installed in strict accordance with Part 1 of this Section 9.

12.3.2 Testing

- 1 Test Procedures shall be in accordance with Part 1 of this Section 9 and the particulars of the Contract.

END OF PART