

II – Design – Build Requirements

Part 3 – Material and Equipment Building Works

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2.5. GENERAL PROVISIONS

This specification has been prepared to provide general information about the construction works to be carried out.

The Contractor shall ensure the construction of high-quality buildings by integrating both structural integrity and architectural excellence. The architectural and structural designs of the new Hurma WTE Facility shall encompass all units specified in the process description and shall be developed in a way that ensures interconnected transitions and compatibility between them, achieving a functional and aesthetic unity.

In accordance with this specification, unless otherwise stated, the Contractor shall include in their proposal all costs related to every stage of the proposed/presented systems and units, including all tests, research, obtaining legal permits, design, supply and installation of equipment, commissioning, etc.

The facility shall be constructed in line with the "**Best Available Technology**" and shall comply with Turkish legislation and European Union Directives concerning incineration facilities.

The scope of work under the contract shall include all calculations, designs, and studies required for the construction of the **Hurma WTE Facility** proposed by the Contractor. This includes excavation and backfilling works, site investigations and studies, geotechnical surveys and improvement methods, facility structures, site works, distribution structures, replacement works, landscaping works, piping works, and other civil, electrical, and mechanical works.

All project designs, including structures, piping, architectural layouts, electrical and mechanical installations, shall be the responsibility of the Contractor within this scope. The Contractor shall obtain the approval of the Employer's Representative for all design and equipment selections and shall consider all necessary details to optimize the design, construction, operation, and maintenance efficiency.

The Contractor shall consider weather conditions, groundwater levels, soil conditions of the construction site, and geotechnical data to prepare the work program in order to ensure the successful completion of the works under the conditions of the contract.

The Contractor shall be responsible for all temporary structures, such as piping, equipment, etc., required to ensure that the planned structures within the scope of the works are connected to the existing structures with performing safely, efficiently, and with minimal disruption to ongoing operations of Hurma WWTP. The temporary Works shall be covered by the Contractor. The construction methodology for the erection of the new units and structures, as well as their integration into the operational facility with performing safely, efficiently, and minimal disruption to ongoing operations of Hurma WWTP, shall be prepared by the Contractor and submitted for approval to the Employer's Representative.

Approval by the Employer's Representative shall not relieve the Contractor of its responsibilities. Any necessary revisions or additional works related to the temporary works shall be executed promptly by the Contractor. The Contractor shall be responsible for all necessary demolition, dismantling, additional auxiliary construction works, and the use of equipment required for the proper installation of the mechanical and electrical equipment to be supplied under the scope of the work, in compliance with their specifications.

The Contractor shall design and implement all necessary filling works and additional service roads to ensure personnel and vehicle access to the units to be constructed within the scope of the work. In this context, service roads required for personnel and vehicle entry, as well as for the installation and dismantling of equipment, shall be provided as part of the work.

The structural elements, filling materials, pipes, and other materials to be used by the Contractor within the scope of the work shall be tested in an accredited construction laboratory under the instructions of the Employer/Employer's Representative. The test procedures shall be carried out in accordance with the section on Sampling, Sample Quantity, and Acceptance Criteria for Materials to be used. The costs of these tests shall be covered by the Contractor. The laboratory results shall be binding, and any materials or equipment that fail the tests shall be immediately removed from the site and shall not be permitted for use.

Note: The average external surface temperature of the areas specified in the mechanical specifications where hot air and waste gases come into contact with heat shall be 40°C.

2.5.1. SCOPE OF CONSTRUCTION WORKS

The primary construction works to be carried out within the scope of the project include:

- **Hurma WTE Facility** [*Sludge acceptance/storage unit, Sludge Pre-drying Unit, Fluidized Bed Incinerator (FBI) Unit with heat recovery system, Energy Recovery/Steam Turbine Unit, Flue gas Emission Control Unit, and Ash Management Unit*] (including all necessary foundation works, concrete and/or steel structures, and if necessary, ground rehabilitation, soil improvement, etc.,)
- **Auxiliary buildings for the Hurma WTE Facility**, including but not limited to:
 - Administrative Building/Unit
 - SCADA Monitoring and Control Room
 - Warehouse Area
 - Workshop Area
 - Technical Offices
 - Personnel Locker Room
 - Cafeteria
 - WC, Showers etc.
 - Laboratory Building/Unit
- **All types of infrastructure work**
- **Construction of new service roads on-site**
- **Excavation and filling works on-site, along with the removal and disposal of all residual materials**
- **All rough and fine construction works of the new structures**
- **Insulation and waterproofing of the new structures**
- **Surface water drainage and disposal**

- **Landscaping works**
- **Permanent outdoor lighting systems**
- **Additional site and soil investigations, if required**
- **Testing of improved soil conditions**
- **Design of the foundations, infrastructure, concrete and/or steel structures, building cladding and painting works within the scope of the contract**
- **Design and layout of cooling systems of the auxiliary buildings**
- **Design and layout of service trenches, tunnels, channels, and manholes**
- **Full compliance with safety, planning, and environmental requirements**
- **All interfaces between construction works and various components of mechanical and electrical installations**

The Contractor shall ensure that the design and construction of the works do not negatively impact or cause any damage to the existing structures. In the event of unforeseen damage or replacement to the existing facility during the execution of the works, the Contractor shall be responsible for carrying out the necessary remedial actions, such as constructing temporary manholes or distribution structures as required. No additional payment shall be made for the costs associated with such measures.

The architecture of the **Hurma WTE Facility** shall be designed in accordance with the Contractor's proposed layout. It is recommended that this integrated facility to be constructed using a steel structure. The sludge reception unit, pre-drying and incineration furnaces, heat recovery boilers, heat-energy recovery sections, electrical power generation, emission control unit, ash collection, workshop, laboratory, automation, and technical offices shall be designed as interconnected units, ensuring a unified architectural layout within a single structural framework.

The Contractor shall submit visual representations of both the **interior and exterior architectural design** of the facility as part of their technical bid during the Bidding stage.

2.5.2. EXCAVATION WORKS

2.5.2.1. General

The Contractor shall be responsible for all excavation works specified herein, including the necessary excavations for construction activities and the disposal of excavated materials. Excavations shall be carried out in accordance with the dimensions and elevations indicated in the design projects prepared by the Contractor and shall be approved by the Employer's Representative. The works shall be executed in accordance with the approved Work Program and the Employer's Representative's instructions.

Excavation works shall include, but are not limited to:

- Execution of excavation in all types of ground, including rock.
- Provision of necessary shoring, sheet piling, bracing, or other support structures to prevent collapse, sliding, or subsidence in excavations for structures and trenches.

- Implementation of all necessary measures to drain and remove water from the excavation areas.
- Transport of excavated material within the site, or if required, direct loading onto trucks and transport to a designated disposal site with the approval of the Employer's Representative.
- Disposal and spreading of excavated material as required.
- Site levelling and restoration upon completion of excavation activities.

Unless otherwise specified, all excavated material shall be transported within the site with the approval of the Employer's Representative. If the excavated material is to be transported outside the facility/worksite, no additional payment shall be made to the Contractor for this operation.

If, with the approval of the Employer's Representative, excavated material is to be transported outside the Facility, the following provisions shall apply:

- According to UKOME General Assembly's decision No. 2017/06-372 dated 07.06.2017, GPS (vehicle tracking system) devices and dump body lid sensors shall be installed on excavation trucks to integrate with the existing system of Antalya Metropolitan Municipality.
- If required, and with the approval of the Employer's Representative, excavation waste shall be transported to a disposal site designated by the Antalya Metropolitan Municipality.

Within this framework, if required and upon approval by the Employer's Representative, the following measures shall be implemented:

- Ensuring that excavation vehicles used within the worksite comply with the Excavation Management Plan of Antalya Metropolitan Municipality.
- Obtaining a Waste Transport Permit from Antalya Metropolitan Municipality.
- Disposal of all excavated soil, construction, and demolition waste at excavation storage sites and/or recreation areas designated by Antalya Metropolitan Municipality, with the associated disposal costs to be borne by the Contractor.

The Waste Transport Fee payable to Antalya Metropolitan Municipality for the transport of excavation material to storage sites and/or recreation areas shall be borne by the Contractor.

The Contractor shall commence excavation works only after implementing all necessary safety measures, including the installation of barriers and traffic management arrangements, and obtaining approval from the Employer's Representative.

Excavation works shall be carried out in compliance with applicable Turkish standards, norms, and regulations. In cases where such standards are not available, internationally recognized standards and norms approved by the Employer's Representative shall be followed.

If access to excavation areas is restricted due to limited workspace, traffic conditions, or other factors preventing the use of earthmoving equipment, excavation shall be carried out manually.

The Contractor shall be responsible for recording the location and scope of all encountered utilities and obstacles during construction, as well as maintaining records of collected samples and test results. No additional payment shall be made to the Contractor for these tests.

2.5.2.2.Potential Replacement of Existing Infrastructure

The Contractor shall take all necessary measures to identify, protect, and maintain the functionality of existing or newly installed channels, pipes, cables, and similar utility services throughout the duration of the contract. The Contractor shall ensure that these services remain in good working condition and are not disrupted during the execution of the works.

2.5.2.3.Demolition of Existing Structures

If required within the designated areas of the Contractor's proposed design and layout, the Contractor shall be responsible for the demolition of all types of structures, including steel/steel-construction, reinforced, and non-reinforced buildings, using appropriate machinery. The resulting debris shall be removed from the construction site and transported to a rubble disposal or storage area approved by the Employer's Representative. Additionally, the Contractor shall ensure thorough site cleaning upon completion of the demolition works.

During the demolition process, the Contractor shall:

- Take necessary precautions to preserve the existing electrical and mechanical installations to the extent possible.
- Implement all safety measures to prevent accidents and damages.
- Be fully responsible for restoring any damaged installations to their original condition.

To mitigate dust-related environmental pollution, water spraying with tanker trucks shall be carried out during the demolition process.

The cost of debris disposal shall be included in the contract price; no additional payment shall be made for the transportation of debris to the disposal site or for disposal fees.

2.5.2.4.Drainage and Dewatering

The Contractor shall ensure that excavations for structures and pipelines remain free from water, regardless of its source, and that all construction activities are carried out in a dry environment.

The methods for keeping excavation areas free from water, including dewatering and water disposal, shall be subject to the approval of the Employer's Representative. The Contractor shall supply all necessary equipment for pumping operations and ensure the continuous availability of backup equipment on-site to prevent any interruption in dewatering activities.

For the dewatering of excavation areas, the following methods may be employed, subject to approval by the Employer's Representative:

- Dewatering by pumping from wells
- Direct dewatering by pumping from the excavation area
- Dewatering from drilled, filtered wells
- Dewatering using the WellPoint system

The Contractor shall select an appropriate method and implement it only upon receiving approval from the Employer's Representative. All dewatering operations and associated costs shall be included in the contract price, and no additional payment shall be made for these works. The Contractor shall acknowledge this requirement when preparing its bid.

Considering the potential adverse effects of groundwater on the foundation, as well as the risk of liquefaction due to seasonal groundwater level fluctuations, it is essential to implement engineering measures such as drainage systems and soil stabilization during and after construction. The foundation excavation and foundation type shall be assessed by the project designer, taking into account the static water level.

Additionally, fluctuations in the groundwater level can negatively impact building foundations, the lifespan of reinforced concrete, and settlement behavior. To prevent water infiltration and subsequent foundation damage, it is mandatory to:

- Install appropriate surface and subsurface drainage systems to divert surface and groundwater away from the foundation.
- Ensure proper isolation and waterproofing measures at the foundation level.
- Develop drainage systems that allow water accumulating in the excavation pit to be collected through pumping systems and discharged to a location approved by the Employer's Representative.

2.5.2.5. Excavation Works for Structures

Excavation works within the scope of the contract shall include the removal and disposal of excavated materials. If, for any reason, the excavation surface at the foundation level deteriorates, the Contractor shall remove all unsuitable materials, as determined by the Employer's Representative, and replace them with approved materials at its own expense in accordance with the instructions of the Employer's Representative.

Excavation works for structures shall be carried out in compliance with the slope ratios specified in the architectural project submitted by the Contractor and approved by the Employer's Representative.

The Contractor shall be responsible for the replacement of existing wastewater treatment plant infrastructure within the work area, ensuring minimum disruption to plant operations, in coordination with and under the approval of the Employer's Representative. The Contractor shall also be responsible for repairing any unforeseen damage to underground infrastructure or any necessary replacement of temporary manholes, distribution structures, or similar facilities. No additional payment shall be made for these works.

After the removal of unsuitable materials from the worksite, the entire foundation area shall be moisture-conditioned and compacted to the required degree. The time interval between foundation preparation and the start of construction activities shall be kept as short as possible.

Excavations for foundations, trenches, ditches, and other structures shall be carried out in accordance with the levels, elevations, and dimensions specified in the approved project plans, as approved by the Employer's Representative. Excavation tolerances shall be strictly adhered to, and deviations beyond the specified limits shall not be permitted.

Unless otherwise specified by the Employer's Representative, grading and leveling works shall be performed simultaneously with excavation activities. However, if excavation base or sidewalls

collapse, loosen, or shift, or if the Contractor exceeds the specified excavation limits in depth, width, or length, the Contractor shall remove all excess or disturbed material at its own expense and shall not be entitled to any additional payment for these corrective measures.

During excavation works:

- A minimum clearance of 50 cm shall be maintained when crossing parallel to existing infrastructure.
- A minimum clearance of 30 cm shall be maintained when crossing perpendicular to existing infrastructure.
- The Contractor shall obtain necessary information from relevant authorities regarding existing wastewater treatment plant infrastructure before commencing excavation and shall provide supervisory personnel as required.
- When existing pipes intersect with newly installed pipes, a minimum clearance of 50 cm shall be maintained.
- For areas containing natural gas or fuel pipelines, backfilling shall be carried out using materials that comply with the requirements of the relevant authority, and the backfill material shall be provided by the Contractor.

If unsuitable material is encountered at the excavation base, the Contractor shall remove and dispose of it as per the Employer's Representative's instructions. Unless otherwise specified or instructed by the Employer's Representative, the Contractor shall fill any resulting voids with suitable granular material, subject to the approval of the Employer's Representative.

2.5.2.6.Tolerances

Unless otherwise specified, the surface of the completed excavation works shall not deviate by more than ± 30 mm from the designed surface level. Within these tolerances, the final surface shall have a smooth and uniform finish, as deemed appropriate by the Employer's Representative.

The excavation levels shall be strictly maintained in accordance with the calculated elevations based on the project slopes, and no tolerance shall be permitted in this regard.

2.5.2.7.Slippage, Subsidence, and Excess Excavation

The Contractor shall be responsible for implementing all necessary preventive measures to prevent material slippage and subsidence at the edges of the excavation area and within trenches.

If slippage or subsidence occurs during excavation activities, or if excavation exceeds the specified dimensions, any unsuitable material that has entered the excavation area shall be removed.

The backfilling of such areas shall be carried out using either:

- The original excavated material, if deemed suitable, or
- Imported material that complies with the contract specifications, if the excavated material is unsuitable.

The selection and compaction of backfill materials shall be subject to the approval of the Employer's Representative.

2.5.2.8.Safety of the Excavation Area and Nearby Structures

The Contractor shall implement all necessary safety measures to ensure the protection of the excavation site, nearby roads, structures, buildings, pipelines, infrastructure, and manholes. These measures shall include, but are not limited to:

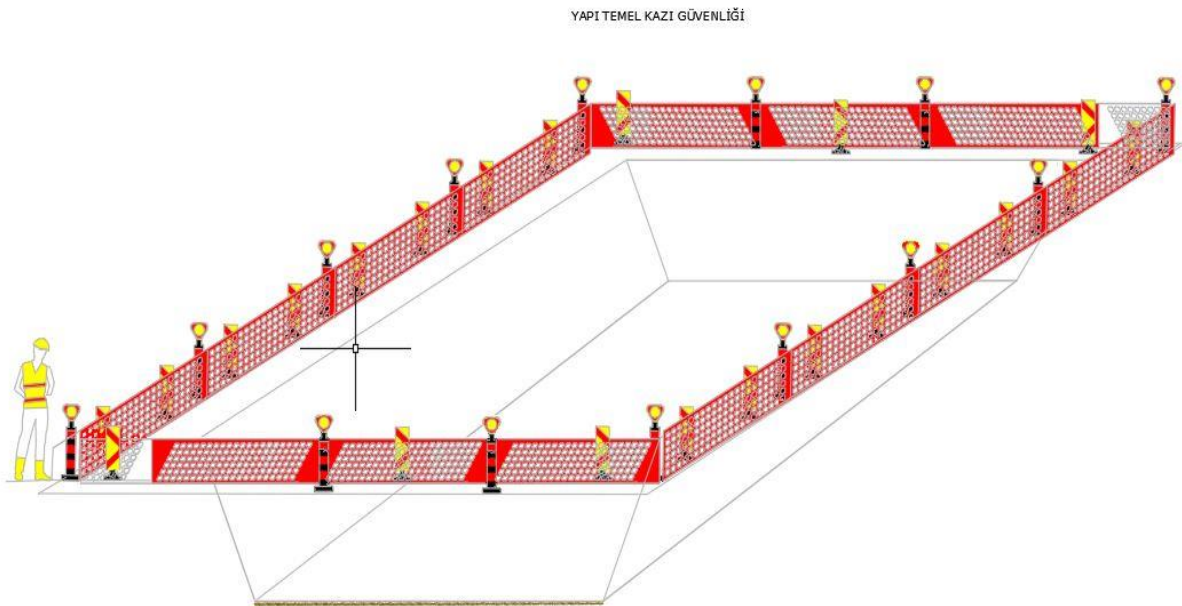
- Shoring
- Sheet piling
- Retaining walls
- Open caissons
- Pneumatic caissons

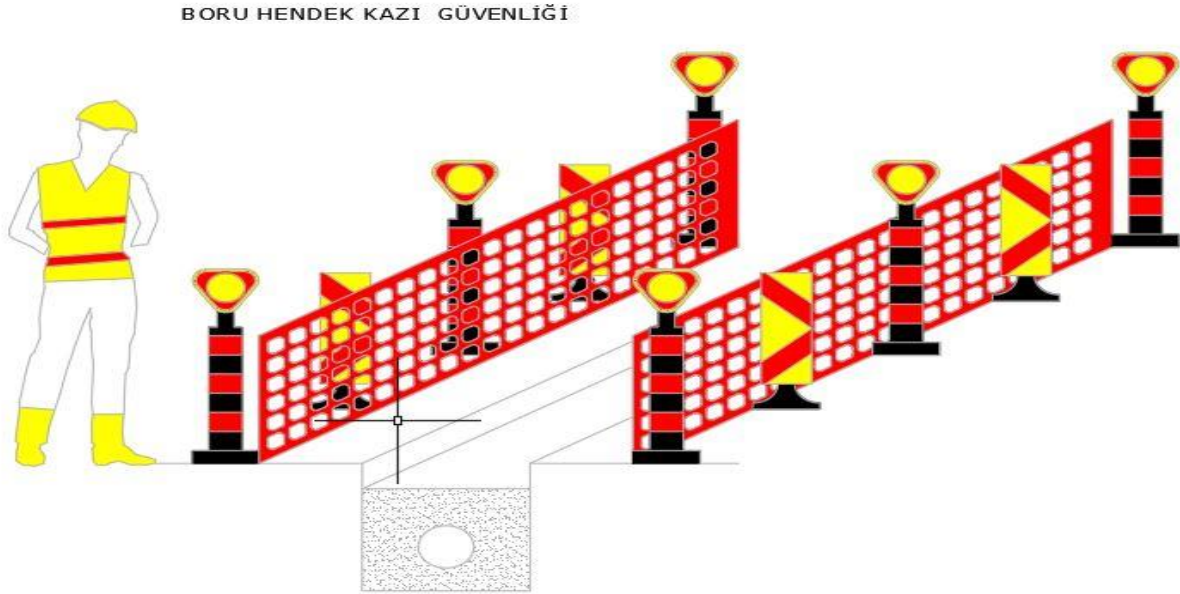
All such protective works shall be included in the contract price, and no additional payment shall be made for their execution.

During excavation activities, if the excavation slope intersects with existing infrastructure or superstructure, the Contractor shall prepare a detailed excavation methodology and application plan that ensures no damage to the existing infrastructure and superstructure. This plan shall be submitted for approval to the Employer's Representative before implementation.

The approval of the Employer's Representative does not absolve the Contractor of liability for any damages caused to existing infrastructure and superstructure during excavation.

The Contractor shall be fully responsible for repairing or replacing any damage to existing structures, including buildings, pipelines, manholes, roads, etc., at its own expense, in accordance with the contract terms. Any damaged section shall be immediately restored or replaced to ensure that operational activities are not disrupted.





2.5.2.9.Site Cleaning Prior to Excavation

Before commencing any excavation or stripping activities within the contract site, the Contractor shall clear the area of all trees, stumps, roots, waste, debris, and any other unsuitable materials.

The materials resulting from the cleaning process shall be removed from the construction site or disposed of within or outside the site boundaries, as deemed appropriate by the Employer's Representative.

All felled trees shall be stored by the Contractor in a designated storage area and later delivered to the Employer.

No additional payment shall be made to the Contractor for site cleaning activities.

2.5.2.10. Water Discharge During Excavation

Throughout the construction period, the Contractor shall be responsible for removing water from all work areas, including pumping, draining, and discharging surface and groundwater where necessary to facilitate construction activities. At the completion of the works, any previously excavated pump pits, diversion channels, and trenches shall be backfilled with appropriate materials. These works are included in the contract price, and no additional payment shall be made to the Contractor.

In areas where water accumulation is likely, the Contractor shall install appropriate drainage systems and, if necessary, construct collection pits. If deemed necessary by the Employer's Representative, such pits shall be located completely outside the work area, and any required pumping during or after construction shall be carried out through these pits to prevent damage or collapse of the excavation base and sidewalls.

The water level in any operating pump pit shall always be maintained below the lowest level of any concrete pouring or construction activity.

If excavation or storage activities disrupt the existing drainage system of roads or land, the Contractor shall immediately take necessary actions to restore drainage and water discharge in a manner that

satisfies the Employer's Representative. Upon completion of the works, the drainage system shall be restored to a permanent and functional condition.

The Contractor shall ensure the availability, operation, and maintenance of an adequate number of pumps and dewatering equipment throughout the project.

All pumping, drainage, and discharge operations shall be conducted in a manner that:

- Does not cause damage to adjacent properties, land, structures, or water bodies.
- Does not obstruct or interfere with the work of other contractors.
- Complies with environmental regulations and respects private property rights.
- Ensures that vehicular and pedestrian traffic remains unaffected.

For construction revision works within existing structures, the Contractor shall perform the removal of wastewater inside the structure under the supervision of the Employer's Representative and in coordination with the Employer.

The Contractor shall be responsible for providing and maintaining all necessary power supply, pumps, tools, and equipment for dewatering inside structures, as well as implementing all required safety measures. No additional payment shall be made for these works.

2.5.2.11. Shoring and Support Systems

In cases where excavation slopes are unstable, the Contractor shall implement shoring, sheet piling, bracing, and other support systems as required to prevent erosion, slippage, or collapse in excavations for structures and trenches. The cost of these works shall be included in the contract price, and no additional payment shall be made for these works.

The Contractor shall take all necessary precautions to ensure that adjacent or nearby structures, utilities, and other facilities are not damaged due to vibrations from sheet piling or similar construction activities. If any damage occurs to these structures or services, the Contractor shall be fully responsible for all repairs, replacements, and restoration works at its own expense.

Shoring and trench supports shall not be removed until either:

- Backfilling has been completed, or
- The structure or trench has reached a load-bearing stage that eliminates the need for temporary support.

The Contractor shall be fully responsible for the adequacy, stability, and effectiveness of the temporary support system implemented for all excavation works. The Contractor shall also bear full responsibility for the cost and repair of any damages resulting from design or execution errors in these systems.

The foundation soils of structures and trench bases shall be stable, compacted, fully consolidated, and free from mud and silt. Required compaction shall be carried out using vibratory rollers/compactors with water tanks to ensure proper soil stabilization.

2.5.2.12. Disposal Sites

Unless otherwise specified or instructed by the Employer's Representative, all excavated materials from foundation excavations, manhole excavations, and topsoil stripping shall be transported to the designated on-site disposal area.

Excavated materials shall not be transported to disposal sites outside the Facility without the explicit approval of the Employer's Representative.

2.5.2.13. Filling and Backfilling Works

The compaction of the fill material shall be periodically tested at intervals determined by the Employer's Representative. Fill materials shall be transported, placed, spread, and compacted in a manner that ensures a stable, homogeneous, and well-compacted structure, preventing segregation of the material.

The Contractor shall plan and execute the timing and sequence of backfilling and filling operations to prevent any tension, weakening, damage, or risk to any part of the works. The placement of fill layers shall ensure adequate drainage, preventing water accumulation. Particularly, no material shall be placed around concrete structures until they are fully completed and have attained their specified strength. Care shall be taken to ensure uniform pressure distribution around the structures during material placement.

Regardless of the backfilling method used, the Contractor shall perform backfilling to the satisfaction of the Employer's Representative. The Contractor shall also take all necessary precautions to prevent damage to permanent works or nearby structures.

If rainfall or adverse conditions prevent achieving the required compaction results, filling operations may be suspended at any time. The Contractor shall consider the expected climatic conditions in the region while planning the works. If the placed material becomes unacceptable due to any reason, the Contractor shall remove and reprocess the material until it meets the required specifications, at its own expense, with no additional payment.

The Contractor shall compact the fill to the specified density using approved compaction methods and equipment, ensuring compliance with the contract requirements. Backfilling operations shall not impose excessive or unbalanced loads on the structures.

The filling of embankments and other areas shall be performed uniformly across the entire width, maintaining an adequate settlement allowance and an even surface to ensure proper drainage of surface water. Unless otherwise specified, fill material shall be placed in horizontal layers and compacted to 95% of the Standard Proctor Density.

2.5.2.14. Fill Material Test Area

If deemed necessary by the Employer's Representative, and prior to commencing filling operations, the Contractor shall construct a fill material test area at its own expense. This test area shall be compacted using the specified compaction standards and the proposed equipment to verify compliance with the project requirements. The size and depth of the test area shall be determined to appropriately represent the general fill operations.

Any modification to the compaction methods or equipment during the works shall only be permitted if the Contractor demonstrates through field trials that an alternative method achieves compaction results equivalent to the approved method.

Throughout the progress of the works, if the Contractor encounters unforeseen factors beyond its control that negatively impact compaction efficiency, the Employer's Representative shall be notified. Based on this information, the Employer's Representative may evaluate and approve adjustments to the equipment or methods as necessary.

2.5.3. PIPEWORKS

2.5.3.1. General

The requirements outlined in this section apply to external and underground pipelines connecting treatment units, pump stations, and buildings. These specifications shall be applicable to the following pipeline systems:

- **Wastewater**
- **Dewatered and wet sludge**
- **Drinking water**
- **Process water**
- **Treated wastewater for reuse**
- **Stormwater drainage**
- **Groundwater drainage (if required)**
- **Ventilation**
- **Gas transmission**

2.5.3.2. Functional Requirements for Specific Pipeline Systems

For the manufacturing and construction activities related to the pipeline systems specified below, the technical specifications relevant to each unit and site shall be strictly followed.

Drinking Water

The drinking water systems for new structures, buildings, and temporary facilities shall be connected as per the Contractor's design, subject to approval by the Employer's Representative.

Firefighting Water

The Facility shall be equipped with an adequate number of fire hydrants, positioned in accordance with Turkish norms and standards.

Stormwater Drainage

The WWTP site shall be equipped with a stormwater drainage system to protect the area from flooding and surface runoff-induced erosion. The system may consist of surface drainage reinforced with a pipeline system to discharge stormwater into a nearby watercourse.

The Contractor shall implement all necessary waterproofing measures during the execution of these drainage works.

Irrigation System

As part of the contract, the Contractor shall establish a complete irrigation system for the entire facility area.

Gas Pipeline System

The gas pipeline system shall be designed and installed in accordance with the relevant technical specifications, ensuring safe and efficient transport of gases within the facility. The system shall comply with all applicable safety regulations, material standards, and operational requirements.

Sludge Pipeline/Conveyor System

The sludge transport system, consisting of pipelines and/or conveyors, shall be designed to handle both dewatered and wet sludge. The system shall ensure leak-proof transport, minimal maintenance requirements, and resistance to wear and corrosion. The installation shall be executed in compliance with the specified layout and process requirements.

Air Pipeline System

The air pipeline system shall be installed to supply and distribute compressed air to the necessary treatment units and equipment. The system shall be designed to withstand the specified operating pressures and be free of leaks and pressure losses to ensure efficient air delivery.

Canopy Steam Pipeline System

The canopy steam pipeline system shall be installed for the safe and efficient transport of steam within the facility. The pipeline materials and components shall be selected to withstand high temperatures, pressure fluctuations, and thermal expansion. Proper insulation and condensate removal systems shall be incorporated to prevent heat loss and condensation-related issues.

Ash Collection System

The ash collection system shall be designed to efficiently collect and transport ash generated during the incineration process. The system shall be equipped with appropriate piping, storage units, and discharge mechanisms to ensure the safe and dust-free handling of ash. Materials used for the system shall be resistant to high temperatures, abrasion, and corrosion.

Water Drainage Piping

The water drainage piping system shall be installed to effectively collect and discharge wastewater, process water, and stormwater. The system shall be designed to prevent leakage, clogging, and water accumulation while ensuring proper flow to designated discharge points. The installation shall comply with all hydraulic design requirements and environmental regulations.

2.5.3.3.Pipe Materials

In general, all installed pipes, valves, and pipe fittings shall conform to relevant international norms and standards.

The Contractor shall provide documentation to the Employer's Representative confirming that the materials have been tested and comply with the requirements of this technical specification and applicable standards. The Employer's Representative reserves the right to request additional tests as necessary.

To minimize the number of joints, pipes shall be ordered in the maximum available lengths whenever possible.

The Contractor shall be responsible for procuring sufficient quantities of all required materials. In particular, for imported products, the Contractor shall determine the required quantities before placing any orders to avoid delays.

2.5.3.4. Concrete Pipes and Manhole Components

Both reinforced and non-reinforced concrete pipes, as well as flexible joint components, shall comply with TS 821 EN 1916. The pipes shall be reinforced to withstand both installation loads and permanent operational loads.

All concrete/reinforced concrete pipes used under this contract shall be equipped with integrated gaskets to ensure leak-proof connections.

If any pipes fail to meet the required test criteria or exhibit cracks, damaged ends, manufacturing defects, or any other faults caused by handling, transportation, or installation, the Employer's Representative reserves the right to reject and return the defective products at the Contractor's expense.

2.5.3.5.PVC and PP Pipes

All PVC and PP pipes shall be manufactured by a certified producer operating under the ISO 9000 quality assurance system.

Unplasticized PVC pipes and fittings for gravity drainage and stormwater systems shall comply with the relevant provisions of CEN Standard EN 1404.

PP pipes shall conform to CEN Standard EN 1852.

Unplasticized PVC pipes and pressure pipe connections shall comply with the relevant provisions of CEN Standard EN 1452.

All connections for PVC and PP pipes shall be made using single 45-degree branches, and no foot bends shall be used.

2.5.3.6.HDPE Pipes

All HDPE pipes and fittings shall be manufactured by a certified producer operating under the ISO 9000 quality assurance system.

- HDPE pipes shall be made of PE 100 material, as classified in the European Technical Committee Report CEN/T.C. 155.
- In accordance with ISO 12162, PE 100 material shall have a minimum required strength (MRS) of 10 MPa.
- Pipes and fittings shall be produced in specific colors for different applications:
 - Blue for drinking water
 - Yellow for gas
 - Black for wastewater
 - All pipes shall be suitable for underground installation.

Gravity pipelines shall be designed using structural wall pipes with a ring stiffness of $SN \geq 8 \text{ kN/m}^2$. The pipes shall be manufactured in a way that allows water to fill the gap between the inner and outer pipe walls.

All pressure and gravity pipes used in manufacturing shall be labeled as required by the Employer's Representative.

- Pressure pipes shall have a minimum pressure rating of PN 10.
- PE pipes and fittings shall comply with the relevant provisions of:
 - CEN Standard TS EN 12201-1 (for water and wastewater)
 - CEN Standard TS EN 1555-1 (for gas)

Jointing Methods

- All buried pipes shall be joined using butt fusion, electrofusion welding, or socket fusion techniques.
- Small-diameter pipes (diameter < 63 mm), pipes inside structures, and pipes connected to metal fittings shall be joined using mechanical fittings, such as:
 - Compression joints
 - Flanged joints
 - Push-fit connections
- Extrusion welding shall be used for lightweight, large-diameter pipe connections.

Welding Requirements

- All welding works shall be performed by certified welders who hold a valid welding license issued by a recognized institution.
- Licenses shall be issued within the last 12 months and shall be approved by both the manufacturer and the Employer's Representative.

2.5.3.7.GRP Pipes

All GRP (Glass Fiber Reinforced Plastic) pipes and fittings shall be manufactured by a certified producer operating under the ISO 9001 quality assurance system.

GRP pipes shall be produced using either:

- Centrifugal casting technology, or
- Continuous filament winding technology

GRP pipes shall comply with the following standards:

- DIN 19565
- DIN 16858
- TS EN ISO 23856

GRP pipes with a diameter greater than 200 mm shall be supplied for the following main categories:

Pressure Class (PN) (bar)	Ring Stiffness (SN) (N/mm²)
PN 6	SN 5.000
PN 10	SN 10.000

GRP Pipe Joints and Flange Connections

- All GRP pipes shall be joined using couplings or sleeve connections with integrated full-width EPDM rubber seals.
- All joint connections shall comply with DIN 19565.

Flange Connections

- Flange joints, elbows, tees, end caps, and fittings shall be standard GRP fittings and comply with DIN 19565.
- All flanges shall be drilled and, unless otherwise specified, shall comply with EN 4504.
- The nominal pressure classification of the flanges shall be at least equal to the highest pressure classification of the connected pipes or fittings, but not less than PN 10.

Flange Assembly Requirements

- All flanges shall be supplied complete with all necessary nuts, bolts, and sealing gaskets as specified.
- After cleaning the flange, the seal gasket shall be placed onto the flange.
- The initial tightening of the nuts shall be done manually.
- The final tightening of the nuts shall be performed gradually and crosswise, using only standard wrenches approved by the Employer's Representative.

Sealing Materials

- Sealing gaskets and joint rings shall be made of natural or approved synthetic rubber.
- Flange gasket seals shall be of the inner bolt ring type and shall comply with DIN 19565, unless otherwise specified.
- Any other types of sealing gaskets may only be used with prior approval from the Employer's Representative.

2.5.3.8. Stainless Steel Pipes

General Technical Specifications – Mechanical Works shall comply with the requirements set out in Clause 2.4.2.2. (B)

2.5.3.9. Transportation of Pipes

- Pipes shall be transported in accordance with the manufacturer's recommendations to prevent damage during handling and transit.
- The transport vehicles used for pipe delivery shall have a chassis length sufficient to fully support the pipes, ensuring that no part of the pipes extends beyond the vehicle frame.

- During transportation, approved straps shall be used for securing the pipes, and all hooks, clamps, and other metal fixtures shall be reinforced to prevent damage.
- Hooks that penetrate the inner surface of the pipe walls shall not be used at any time.
- Pipes shall never be dropped or allowed to collide with each other to avoid structural damage or deformation.

2.5.3.10. Storage of Pipes

All pipes shall be stored in accordance with the manufacturer's recommendations to ensure that their quality and condition are preserved in compliance with the standards specified in the technical specifications.

- Special care shall be taken in storing HDPE, PVC, and GRP pipes. For example, PVC pipes shall not be exposed to direct sunlight to prevent material degradation.
- Pipes and fittings shall be stored off the ground and carefully supported to prevent deformation.
- Welding shall not be performed near stored pipes.
- Pipes shall not be stacked directly on top of each other. The stacking height shall not exceed:
 - Four pipe layers for standard-sized pipes.
 - Two pipe layers for pipes with a diameter greater than DN 500.
- Couplings, joints, and all related components shall be stored in dry conditions, preferably under shelters or in enclosed spaces, and kept off the ground to prevent contamination or damage.

The storage area shall be carefully organized to facilitate the loading, unloading, and inspection of materials. Different shipments shall be clearly segregated and labeled to ensure that identification markings remain visible.

2.5.3.11. Inspection of Pipes and Fittings

- Before installation, each pipe and fitting shall be brushed clean and carefully inspected for structural integrity and durability.
- If any pipes or fittings are found to be damaged beyond acceptable repair, as determined by the Employer's Representative, they shall be rejected and removed from the site.

If, during testing, the Employer's Representative determines that certain sections of the pipeline fail to meet acceptance criteria, the Contractor may be required to conduct hydraulic pressure testing on each pipe and joint at site pressure before installation.

- In such a case, test results shall be submitted to and approved by the Employer's Representative before further pipe installation proceeds.
- All costs associated with pipe testing shall be borne by the Contractor.

The Employer's Representative shall inspect all pipe joints, regardless of their type. No voids or cavities over the joints shall be filled unless specifically instructed by the Employer's Representative.

The Employer's Representative may instruct the Contractor to proceed with pipe laying or backfilling without joint inspection. However, this does not relieve the Contractor of its responsibility to conduct excavation and allow joint inspections if required during pipeline testing.

2.5.3.12. Bedding, Encasement, and Backfilling for Piping and Structures

For site piping, the excavation shall be carried out to a minimum depth of 20 cm below the pipe (or as specified in the detailed design drawings based on pipe diameters). The excavation base shall be leveled and prepared for bedding and encasement using materials that meet the quality requirements specified in the table below.

- Lower bedding material shall be placed across the full trench width and properly compacted.
- Pipes shall be installed on the prepared bedding material at the correct elevations.
- After successful pipe testing and approval by the Employer's Representative, the pipe shall be encased with suitable material up to the height specified in the design drawings (with a minimum of 20 cm above the pipe).
- The encasement material shall be placed and compacted to ensure no voids remain around the pipe.
- Upon completion of encasement, backfilling shall be carried out, compacted, and tested.

Unless otherwise specified, excavated material shall be used for backfilling around structures. If the excavated material is deemed unsuitable, the Contractor shall use alternative materials that meet the standards specified below.

For materials sourced from quarries, the following criteria shall apply:

Bedding, Encasement, and Backfill Material Properties

For site piping and backfilling around structures, bedding, encasement, and backfill materials shall be used as per the approved material specifications provided by the Employer's Representative.

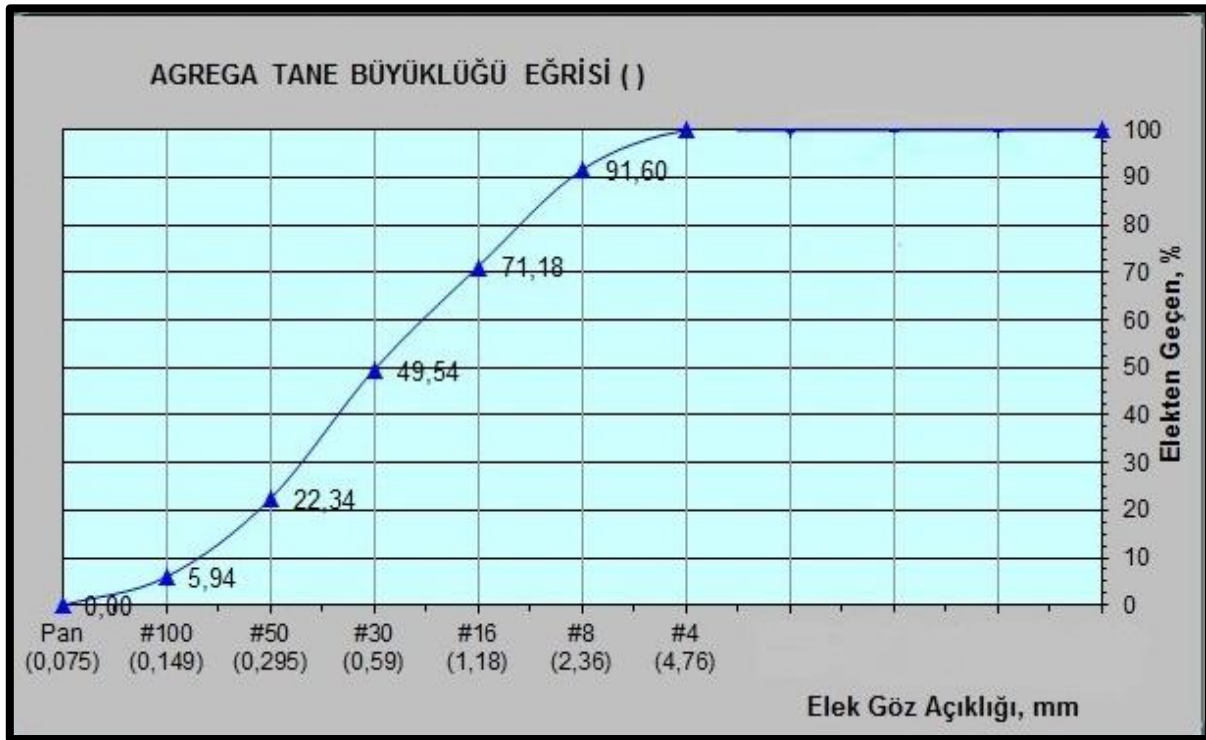
Only graded materials that meet the requirements specified in the tables below shall be used for these works. The materials shall be:

- Approved by the Employer's Representative before use.
- Well-graded to ensure proper compaction and load distribution.
- Free from organic matter, debris, and oversized particles that could cause instability or damage to the pipes.

The gradation and material composition shall conform to the approved specifications, ensuring optimal bedding support, pipe protection, and structural stability in accordance with the requirements.

HDPE PE100 or Corrugated Pipes, Steel/Ductile Iron Pipes		
Concrete/Reinforced Concrete Pipes		
Bedding Encasement	0 – 4,76 mm. Material (Crushed stone, washed and sieved sand, or well-graded gravel with the required distribution)	8–22,4 mm. Material (Crushed stone or well-graded gravel with the required distribution) (The gradation may be adjusted based on soil type and pipe diameter with the approval of the Employer’s Representative.
Backfill	0 – 38,1 mm Material	
	Sieve Size	Sieved (%)
	38,1 mm (1 1/2 inch)	100
	31,5 mm (1 ¼ inch)	85 – 100
	25,4 mm (1 inch)	75 – 97
	19,01 mm (3/4 inch)	65 – 90
	12,54 mm (1/2 inch)	55 – 80
	9,52 mm (3/8 inch)	40 – 65
	4,76 mm (No.4)	30 – 50
	2,36 mm (No.8)	22 – 40
	1,18 mm (No.16)	10 – 30
	0,59 mm (No.30)	0 – 18
	0,295 mm (No.50)	0 – 10
0,149 mm (No.100)	Pan	

The Particle Size Distribution for 0-4.76 mm Bedding and Encasement Material Shall Be Similar to the Following Graph Data.



- Prior to use, the source of the supplied material, along with sample specimens and material gradation values, shall be submitted in writing for approval to the Employer's Representative.
- Any material not approved by the Employer's Representative shall not be used on-site under any circumstances.
- During backfilling operations, necessary care and precision shall be exercised.
- The materials used in construction shall strictly comply with the requirements specified in the technical specifications.
- No work shall be carried out without the approval of the site supervision team.
- Before installing each pipe, the elevation of the bedding surface shall be checked and adjusted for slope accuracy.
- While positioning the pipe, sudden impact loads or pressure shall not be applied.
- Once the final position of the pipeline has been set in terms of elevation and alignment, bedding material shall be placed and compacted on both sides of the pipe to provide full lateral support, leaving adequate space at the end for the next pipe connection.
- Bedding and encasement material shall be evenly placed on both sides of the pipe and compacted simultaneously to prevent replacement of the pipe position.

2.5.4. INSTALLATION

2.5.4.1.General

This section covers the replacement of existing pipelines, the installation of new pipelines, and the supply, laying, and joining of pipes and fittings. It also includes bedding and foundation works, the construction of manholes and other structures along the pipeline, as well as testing and commissioning of the pipeline system.

When constructing road crossings, appropriate protection measures shall be taken, such as casing the pipes within protective sleeves.

Pipes shall be laid in accordance with the following standards:

- Gravity pipelines: TS EN 1610
- Pressure pipelines: TS EN 805

Pipes shall be handled and installed in compliance with the manufacturer's recommendations to ensure proper alignment and structural integrity.

- Pipes shall be placed into the trench on the bedding material and joined at the specified connections.
- During installation, careful inspection and monitoring shall be conducted to ensure that the pipes are laid at the correct alignment and elevation.
- Special attention shall be given to ensure that each joint, fitting, and manhole connection is properly sealed to prevent leakage.

For gravity pipelines, after the HDPE pipes have been welded, they shall be filled with water. The Contractor shall ensure that any potential air is discharged from the top of the pipeline in accordance with the procedures agreed upon with the Employer's Representative.

2.5.4.2.Replacement of Existing Pipelines

The Contractor shall investigate alignments of existing pipelines and accordingly reflect these investigations to the new design.

Where the newly installed pipelines intersect with existing ones, the replacement of the existing pipelines shall be carried out with the following considerations:

1. Existing steel pipelines can be reused, ensuring their structural integrity is maintained after the approval of the Employer's Representative.
2. The disposal or removal of existing concrete or other pipelines shall be determined by the Employer's Representative and the demolition/disposal of related pipes shall be under the Contractor's responsibility.

During construction, if pre-identified or unforeseen existing infrastructure pipelines require replacement or repair due to damage, the Contractor shall ensure that:

- The existing diameter, pressure class, and material type of the relocated or repaired pipelines shall be preserved.
- All repairs and replacements comply with the existing operational requirements to ensure continued functionality.

2.5.4.3. Pipe Joints

All joints shall comply with the relevant provisions of the appropriate international standard and shall be made to the manufacturer's recommendations and the specifications hereafter.

Flanged joints shall be properly aligned before any bolts are tightened. Gaskets for flanged joints shall be of the inside-bolt-circle type. Jointing compounds shall not be used when making flanged joints, except that to facilitate the making of vertical joints, gaskets may be secured temporarily to one flange face by a minimum quantity of clear rubber solution. Bolt threads shall be treated with graphite paste and the nuts shall be tightened evenly in diametrically opposite pairs. Nuts shall be secured against loosening by vibration. In rainy weather conditions, pipe-to-fitting welding, mechanical jointing, and other relevant works shall be performed in mechanical workshops whenever possible to ensure quality.

Rubber joint rings for water mains and drainage purposes shall be obtained from the pipe manufacturer. Joint lubricants for sliding joints and used for jointing water pipes shall not impart to water taste, colour, or any effect known to be injurious to health, and shall be resistant to bacterial growth.

Unless specified otherwise joints having exposed mild steel components shall be cleaned and all loose rust shall be removed. The internal lining in a gap, which has been left for the joint to be made, shall be completed in accordance with the recommendations of approved supplier, unless specified otherwise. The external protection shall comprise bitumen applied to a thickness of not less than one millimeter on to the external surface of the joint, followed where appropriate by a spiral wrap of heavy-duty glass fiber tape bonded with hot bitumen. For gas pipeline installations, all underground pipeworks shall be encased and backfilled following the insulation measures approved by the Employer's Representative.

For closing lengths, it may be necessary to cut pipes of various materials. Pipes shall be cut by a method which provides a clean square profile without splitting or fracturing the pipe wall, and which causes minimum damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used and any protective coatings shall be made good.

2.5.4.4. Curves and Bends

Pipes shall be installed as straight as possible along their axis. Sagging at joints leading to curvature shall not be permitted, and directional changes shall be made using prefabricated elbows. If elbows are fabricated in a workshop, the internal diameter shall be maintained to ensure proper flow characteristics.

Except for welded steel pipes and self-locking joints, concrete thrust blocks shall be provided for reducers, T-connections, end caps, and elbows or bends with a deflection angle of 11.25° or greater. The type and dimensions of the thrust blocks shall be determined with the approval of the Employer's Representative.

Thrust blocks shall be constructed using C16 concrete and shall be carefully placed on earth or rock with suitable bearing capacity. The top level of the thrust block shall extend at least 150 mm above the pipe crown. During casting, couplings and joints shall not be covered, ensuring accessibility. If necessary, the fittings and pipes shall be securely anchored to the block using stainless steel tension rods.

When using timber formwork, it shall be removed before backfilling. Before applying any pressure to the pipeline, the concrete shall be allowed to achieve the required strength to ensure structural integrity.

2.5.4.5. Protective Concrete and Concrete Encasement Process

In cases where the distance between the pipe crown and the ground surface is less than 100 cm, as specified in the project design requirements or due to existing infrastructure lines, the pipes shall be encased in C16/20 protective concrete.

If deemed necessary by the Employer's Representative, concrete encasement (protective sleeve concrete) shall also be applied to deeply installed pipes.

For pipes with flexible joints, compressible filler material shall be cut and placed at each joint along the entire concrete cross-section to allow for movement and flexibility.

The concrete shall be poured in a single operation and shall comply with the requirements specified in the "Concrete Works" section.

During the concrete pouring process, pipes shall be properly secured to prevent lifting or displacement.

2.5.4.6. Testing of Pipelines

2.5.4.6.1. Precautions Prior to Testing Pipelines

Before testing any pipeline, the Contractor shall ensure that it is anchored adequately and that thrusts from bends, branch outlets or from the pipeline ends are transmitted to solid ground or to a suitable temporary anchorage.

Open ends shall be stopped with plugs, caps or blank flanges properly jointed.

It shall not be permitted to transfer the thrust on to a completed length of pipeline or onto an existing pipeline.

Before the pressure testing of the pipeline is carried out, the trench shall be sufficiently refilled to ensure that the requisite anchorage is provided for each pipe to prevent movement during the testing period.

Adequate provision for the release of air from the pipeline shall be made at any high points and blank flanges.

Potable water shall be used for the cleansing, testing and swabbing of the water pipelines unless otherwise directed by the Employer's Representative.

2.5.4.6.2. Testing Method, Program and Notification

The Contractor shall submit a program at least two working days before any testing of a pipeline to the Employer's Representative.

On completion of main laying and sectional testing and before leaving the site, the whole pipeline shall be subjected to an overall comprehensive pressure test. The consent of the Employer's Representative is to be sought for the testing arrangement before the tests commence.

The Contractor shall be solely responsible for deployment of his labor, equipment and materials during the period of notice and test, and no claims for extra payment for unproductive time in this period shall be made.

Tests shall be against blank flanges or end caps. Tests against closed valves shall not be permitted unless specified elsewhere in the Contract.

The Contractor shall take all reasonable precautions to prevent any undue wastage of water, and shall provide, fix, maintain and work all necessary storage tanks, pumps, pipes, cocks, fittings, hoses and other appliances as necessary.

2.5.4.6.3. Testing of Non-Pressure Pipelines

Non-pressure pipelines laid in open cut shall be tested after they are jointed and before any backfilling is commenced, other than such as may be necessary for structural stability whilst under test.

The pipelines shall be tested by means of an air or water test or by a visual or close circuit television (CCTV) inspection (as agreed with the Employer's Representative), in lengths determined by the course of construction, in accordance with a programme approved by the Employer's Representative. CCTV records shall be submitted together with as-built drawings of each part, zone or section of the Works.

A further test shall be carried out after the backfilling is complete.

Testing of non-pressure pipelines shall be performed in accordance with requirements of EN 1610 or as specified below.

2.5.4.6.4. Leakage test

Each part of the pipeline shall be tested for leakage. Contractor shall submit the method for testing of pipelines for Employer's Representative's approval.

2.5.4.6.5. Water Test for Non-Pressure Pipelines

The test pressure for non-pressure pipelines up to and including 750mm nominal bore shall be not less than 1.2 m head of water above the pipe soffit or ground water level, whichever is the higher at the highest point, and not greater than 6m head at the lowest point of the section. Steeply graded pipelines shall be tested in stages in cases where the maximum head, as stated above, would be exceeded if the whole section were tested in one length.

The pipeline shall be filled with water and a minimum period of 2 hours shall be allowed for absorption, after which water shall be added from a measuring vessel at intervals of 5 minutes and the quality required to maintain the original water level noted. Unless otherwise specified, the length of pipeline shall be accepted if the quantity of water added over a 30 minute period is less than 0.5 liter per linear meter per meter of nominal bore.

2.5.4.6.6. Air Test for Non-Pressure Pipelines

Non-pressure pipelines to be air tested shall have air pumped in by suitable means until a pressure of 100 mm head of water is indicated in a U-tube connected to the system. The pipeline shall be accepted if the air pressure remains above 75 mm head of water after a period of 5 minutes without further pumping, following a period for stabilization. Failure to pass the test shall not preclude acceptance of the pipeline if a successful water test, ordered by the Employer's Representative, can subsequently be carried out.

2.5.4.6.7. Testing of Pressure Pipelines (excluding PVC and Polyethylene pressure pipes)

Hydrostatic testing of pressure pipelines shall be performed in accordance with the requirements of EN 805 or as specified below:

- a) The entire pipeline shall be pressure tested.
- b) Gauges used for testing pressure pipelines shall either be of the conventional circular type, not less than 200mm diameter, calibrated in meters head water, or shall have a digital indicator capable of reading increments of 0.1m head. Before any gauge is used, the Contractor shall arrange for it to be checked independently, and a dated certificate of its accuracy shall be provided.
- c) Before testing, valves shall be checked and sealed, the sections of pipeline filled with water and the air released. After having been filled, pipelines shall be left under operating pressure for 24 hours, so as to achieve conditions as stable as possible before commencing testing.
- d) The pressure in the pipeline shall then be raised steadily until the specified test pressure is reached in the lowest part of the section, and the pressure shall be maintained at this level by pumping, if necessary, for a period of one hour. The pump shall then be disconnected, and no further water shall be permitted to enter the pipeline for a further period of one hour. At the end of this period the original pressure shall be restored by pumping and the loss measured by drawing off water from the pipeline until the pressure as at the end of the test is again reached.
- e) The permissible loss shall not exceed 2 liters per meter nominal bore per kilometer length per meter head (calculated as the average head applied to the section) per 24 hours.
- f) Test pressures shall be 1.5 x working pressure, with a minimum of 6 bars, except where instructed by the Employer's Representative.
- g) All testing apparatus and materials including cap-ends, blank flanges, etc. shall be provided by the Contractor. The Contractor shall provide all labor, plant and materials to carry out the pressure testing.
- h) The Contractor shall be responsible for the supply of water for pressure testing. Water for disposal shall be channeled to the nearest available watercourse/storm water drainage system as approved by the Employer's Representative.
- i) For the duration of the test air valves shall be isolated, valve gland packings shall be tightened down where applicable, and re-adjusted on completion of the successful test.
- j) Air tests shall not be permitted.
- k) Hydrostatic testing of steel pressure pipelines shall be carried out as specified in the relevant National guidelines. The test pressure for steel pipelines shall be a minimum of 1.5 times the working pressure.
- l) Hydrostatic testing of ductile iron pressure pipelines shall be as specified in the relevant National guidelines. The test pressure for ductile iron pipes shall be a minimum of working pressure plus 5 Bar.

- m) For all other pressure pipelines the test pressure shall not be less than the maximum pressure under surge conditions or the maximum pressure caused by pumping against a closed valve.
- n) The test pressure at the lowest point in the pipeline shall not exceed the maximum pressure recommended for the pipe being tested.
- o) Where a new pipeline is to connect to an existing pipeline, the new pipeline shall be tested up to the point of connection. After testing the connection shall be made up and left exposed for visual inspection by the Employer's Representative. The pipeline shall be accepted if no leakage can be detected under normal operating pressure after a period of 24 hours.
- p) Prior to testing any pressure pipeline the Contractor shall submit for the Employer's Representative's consent details of all temporary thrust blocks. These details shall be submitted with sufficient calculations to demonstrate that the thrust blocks shall resist the specified test pressure. The Contractor shall submit these details at least 10 working days before the commencement of the particular test.

2.5.4.6.8. Testing of PVC and Pressured Polyethylene Pipelines

Hydrostatic testing of pressure pipelines shall be performed in accordance with the requirements of EN 805 or as specified below.

Testing is to be done in accordance with the manufacturer's recommendations.

The hydrostatic test pressure for polyethylene pipes shall be 1.5 times the rated pressure for systems rated up to 10 bar and 1.5 times the working pressure for 12 or 16 bar systems.

Hydrostatic testing of PVC-U pipelines shall be carried out as specified in the relevant National guidelines or in accordance with manufacturer's instructions. The test pressure for PVC-U pipes shall be the greater of the rated pressure and 1.5 times the working pressure.

2.5.4.6.9. Deformation testing of plastic pipes

All plastic pipes for gravity use shall be tested for deformation after backfilling and compaction.

For non-man-entry pipes the deformation test can be performed by a robot or by using a calibre which is pulled through the pipe. The calibre size shall be agreed with the Employer's Representative.

The deformation shall be less than recommended by the pipe manufacturer for the installation of the specific location and considering the future load of soil cover, ground water at ground level and traffic, when the pipes are located in a road.

For man-entry pipes the deformation shall be determined by internal measurements at least for every 2 m of the pipeline length or as agreed with the Employer's Representative.

For deformations exceeding the acceptable values the soil above and around the pipes shall be removed and measures approved by the Employer's Representative shall be performed to rectify the deformation. A new test shall be performed after rectifying the deformation.

2.5.4.7. Manholes and Chambers

Unless otherwise specified in the contract, manholes on stormwater lines shall be constructed as reinforced concrete or precast concrete chambers in accordance with TS EN 1917. They shall be

provided with a reinforced cover slab and a ductile iron cover, and in areas with traffic, with a square, rectangular, or circular frame. The covers shall be suitable for a minimum anticipated load of 40 tonnes (class D400) on roads and shall comply with the provisions of CEN standard TS EN 124 and the equivalent Turkish Standard.

The bases, frames, and precast covers/cones used in the manholes shall be integrally gasketed to ensure 100% watertightness. From an operational perspective, the maximum spacing between manholes shall be designed as 60 m. Any increase in this spacing shall be subject to the approval of the Employer's Representative. At junctions and change-of-direction points, manholes with a minimum diameter of 1000 mm shall be installed.

Pipes passing through the concrete walls of a manhole shall be provided with ductile iron or water-retaining steel spool pieces. Alternative means to prevent water passage shall be subject to the approval of the Employer's Representative. A flexible joint shall be constructed as close as possible to the external surface of any manhole or other structure. The Contractor shall prepare the necessary design and type details for the stormwater collection manholes and, upon receiving the approval of the Employer's Representative, proceed with their manufacture.

2.5.4.7.1. Main Manhole Cover Assembly (Ductile Iron)

This specification covers the technical and other characteristics of the manhole closure element to be used within the scope of the work. The ductile iron covers to be used shall be submitted for approval by the Employer's Representative.

The ductile iron manhole cover to be used on the manholes within the scope of this specification shall have 3 ventilation holes, 3 stainless steel locks, a hinged mechanism that allows an opening of 110 degrees and shall be resistant to heavy loads of class D 400.

Cover Specifications

- Traffic Load: Heavy Traffic D400
- Load Bearing Class: D400 (400 kN) (minimum 40 tons)
- Locking System: The cover shall have 3 locking mechanisms.
- Ventilation Holes: The cover shall be manufactured with 3 holes.
- Cover Design: The surface patterns approved by the Employer's Representative shall be used.
- Hinge System: One stainless steel bolt shall be used in the hinge system. The bolt shall be manufactured from stainless steel in compliance with TS EN 10088-3 standards. The bolt diameter shall be Ø 18.
- Opening Angle: The covers shall be capable of opening at least 110 degrees.
- Coating and Painting:
 - The first layer shall be epoxy resin-based anti-corrosive primer spray.
 - The second layer shall be industrial-based paint applied without leaving any unpainted surface.
- Material Standard: The casting materials shall be manufactured from graphitic cast iron (ductile iron) in compliance with TS EN 124-2 and TS EN 1563.

- Casting Quality:
 - Material: GGG50
 - Tensile Strength: 500-650 N/mm²
- Casting Tolerances: Manufacturing drawings shall comply with the applicable standards of molding and casting techniques for tolerances and conicity that are not explicitly specified in the drawings.
- Markings: Covers and frames shall be marked as follows:
 - Manufacturer's name and logo
 - TS EN 124-2 standard
 - Manufacturing date (month/year)
 - These markings shall be embossed/engraved in the casting.
- Surface Finish and Quality:
 - Casting burrs on the materials shall be cleaned before painting. The cleaning process shall not deform the shape of the covers.
 - Covers shall be free from defects such as voids, bubbles, layering, and cracks.
 - Surfaces shall be smooth and cleaned by grinding and sandblasting.
 - Major surface defects requiring excessive grinding shall not be present.
 - The casting materials shall be free from casting voids and sand residues. (Covers shall undergo a sandblasting process.)
- Machining Requirements:
 - Seating surfaces of covers and frames shall be machined using turning and milling processes to remove burrs.
 - When the covers are placed on the frames, there shall be no gaps on the seating surfaces.
 - When pressure is applied at various points, there shall be no movement between the cover and its frame.
 - Chips and residual materials between the cover and the frame shall be removed by turning and milling to ensure a snug fit.
- Sealing Gaskets: No gasket grooves shall be made, and no gaskets shall be used.
- Storage and Protection: Covers shall be securely fastened, and their tops and sides shall be covered with stretch film to minimize exposure to water during storage.
- Manufacturing Capability Requirement: Only manufacturers with in-house automatic molding lines shall be accepted for the production of manhole covers. The manufacturer shall provide documentary evidence to prove compliance with this requirement.

Manhole Elevation Adjustment (Raising/Lowering)

To prevent damage to manhole covers after manufacturing, the manhole elevations shall be adjusted by considering the road pavement thickness, and the manhole covers shall be carefully installed. Following the backfilling work by the Contractor, during the asphalt paving process, if the manhole elevation is found to be higher or lower than the finished road level, adjustment rings shall be used to align the manhole elevation with the final road level.

If the manhole covers need to be raised or lowered, the surrounding asphalt shall be cut using an asphalt cutting machine. The asphalt shall be broken using a compressor, and the manhole cover shall be removed.

- Raising Process: If raising is required, precast concrete elements shall be used to elevate the manhole to the asphalt level.
- Lowering Process: If lowering is required, the necessary breaking work shall be performed, and after cleaning the inside of the manhole, the manhole cover shall be lowered to the existing asphalt level. The surrounding area shall then be re-asphalted.

During these operations, the necessary safety precautions shall be taken, and the work area shall be secured with a safety barrier.

2.5.4.8. Ductile Iron Stormwater Grating

This section covers stormwater grating assemblies consisting of a frame and grate element, manufactured in accordance with TS EN 124-2 standards and classified under the D400 heavy traffic load class. The ductile iron stormwater gratings proposed for use shall be submitted for approval by the Employer's Representative.

Technical Specifications

- Load Capacity Class: The stormwater grating shall have a load-bearing class of D400 (400 kN) (minimum 40 tons).
- Material Standard: As defined in TS EN 124-2, the grate and frame shall be made of spheroidal graphite cast iron (ductile iron) of grade GGG50 (EN GJS-500-7), in accordance with TS EN 1563. The mechanical properties of the spheroidal graphite cast iron used are provided in **Table 1**.

Table 1: Mechanical Properties of Spheroidal Graphite Cast Iron

Material	Tensile Strength (N/mm²)	Yield Strength (N/mm²)	Elongation at Break (Min. %)	Brinell Hardness
GGG50 (EN GJS-500-7)	500-650	320-420	7	170-240

Stormwater gratings shall be equipped with two automatic locks and one manual lock mechanism. The hinge and locking mechanism shall be manufactured from spheroidal graphite cast iron (ductile iron) of GGG50 (EN GJS-500-7) quality in accordance with TS EN 1563.

The bolt used in the locking mechanism shall be made of stainless steel, manufactured with an M16 thread in compliance with TS EN ISO 3506-1, and shall have a square head. Five (5) lock opening/closing keys compatible with the locking mechanism shall be delivered to the Employer's Representative along with the grating assemblies, at no additional cost.

The hinge system of the gratings shall include two stainless steel bolts and nuts,

- The bolts and nuts shall be manufactured from stainless steel in compliance with TS EN ISO 3506-1. The bolts shall be Ø14.
- The stormwater grating cover design shall conform to the surface patterns approved by the Employer's Representative.
- The grating covers shall be capable of opening to at least 110 degrees.
- The gratings shall be coated with industrial-based black paint, ensuring complete coverage with no unpainted areas.
- For any tolerances and taper not specified in the manufacturing drawings, the relevant molding and casting standards shall apply.
- Casting burrs shall be removed prior to painting without deforming the cover shape.
- The cover surfaces shall be free of voids, bubbles, layering, and cracks.
- Surfaces shall be smooth, cleaned by grinding and sandblasting, with no excessive grinding to correct major defects.
- The materials shall be free from casting voids and sand residues. (Grating covers shall undergo a sandblasting process.)

Marking and Packaging

Stormwater grating elements shall be assembled and ready for use, securely bundled in groups of ten (10), and delivered with their tops and sides covered with stretch film to ensure protection against water exposure.

The following information shall be embossed or recessed on the grating and its frame during the casting process at the locations specified in the drawings:

- Antalya Metropolitan Municipality name and logo
- Manufacturer's name or logo
- Standard Number – TS EN 124-2
- Class Marking – D400
- Material Type and Quality – GGG50
- Manufacturing Year and Month
- Batch Number

2.5.4.8.1. Tolerances

The maximum allowable deviation from the specified alignment and level for pipeline installations shall be as follows:

- For diameters up to 600 mm: 10 mm
- For diameters greater than 600 mm: 15 mm

However, any reverse slopes that may occur during pipe installation shall not be accepted, and special care shall be taken to ensure the accurate implementation of project elevations in the field.

2.5.4.9. Corrugated High-Density Polyethylene (HDPE) Pipes, Equipment, and Accessories

2.5.4.9.1. Scope

This material specification covers the minimum requirements for the design, manufacturing, testing, inspection, and supply of double-walled pipes and fittings produced from HDPE raw material through extrusion-corrugator molding for use in construction.

2.5.4.9.2. Applicable Standards and Codes

The codes and standards specified here form part of this specification. The latest editions of these codes and standards shall be applied to the works.

HDPE double-walled stormwater pipes and fittings shall be manufactured in compliance with TS EN 13476-3:2018+A1, while the seals shall comply with TS EN 681-1. The conformity certificate for the mentioned materials shall be obtained from the Turkish Standards Institute (TSE).

- Impact tests shall be performed in accordance with TS EN ISO 3127 (Maximum 10% breakage is allowed).
- Leakage tests shall comply with TS EN ISO 13254 (No leakage at 0.5 bar).
- Longitudinal dimensional change test shall comply with TS EN ISO 2505 (Dimensional change shall not exceed 3%).
- Thermal behavior tests shall be conducted in accordance with TS ISO 12091 and TS 12132 (No deformation should occur).
- Raw material specifications shall comply with TS EN 12201-1 and TS EN 12201-2 (Chemical composition).

All tests shall be conducted in compliance with TSE and ISO requirements.

2.5.4.9.3. Technical Specifications

Material Requirements

All HDPE corrugated pipes shall be manufactured to meet the minimum SN 8 class requirements.

HDPE double-walled stormwater pipes shall comply with TS EN 13476-3:2018+A1 (SN 8). The hardness value of the seals shall be 60±5 IRHD. Pipes shall be supplied in 6-7 m or 12 m lengths with socket-type connections. Upon the request of the Employer's Representative, 12 m pipes may be used in areas with high groundwater levels to reduce the number of connection points.

The Contractor shall specify the resin manufacturer, resin type, and class. Additionally, the Contractor shall provide evidence that the proposed resin is suitable for the specified project temperature and pressure conditions.

Any modifications to material specifications or the manufacturer's production site shall be subject to approval by the Employer's Representative. The pipes and fittings shall have a homogeneous structure and shall be free from visible cracks, holes, external materials, bubbles, scratches, or other defects. Joints or additions shall not be accepted.

The material shall be uniform in opacity, density, internal surface smoothness, and other physical properties. After manufacturing, the pipes shall exhibit sufficient resistance to wear and degradation for at least two years under outdoor storage conditions.

Pipes and fittings shall be made exclusively from polyethylene containing only the necessary antioxidants, UV stabilizers, and pigments required for pipe production, in compliance with the Employer's Representative's requirements and the technical specifications.

The pipes shall have sufficient wall thickness to withstand an internal pressure of at least 0.5 bar.

HDPE and PP pipes shall be equipped with gasketed socket-type joint connections.

The inner surface of the pipes shall be smooth, while the outer surface shall have a profiled structure. The inner layers and profiles shall have a homogeneous and uniform structure.

The pipe ends shall be cut perpendicular to the pipe axis, and the pipes shall be free from bulges, voids, sharp edges, burrs, or similar defects.

For pipes and fittings, compliance with TS EN 13476-3:2018+A1 shall be certified, and for gaskets, compliance with TS EN 681-1 shall be documented.

C-shaped fittings shall be produced using the injection molding method.

The produced pipes shall be permanently marked with the ASAT General Directorate's name and the pipe type, in a way that cannot be erased.

The inner lining of the pipes shall be yellow or orange in color.

Test Results

The manufacturer shall maintain records of test results in accordance with the relevant standards and the requirements of this specification.

The manufacturer shall conduct all necessary tests to verify the properties and quality of the resin-based material and to confirm the dimensional tolerances of the pipe.

The manufacturer shall prepare documentation containing the test results at the specified intervals in accordance with the standards.

Notes for determining test frequencies:

- Straight-length pipes shall be tested at the same frequency as spiral-wound pipes.
- A continuous trial operation refers to the production of pipes of the same resin, diameter, and wall thickness under a single order without interruptions or modifications in the manufacturing process.

The Contractor/Manufacturer shall provide the Employer's Representative with copies of all material certificates, including the control and test results obtained during the quality verification process. Upon request, the manufacturer shall also provide all production records, process control diagrams,

and other documentation compiled during the manufacturing process, ensuring full access to these records.

2.5.4.9.4. Marking and Manufacturer's Documentation

Pipe Indification

Each manufactured pipe shall be marked twice per length with the following information:

- Manufacturer's name or logo
- Antalya Metropolitan Municipality ASAT General Directorate inscription
- Inner diameter of the pipe
- Ring stiffness SN class
- Year of manufacture
- Standard number

The identification information and its order shall comply with DIN 16961, EN 155, TS 12132, and the requirements of this specification.

Shipping

The Contractor/Supplier shall submit the packaging and shipping procedures for the Employer's Representative's approval and shall comply with the requirements outlined below.

Protection Against Ultraviolet (UV) Radiation and Storage

The Contractor/Manufacturer shall notify the Employer's Representative of the protection method to be applied one month before production for review and approval.

The stacking height of the pipes shall not exceed 2.5 meters.

Pipes shall not be stacked in a way that could cause deformation.

Additionally, appropriate protective covers shall be used to prevent direct exposure of the pipes and fittings to sunlight.

Transportation

For the transportation of pipes by road vehicles:

- The vehicle bed shall be flat, with no sharp edges or protrusions.
- During transport, polyethylene pipes shall be protected from diesel exhaust fumes.
- The pipes shall be properly supported to prevent friction between the pipe and the support structures.

2.5.4.10. Manufacturing, Testing, and Commissioning of Corrugated Pipes

2.5.4.10.1. Scope

This specification covers the minimum requirements for the assembly, butt welding, socket jointing, fusion welding, installation, and related processes of high-density polyethylene (HDPE) pipes and fittings in the field.

2.5.4.10.2. Applicable Standards and Codes

The codes and standards specified here form an integral part of this specification. The latest editions of these codes and standards shall be applied to the works.

The following standards shall be followed:

- For pipes: DIN 16961, EN 155-10, TS 12132
- For raw materials: TS EN 12201-2
- For all testing procedures: TSE and ISO standards

All pipes and fittings shall be resistant to chemicals.

2.5.4.10.3. Pipe Laying and Jointing

Pipe Laying

The pipes shall be laid in accordance with the alignment and slopes proposed by the Contractor and approved by the Employer's Representative. String lines, laser beam equipment, or optical measuring instruments shall be used to ensure the correct alignment and slope.

If laser measuring instruments are used, periodic elevation measurements shall be carried out with optical measuring instruments to verify the accuracy of the slopes. If thermal deviations occur due to temperature differences between the ground and the air inside the pipe, necessary corrective measures shall be taken to minimize or eliminate such deviations.

During the bedding process, lateral displacement of the pipe shall be prevented. The pipes shall not be laid in water or under adverse weather and trench conditions.

Unless otherwise permitted by the Employer's Representative, pipe installation shall commence from the downstream end (outlet).

When pipe laying is suspended, the open end of the pipe shall be securely closed with an end cap to prevent the ingress of soil and sand. The end cap shall have several small holes in its center to allow controlled water entry, preventing the pipe from floating in case the trench is flooded.

All joint preparation and connection procedures shall comply with the manufacturer's instructions and recommendations.

Pipe laying and jointing operations shall be conducted in dry trench conditions. The end caps shall only be removed immediately before the pipe jointing process.

To avoid stress-inducing actions at pipe placement and jointing locations, the following precautions shall be taken:

- During installation, the pipe shall not be damaged due to contact with sharp objects.
- If the corrugated pipe is pulled into place, the pulling force shall not exceed the safe pulling force specified by the manufacturer or supplier.
- Uniform support for the pipe shall be ensured.
- Pipe bedding, encasement, and backfilling shall be performed using materials specified in the backfill section of this specification.

- If the pipe is installed within a casing, the casing ends shall be arranged to prevent the transfer of stress or shear forces to the corrugated pipe.

Corrugated Pipe Jointing

The Contractor may engage a subcontractor to apply the jointing techniques specified below, using either socket-type or spigot-type connections to assemble the corrugated pipe system. The subcontractor shall be approved by the Employer's Representative.

For connections to existing pipelines and at locations designated and approved by the Employer's Representative, socket and spigot jointing methods may be used.

2.5.4.10.4. Method Statement

Method Statement for Corrugated Pipe Jointing

A detailed Method Statement for corrugated pipe jointing shall be prepared by the Contractor and submitted for approval by the Employer's Representative. The Method Statement shall provide a comprehensive explanation of how the work shall be carried out in compliance with the manufacturer's or supplier's requirements and recommendations, as well as the conditions specified in this technical specification.

Testing Method

Upon completion of each section between two manholes, the pipeline shall be cleaned and tested hydrostatically to verify its structural integrity and watertightness. The testing shall be conducted in accordance with the relevant codes and standards specified in this specification and the manufacturer's recommendations. The Contractor shall supply all necessary testing components, equipment, and facilities, including test connections.

Method Statement for Pressure Testing

The Contractor shall prepare a detailed Method Statement for the pressure test and submit it for approval by the Employer's Representative. The Method Statement shall be based on the relevant codes, standards, and conditions outlined in this specification, but shall not be limited to these provisions.

Test Pressures

- The test pressure shall be a maximum of 0.5 bar or 5 meters of water column in the manhole.
- Pipe tests shall be conducted from manhole to manhole using water.
- Each section of wastewater and stormwater drainage pipes shall comply with the acceptance test conditions and be approved by the Employer's Representative.
- However, for gravity pipelines with an internal diameter of 800 mm or larger, the pipeline shall be visually inspected from the inside and tested using appropriate sealing test equipment at the joint locations.

The Contractor shall submit the testing method and equipment to the Employer's Representative for approval. If repairs are required at the pipe joints, the Contractor shall carry out these repairs using materials compliant with the technical specifications and approved by the Employer's

Representative. All defects shall be rectified in accordance with the Employer's Representative's acceptance criteria.

Inspection Before Commissioning

Before commissioning, all pipelines shall be inspected using a Modular TV Inspection System, which shall involve sending a robotic camera inside the pipes to examine the entire length of the pipeline.

Light Test

Unless otherwise specified by the Employer's Representative, each section of the wastewater pipeline between manholes shall be laid straight and at a uniform slope. Each section shall be inspected using a light test, performed by the Employer's Representative.

The Contractor shall provide personnel to assist the Employer's Representative and supervisory staff in conducting this inspection.

2.5.4.11. High-Density Polyethylene (PE100 PN10) Pipes, Equipment, and Accessories

2.5.4.11.1. Scope

This material specification covers the minimum requirements for the design, manufacturing, testing, inspection, and supply of PE100 PN10 pipes and equipment produced from high-density polyethylene (HDPE) raw material using the extrusion molding process within the scope of the project.

2.5.4.11.2. Technical Specifications

Material Properties

Compound

The compound is the mixture obtained by adding only the necessary additives for manufacturing and final use to the polyethylene-based polymer from which the product is made. The properties of this compound shall comply with the relevant sections of TS EN 12201-1, TS EN 12201-2, and TS EN 12201-3 standards. The additives shall be uniformly distributed throughout the material.

Colour

The compound shall be black. The carbon black used in the manufacturing of black compounds shall have an average particle size between 10 nm and 25 nm.

Use of Reprocessable and Recycled Material

No material other than the original raw material shall be used in production.

Physical Properties of the Compound

The granular properties of the PE100 compound used in pipe manufacturing shall conform to the specifications outlined in the following table.

Table 2: Raw Material Tests and Acceptance Criteria

Test Name	Standard	Acceptance Criteria
Carbon Black Content	TS ISO 6964	2.0 – 2.5% by mass
Ash Content	TS ISO 6964	Max. 0.1% by mass
Carbon Black Dispersion	TS ISO 18553	Arithmetic mean ≤ 3.0
Melt Flow Rate (MFR)*	TS EN ISO 1133-1 Method A	190°C, under 5 kg load: 0.20 – 0.35 g/10 min
Oxidation Induction Time (OIT)	TS EN ISO 11357-1, 11357-6	At 200°C test temperature: ≥ 20 min
Density	TS EN ISO 1183-1 Method A	≥ 950 kg/m ³
Volatile Content	TS EN 12099	≤ 350 mg/kg
* MFR tests shall be conducted separately for the raw material and the pipe. The difference between the two results shall not exceed $\pm 10\%$ of the raw material value. ** According to TS EN ISO 12162, at 20°C, the MRS (Minimum Required Strength) value after 50 years shall be at least 10 MPa.		

2.5.4.11.3. Pipe and Fitting Marking, Inspection, and Testing Criteria

Pipe Identification

All pipes and fittings, including test samples, shall be marked with permanent, legible, and indelible markings in a color contrasting with the pipe color. The markings shall be repeated at least every 1.0 meter and shall be parameterized to facilitate total pipe length determination (e.g., 1.00, 2.00, ..., 100.00).

The following information shall be visible on the outer surface of the pipe:

Information to be Marked	Marking or Symbol
Standard Number	TS 418-2 or TS EN 12201-2
Manufacturer Identification	Name or Symbol
Authority Name	ASAT General Directorate
Dimensions (dn x en)	Example: 110 x 10.0
SDR Series	Example: SDR11 – SDR17
Material and Classification	PE 100
Pressure Class (in bar)	Example: PN10 – PN16
Manufacturing Date (Date or Code)	Example: 9302(a)

2.5.4.11.4. Shipment

The Contractor/Supplier shall submit the packaging and shipment procedures to the Employer's Representative for approval and shall comply with the conditions outlined below.

2.5.4.11.5. Protection Against Ultraviolet (UV) Radiation and Storage

The Contractor/Manufacturer shall notify the Employer's Representative of the protection method to be applied at least one month before production for review and approval. The stacking height of the pipes shall not exceed 2.5 meters, and pipes shall not be stacked in a way that could cause deformation. In addition, appropriate protective covers shall be used to prevent direct exposure of the pipes and fittings to sunlight.

2.5.4.11.6. Transportation

For the transportation of pipes by road vehicles, the vehicle bed shall be flat, with no sharp edges or protrusions. During transport, polyethylene pipes shall be protected from diesel exhaust fumes. The pipes shall be properly supported to prevent friction between the pipe and the support structures.

2.5.4.11.7. Pipe Jointing

Polyethylene pipe joints shall be made using the butt fusion welding method, and the production stages are described below:

Butt Fusion Welding Method:

The welding process is carried out using a butt fusion welding machine, with the following steps:

- a) If electricity is supplied via a generator, the generator shall have a voltage regulator and a minimum power capacity of 4 kW.
- b) The pipe is placed in the butt-welding machine without causing deformation or ovalization.
- c) The pipe ends are planed and leveled using a trimming tool.
- d) The trimming tool is removed, and the pipes are aligned end-to-end, ensuring proper axial alignment and confirming the pipe ends meet correctly.
- e) A Teflon-coated heating plate is inserted between the pipe ends and heated to 200-230°C.
- f) A pressure of 0.18 – 0.22 MPa is applied until the desired bead height is reached according to the welding parameters.
- g) Once the required bead height is achieved, the applied pressure is released, and free heating continues for the time specified in the parameter list.
- h) At the end of the heating period, the pipes are separated from the heating plate, and within the specified time, the heated pipe ends are pressed together at 0.18 – 0.22 MPa.
- i) The pipes are kept under pressure for the cooling period specified in the welding parameters, after which the pressure is released.

Precautions shall be taken in windy and rainy conditions.

Wind negatively affects welding quality, causes the heating plate to cool, and results in uneven heat distribution. To protect the welding area from sun, wind, and dust, it is recommended to enclose the area with a tent or protective covering. It is crucial to clean the pipe ends and heating plate from dust,

stones, and other contaminants before welding. Open pipe ends should be covered to prevent turbulence.

Contamination of the welding area significantly reduces the durability of the joint. Double-clamp alignment equipment shall be used to prevent ovalization of the pipes.

2.5.4.11.8. Pipe Pressure Tests and Commissioning

Pressure tests shall be carried out in accordance with the relevant specifications of the Employer's Requirements.

During the pressure test, a pressure equal to 1.5 times the maximum nominal pressure shall be applied.

The length of the pipeline section to be tested shall generally not exceed 500 meters.

To ensure the support and stability of the pipeline before filling it with water, not only the pipe ends but also all vertical and horizontal supports and junctions shall be adequately anchored and secured. This prevents pipeline movement, which could cause leaks at the joints during testing and operation. The support structures and anchoring blocks shall be designed according to the applied test pressure, considering the stress impact on the ground. The end supports of the pipeline shall not be removed until the pressure is fully released. On straight pipeline sections, securing the pipes to the trench walls at appropriate intervals is recommended.

The pipeline shall be filled with water of suitable quality, ensuring no air remains inside.

The manometer used for pressure testing shall be calibrated and precise. A backup manometer shall also be available. The manometer is generally installed at the lowest point of the pipeline.

Before applying pressure, a preliminary test shall be conducted as a preparatory step. The preliminary test shall be performed at static pressure for a minimum of 2 hours.

If water leaks (such as dripping or seepage) are detected during the preliminary test, the test shall be interrupted, and the pipeline shall be drained to remove all water from the leak points. The test shall be repeated only after all leaks are completely eliminated.

For the main pressure test, a pressure equal to 1.5 times the maximum nominal pressure shall be applied for 2 hours. In gravity pipelines, the test shall be conducted at static pressure. In pressurized pipelines, the test shall be conducted at 1.5 times the maximum nominal pressure.

If the preliminary test results are positive, the main pressure test shall begin immediately without reducing the pressure.

At the end of the test period, if the pressure drop does not exceed 0.25 kg/cm², if no movement is detected in the pipeline due to insufficient support, fixing, or anchoring, and if no signs of future movement that could lead to water leaks are observed, then the test shall be considered successful.

The tested section shall not exceed 500 meters in length, and all connection points between main pressure-tested sections shall be confirmed to be leak-proof under at least static pressure (main test pressure).

Inspection and quality control shall be conducted according to TSE CEN/TS 12201-7, and system compliance shall be verified according to TS EN 12201-5.

2.5.4.11.9. Polyethylene Pipe Fittings

PE100 polyethylene fittings shall comply with the TS EN 12201-3 standard. Additionally, the valid version of TS EN 12201-3 shall also be accepted.

The properties of the PE compound used in the manufacturing of fittings shall comply with TS EN 12201-1.

General Requirements

All components shall comply with the relevant EN standards. Provided that fitness for purpose is ensured, compliance with other standards shall be acceptable in cases where an applicable EN standard does not exist.

The materials used in the manufacturing of fittings and components (including elastomers, greases, and metal parts) shall be resistant to internal and external environmental conditions, just like the other elements of the pipe system, and their expected lifespan shall be at least equivalent to that of PE pipes compliant with EN 12201-2:2003, under the following conditions:

- a) During storage,
- b) Under the influence of transported fluids,
- c) Under operational environmental conditions.

For components made of materials other than polyethylene, the performance characteristics of the material shall be at least equivalent to those of the polyethylene used for the pipe system.

The fitting material in contact with the PE pipe shall not negatively affect the pipe's performance or initiate stress cracking.

Metallic Components

Metallic parts that are prone to corrosion shall be adequately protected against corrosion. If different metallic materials are used, precautions shall be taken to prevent galvanic corrosion that may occur when they come into contact with moisture.

Elastomers

Elastomeric materials used in the manufacturing of seals shall comply with EN 681-1 or EN 681-2, depending on applicability.

Other Materials

Lubricants, greases, or other substances shall not come into contact with surfaces intended for fusion welding. Such substances shall not affect the long-term performance of the fittings or have a negative impact on water quality.

2.5.5. DESIGN AND CONSTRUCTION CRITERIA

2.5.5.1.Regulations and Standards

The design, construction, testing, implementation, acceptance, and operation of all works shall comply with local specifications and regulations in addition to Turkish Standards (TS), which shall take first priority whenever applicable.

Without being limited to the standards listed below, the most current versions of the following standards shall be used in full or in part as required.

In cases where specific provisions are not defined in the listed standards, other national and international standards may also be used upon approval by the Employer's Representative.

- Turkish Standards (TS)
- European Norm (EN)
- International Standards Organization (ISO)
- Deutsches Institut für Normung (DIN)
- American Society for Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- American Concrete Institute (ACI)
- American Society of Mechanical Engineers (ASME)
- Institute of Electrical and Electronic Engineers (IEEE)
- International Electrotechnical Commission (IEC)
- British Standards (BS)

The Contractor shall be responsible for ensuring compliance with all contractual requirements, including the proper selection of materials and equipment and the design's suitability for the intended purpose.

For load considerations, Turkish regulations and codes (especially seismic regulations) shall be used as the primary reference.

The latest versions of the following Turkish or equivalent regulations and standards shall be used for design purposes, ensuring that settlement, deflection, and stress limits are not exceeded:

Foundation Works:

The design and construction of foundations shall comply with Turkish Standards (TS EN 1998-5).

Structural Concrete Works:

Structural concrete works shall be designed and constructed in accordance with Turkish Standards (TS 500).

Structural Steel Works:

The design, manufacturing, and installation of structural steel works shall comply with Turkish Standards (TS 648).

Brick / Concrete Block / Aluminum Joinery Wall Partitions / Autoclaved Aerated Concrete (AAC) Walls / Fiber Cement Board (Betopan) & Gypsum Board (Sheetrock) Works:

The design and construction of walls shall comply with current TS Standards.

Liquid Retaining Concrete Structures:

The design and construction of liquid retaining concrete structures shall comply with BS 8007, EN 1992-3, or other equivalent standards approved by the Employer's Representative.

Sound Insulation:

All roof and wall cladding systems, including ventilators, openings, doors, windows, etc., shall be designed and constructed to ensure that the noise level at the site boundary does not exceed the values specified in the planning permission requirements.

The Contractor's design shall comply with planning permission requirements, building regulations, and fire safety criteria.

Thermal Insulation:

The design and construction of buildings shall comply with "TS 825 May 2008 – Thermal Insulation in Buildings."

Building Heating:

During building design and dimensioning, sufficient space shall be provided for the safe installation, operation, and maintenance of all facilities and equipment.

2.5.5.2. Submission of Design

The Contractor shall be required to prepare comprehensive design calculations and detailed implementation drawings for foundations, piles, building structures and enclosures, temporary and permanent site infrastructure (services), building services, etc. as necessary. The Contractor shall carry out the detailed design of the structures, ensuring that their strength and safety meet the structural, dynamic, acoustic, hydraulic, and environmental requirements.

Additionally, the Contractor shall be responsible for ensuring that the design complies with planning permission requirements, environmental declarations, and regulatory authority requirements.

When designing structures, adequate space shall be provided to allow for the safe installation, operation, and optimized maintenance of facilities and equipment.

The Contractor shall be responsible for managing all stages of the design process within the scope of the construction works.

All technical services (electrical, mechanical, plumbing, etc.), as well as building automation, landscaping, and traffic engineering services, shall be provided.

The design shall comply with the latest Turkish standards or their equivalents.

2.5.5.3. Calculations and Drawings

Before any construction work begins and sufficiently in advance of manufacturing, the Contractor shall prepare and submit to the Employer's Representative copies of structural and dynamic design calculations and detailed drawings for review.

Design calculations shall be performed in accordance with an approved method and shall include the most unfavorable combination of dead loads, live loads, dynamic loads, and wind loads.

The Contractor shall make any necessary modifications to the design to ensure that the work complies with the contract requirements.

The calculations shall clearly define the subject matter and shall include, but not be limited to, the following information:

All construction-related details shall be provided by the Contractor in the prepared drawings and data sheets.

The Contractor shall be responsible for the design, preparation, and verification of all calculations and drawings.

2.5.5.4. Loads

Dead loads and live loads shall be determined in accordance with Turkish Standard TS 498 or an equivalent standard. Dynamic loads shall be based on the guaranteed and specified values provided by the suppliers of various equipment and installations. The Contractor shall ensure that all loads arising during construction, operation, and maintenance are taken into account in load determination.

The Contractor shall consider the loads occurring in temporary storage areas of the facility. When calculating vehicle loads, the Contractor shall take into account the maximum anticipated moving loads, considering that vehicles may carry various components of the facility and equipment.

Soil loads shall be calculated in accordance with TS 498 or an equivalent standard. Buildings, structures, and their appendages shall be designed to withstand all calculated loads according to Turkish Standards.

Buildings shall be designed to ensure that vibration, noise, and temperature levels remain within specified limits. Building walls, doors, and windows shall be designed to be waterproof under severe weather conditions, considering the assumed wind speed.

Structures and all their components shall demonstrate satisfactory performance under anticipated settlement, deflection, and stress limits, as well as under the combined effects of dead loads, live loads, dynamic loads, wind forces, installation forces, secondary stresses, impact loads, temperature variations, and shrinkage effects.

Buildings and steel structures shall be designed in accordance with Turkish seismic regulations and codes.

2.5.5.5. Foundation Design

The scope of this section includes the preparation of foundations for structures, buildings, roads, pipelines, and other relevant works. All foundations shall be free from loose materials, rubble, and other undesirable organic substances, as approved by the Employer's Representative.

The soil improvement and foundation designs for the units within the project scope shall be specified in the approved project documents submitted by the Contractor, and all construction shall be executed accordingly. The Contractor shall take into account the "Soil and Foundation Investigation Data Report" provided in the specification attachments (Attachments 2a and 2b) while preparing the foundation designs.

The Contractor shall design and construct foundations in compliance with TS EN 1998-5 or an equivalent standard, ensuring stability against overturning, soil failure, excessive settlement, heaving, and sliding. The risks of unacceptable soil deformation and settlement shall be carefully considered. The angular distortion, horizontal and vertical movements resulting from soil compaction shall not exceed the allowable limits, ensuring the facility operates safely and efficiently without excessive wear or deterioration.

The foundations of steam turbines and all other machinery components with significant dynamic effects shall be designed with special consideration. In these designs, the net bearing pressure transferred to the foundation shall be of particular importance. The bearing pressure values, including those induced by static loads and dynamic effects, shall be kept within acceptable limits approved by both the Employer's Representative and the Contractor, ensuring that the machinery operates continuously and efficiently.

A dynamic analysis shall be conducted for such foundations to demonstrate that no resonance occurs between the foundation and the machine components. The analysis methods shall comply with Turkish Standards or internationally recognized standards. The dynamic analysis calculations shall consider predicted and acceptable settlements, frequency and amplitude variations under different dynamic loads, and acceptable limits for different vibration modes. Additionally, the calculations shall include a detailed assessment of the frequency relationship between the machinery's various operating speeds and the natural frequency of the foundation/soil, as well as assumptions based on soil characteristics. The Contractor shall also evaluate the impact of differential settlements on the operation of equipment such as overhead bridge cranes, ensuring that such equipment continues to function at the required performance levels.

For buildings located on local soil class ZE, special emphasis shall be placed on foundation design, soil improvement methods, liquefaction analysis, and seismic safety. Soil investigations and engineering analyses shall play a critical role at every stage of the construction process. The duration between foundation preparation and the construction of the superstructure shall be kept as short as possible.

In areas where the bearing capacity of the soil is insufficient, pile foundations may be required for supporting structures. The Contractor shall prepare a detailed project plan for such structures in accordance with the Contract Agreement and Employer's Representative requirements. The Contractor shall determine the most suitable structural type, the number of piles, their loads, and the optimal pile arrangement for adequate support.

Piles shall be designed in compliance with the most recent TSE standards, properly tested, and constructed using materials and workmanship approved by the Employer's Representative. Piles shall be designed to reinforce settlements under specific loads, ensuring that specified loading limits are not exceeded. The Contractor shall estimate the approximate pile lengths based on the evaluation of existing geotechnical data and additional field investigations conducted by the Contractor. Manufacturing shall only commence upon approval by the Employer's Representative.

The Contractor shall perform an independent assessment of the site conditions and conduct additional field investigations, including necessary drilling and testing. Once the detailed project plans are completed and the loads transferred to the ground are accurately determined, the soil improvement project shall be reviewed if an increase in ground loads is observed.

Once the construction application projects are prepared and the ground loads are precisely identified, soil rehabilitation projects shall be developed if the ground loads increase. These soil rehabilitation projects shall use the above design principles as the minimum soil improvement criteria. The Contractor shall execute the necessary foundation improvements in accordance with the soil rehabilitation projects, which shall be prepared, reviewed, and approved by the Employer's Representative during the engineering and design stage.

2.5.5.6. Reinforced Concrete Shear Walls

All reinforced concrete walls within the scope of the contract shall be designed in compliance with thickness criteria, with a minimum wall thickness of 25 cm.

During the construction of all reinforced concrete walls, the system shall be supported on both sides and in both directions. It shall be assumed that the walls are fixed to the ground slab or deck, and hinged or sliding walls shall not be permitted under any circumstances.

In the design process, the partial walls within liquid-retaining structures shall be designed to withstand unilateral water pressure.

2.5.5.7. Reinforcement

The properties of reinforcement bars shall be as follows:

- Steel Grade: S420 / B420C
- Modulus of Elasticity (E_s): 2,000,000 kgf/cm²
- Yield Strength (F_{sy}): 4,200 kgf/cm²
- Equivalent Carbon Ratio: < 0.55
- (R_m/R_e): < 1.35

Regarding the concrete cover thickness for reinforcement:

- For liquid-retaining structures, retaining walls, etc.: Minimum 50 mm
- For other concrete structures: Minimum 35 mm

2.5.5.8. Crack Width Criteria in Concrete

An elastic analysis shall be conducted to calculate the stress in concrete, considering the potentiality of cracking under service loads as well as the effects of tension and creep.

The maximum allowable crack width in concrete under service load conditions shall be determined in accordance with relevant standards, ensuring that necessary conditions are met to minimize cracks caused by temperature variations, tensile stresses, and creep effects.

For water-retaining structures, the maximum permissible crack width (W_{max}) under service load conditions shall be 0.20 mm.

2.5.5.9. Elevations

All design and construction shall be based on an accepted reference point (benchmark) corresponding to the average sea level. The Contractor shall ensure the design, construction (including pumping), and protection of construction works according to site conditions.

2.5.5.10. Fire Protection Criteria

The Contractor shall design the fire suppression systems, including pipes, pumps, and all electromechanical components, in compliance with the latest applicable Turkish Standard (TS). The design shall be submitted to the Employer's Representative for approval, and fabrication shall only commence after approval is granted.

Non-combustible or fire-resistant materials shall be used in construction. The Contractor is responsible for implementing all fire safety measures in the design, manufacturing, and operational phases of the facility. All buildings within the contract scope shall be designed in accordance with Turkish Standards.

To limit fire spread, all floors and certain walls shall be designed as fire compartment barriers. These barriers shall act as obstructions against the spread of smoke, heat, and other harmful combustion byproducts. These barriers shall be fire-resistant for a minimum of 2 hours.

Doors shall have a fire-resistance rating of at least half the fire-resistance capacity of the wall in which they are installed. Certain exceptional doors in fire compartment walls shall have a fire-resistance rating equal to or greater than the fire compartment wall itself. All doors shall be fire-resistant for a minimum of 2 hours.

Elevator shafts shall be enclosed, and fire protection system approvals shall be obtained from the fire department. Fire exits and external doors shall comply with the Fire Bridge Department's local regulations and the Employer's Representative's and Employer's approval.

2.5.5.11. On-Site Service Connections and Existing Services

The Contractor shall cover the costs of connecting all on-site services, including electricity, water, gas, and telephone, from the connection points indicated in the existing facility drawings. The Contractor shall also be responsible for making the necessary arrangements for air, surface water, and wastewater requirements.

Before commencing any excavation work, the Contractor shall conduct a site survey to confirm the exact locations of all existing cables and service lines. The Contractor shall carry out all excavations with extreme caution. The compliance of excavations with the project specifications shall be inspected by the Employer's Representative.

The absence of records or drawings for a service line shall not exempt the Contractor from the responsibility of covering the costs for repairing any damage caused to such service lines.

2.5.6. DESIGN REQUIREMENTS

All liquid-retaining structures within the scope of the contract shall be designed in compliance with the following regulations:

- TS 498 – Structural Load Calculation Values for Structural Elements (September 2021)
- BS 8007 – British Standard Code of Practice for Design of Concrete Structures for Retaining Aqueous Liquids (1987)
- BS 8110-1 – British Standard Code of Practice for Design and Construction of Concrete Structures (1997)

- General Directorate of State Hydraulic Works (DSİ) – General Technical Specification for the Construction of Water-Retaining Reinforced Concrete Structures (1987)
- ILBANK – Technical Specification for the Preparation of Static-Reinforced Concrete Projects (2013)

2.5.6.1. Buildings

All buildings shall be constructed considering all functional requirements, including equipment installation, ease of operation, and maintenance. The buildings shall be designed to withstand site-specific weather conditions and operating conditions within the facility.

The bidding documents include a site layout plan of the existing facility as a supplementary document. The Contractor shall adhere to this layout plan.

Buildings and process-related structures shall generally conform to the following requirements unless otherwise specified in the technical specifications:

Foundations:

The Contractor shall design suitable foundation systems for buildings, bunkers, furnaces, turbines, transformers, and other major facility components. Adequate drainage and pumping installations shall be incorporated into all infrastructure systems to ensure dry conditions (including pumps).

Floors:

The Contractor shall design the floors considering the design loads and operational requirements. Proper slopes and drainage outlets shall be provided to prevent stagnant water accumulation.

Doors:

The main building doors shall be dimensioned based on equipment and machinery installation/maintenance requirements and building functionality. All doors shall be designed according to site conditions and equipped with suitable stop and support mechanisms to prevent damage when open. Door hardware approved by the Employer's Representative shall be used, ensuring adequate durability. Emergency doors shall be installed as per project approval, positioned at appropriate locations, and fitted with suitable exit mechanisms.

Walls and Roofs:

The walls and roofs (including gutters and downspouts) shall be designed and constructed to be watertight. The wall and roof structures shall be capable of supporting the specified live loads and maintenance loads. They shall also meet the fire resistance, noise insulation, and thermal insulation requirements.

The Contractor shall ensure the design and installation of heating and ventilation systems for all buildings and structures where necessary. The design of buildings and structures shall comply with building regulations. Non-combustible or fire-resistant materials shall be used in construction.

To prevent fire spread, all floors and designated walls shall be designed as fire barriers. These fire compartments shall act as barriers against heat, smoke, and other combustion byproducts. The fire barriers shall have a minimum fire resistance of 2 hours.

Sprinkler systems shall be installed in required areas.

Doors shall have a fire resistance rating of at least half the fire resistance capacity of the wall in which they are installed. Certain exceptional doors in fire compartment walls shall have a fire resistance rating equal to or greater than that of the fire compartment wall. All doors shall be fire-resistant for a minimum of 2 hours.

The Contractor is responsible for ensuring compliance with all building and fire safety regulations for all buildings and structures within the project scope.

2.5.6.2. Specific Structure Requirements

2.5.6.2.1. Fluidized Bed Incineration (FBI) Building

The FBI building shall be constructed using a steel structure in compliance with the Turkish Seismic Code, as well as EU and International standards. The design prepared by the Contractor shall meet all the criteria specified in the Bidding documents, regulations, and standards, and shall be submitted for approval by the Employer's Representative.

2.5.6.2.2. Turbine Building and Workshop Building

The turbine building and workshop building shall comply with building regulations and requirements. The Contractor shall consider the Occupational Health and Safety Law in the design and construction of these buildings.

Large workshop and warehouse doors shall be designed to allow easy access for vehicles. The Contractor shall also provide recommendations regarding the technical rooms, workshops, and warehouses.

2.5.6.2.3. Other Buildings

All other buildings shall be designed, dimensioned, and constructed to facilitate easy installation, operation, and maintenance of the equipment and systems intended for the building.

Where required, protective barriers shall be installed for eye wash stations, showers, and hazardous material storage areas. Internal access shall be arranged to accommodate forklifts and delivery vehicles in all buildings.

2.5.6.2.4. Transformer Complexes

If transformer complexes are included in the design, the Contractor shall be responsible for ensuring that all oil spills and leaks from transformers are contained within the designed enclosure.

To protect nearby facilities and buildings from a potential explosion or fire in the transformer, and to ensure personnel safety, reinforced concrete explosion/fire walls shall be constructed.

A containment barrier shall be installed to prevent the spread of transformer oil. The barrier, including concrete floors and walls, shall be designed in compliance with Turkish Standards or an equivalent standard.

2.5.6.2.5. Building Services

Lighting

All lighting systems shall ensure safe access and operation in all areas of the facility during working and maintenance activities. The lighting levels shall comply with the requirements of Turkish Standards or an equivalent standard.

Ventilation

There shall be no significant or visible condensation on the inner surfaces of ceilings or walls. Necessary precautionary measures shall be taken to prevent such occurrences.

Air quality, pressurization, and mechanical and chemical filtration systems shall meet all legal requirements.

Drainage

The design and construction of the required drainage system for all site areas and buildings shall be the responsibility of the Contractor.

The drainage system shall be designed to handle surface water, normal facility flows, runoff during maintenance operations, and oil drainage. Additionally, it shall be designed to meet all anticipated drainage requirements, including those related to firefighting operations and emergency scenarios.

Precautions shall be taken to prevent water accumulation on building floors, enclosed spaces, and cable/pipe trenches.

When sizing pipes and designing the system, a realistic assessment shall be made regarding the simultaneous occurrence of multiple flow events. The drainage system shall be designed in accordance with Turkish Standards or an equivalent standard.

The Contractor shall supply oil separators as required to ensure that external discharges remain within permissible limits.

Chemicals from wash water, storage areas, and drains shall be directed to the chemical waste collection and treatment system. Acid and alkaline chemicals shall be manually added as needed to adjust chemical balance.

If storage tanks contain corrosive fluids, a corrosion-resistant containment barrier shall be installed. The Employer's Representative shall review and approve the design and implementation of the chemical-resistant coating.

The Contractor shall install rain gutters on the roofs of all buildings and set up the required piping systems. Stormwater downpipes shall be installed inside the building's wall cladding and shall be directed outside the building below ground level.

Where possible, the feasibility of directing stormwater to a separate storage facility for reuse shall be evaluated.

2.5.7. CONCRETE WORKS

2.5.7.1. Materials

General

The materials used for concrete works within the scope of the contract shall comply with the types and specifications stated in the technical specifications and shall conform to the approved samples. Adequate advance deliveries shall be made to allow for additional sampling and testing if necessary. Any unapproved materials shall be immediately removed from the construction site at the Contractor's expense.

All properties of materials used for concrete production shall be tested. These tests shall be conducted at a frequency that ensures compliance with the specification requirements and shall be repeated whenever new materials are introduced.

During transportation, storage, and use, precautions shall be taken to prevent damage, deterioration, or contamination of materials.

Cement

The cement used in the contract shall be sourced from an approved supplier and shall be either sulfate-resistant, low-alkali cement, or Portland cement in compliance with TS EN 197-1. Additionally, the low-alkali cement used in the project shall contain less than 0.6% alkali ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$). The use of high-alumina cement or blast furnace slag cement shall not be permitted. The temperature of the cement during use shall not exceed 60°C.

Cement shall be delivered in sealed, branded bags from the manufacturer and shall be accompanied by a manufacturer's test certificate for each shipment. Damaged bags or cement deemed unsuitable by the Employer's Representative shall be rejected.

Each cement bag shall be used on the day it is opened; any previously opened and stored bags shall be rejected. All rejected cement, including cement affected by moisture and deterioration, shall be removed from the worksite within 48 hours.

Cement stored on-site shall be protected from weather conditions and elevated above ground level. The cement usage sequence shall follow the order of delivery.

Cement that has been stored for more than 6 months or kept in storage for over 3 months shall be tested. It shall not be used unless it meets EN standards and is reapproved. The validity of each retesting approval shall be limited to 6 months.

All cement deliveries to the site shall include the manufacturer's origin and production date, and results of standard tests conducted at the production site for bulk cement.

The Employer's Representative reserves the right to reject any cement that does not meet the specified conditions and tests, as well as any cement that is deemed unsuitable at their discretion.

Water

The water used for mortar mixing, concrete production, and curing shall be sourced from an approved supply and shall not negatively impact the setting time, strength, or durability of the concrete or mortar. It shall also not cause discoloration or efflorescence on the hardened concrete surface. Additionally, at no stage shall the water adversely affect the concrete or any added admixtures.

The water shall be clean, potable, and free from contamination, with a pH value between 5.0 and 9.0. It shall be tested in accordance with EN 1008, and the following limits shall not be exceeded:

- Total Dissolved Solids (TDS): Maximum 2000 ppm
- Suspended Solids: Maximum 2000 ppm
- Chloride (Cl): Maximum 500 ppm
- Sulfate (SO_4): Maximum 1000 ppm
- Alkali (HCO_3/CO_3): Maximum 1000 ppm

The water shall be stored under approved and clean conditions. Storage tanks shall be protected against sunlight, wind, dust, and organic or other contaminants.

Aggregates

The aggregates used in concrete shall be sourced from a recognized supplier with expertise in producing concrete-grade aggregates. They shall be chemically non-reactive, strong, hard, durable, and not excessively porous. The aggregates shall be free from adhesive coatings, clay lumps, coal, or coal residues and shall not contain organic or other impurities that could cause corrosion, reduce the strength, or compromise the durability of the concrete.

Aggregates shall be natural gravel or crushed stone, compliant with TS 706 EN 12620+A1. Aggregates used in concrete mixtures shall not cause damage or weaken the concrete.

Aggregates shall be stored and processed only in approved waterproof, concrete-walled filtration platforms, where each stage is kept separated. Stockpiles shall be formed in layers with a maximum thickness of 1.5 meters to prevent segregation. Any segregated aggregates shall be discarded. All stored aggregates shall be covered with an approved protective sheet until required for mixing. Any contaminated aggregates shall be disposed of.

Fine Aggregates

The fine aggregates (concrete sand) shall comply with TS 706 EN 12620+A1 and shall not contain more than 3% of undesirable shell fragments, as determined by visual inspection. Artificial or manufactured sand shall not be accepted.

The maximum allowable chloride and sulfate content in dry sand shall not exceed 0.06% of total weight (acid-soluble Cl^-) and 0.4% (acid-soluble SO_4).

Crushed fine stone may be mixed into the fine aggregate, provided that the blended product meets all required fine aggregate criteria. Material finer than 75 microns (ISO 3310 test) shall not exceed 5% by weight. However, if these fine particles consist of rock dust rather than clay, the limit may be increased to 7% by weight.

The absorption rate of the material shall not exceed 5%. In the magnesium sulfate durability test (ASTM C88), the weight loss after five cycles shall not exceed 10%.

In the organic contamination test (ASTM C40), the color of the test solution shall be lighter than the standard reference color.

When tested for potential alkali reactivity (ASTM C227), expansion at three months shall be below 0.05%. Alternatively, aggregates may be tested according to ASTM C289, and their evaluation shall follow ASTM C33, Appendix XI.

Coarse Aggregates

Coarse aggregates for concrete shall be produced by mechanical crushing methods (jaw, impact, or cone crushers) or other mechanical methods approved by the Employer's Representative.

All coarse aggregates used in concrete shall be categorized into single-sized aggregates with nominal sizes of 10 mm, 20 mm, and 40 mm.

The maximum allowable chloride and sulfate content in dry coarse aggregates shall not exceed 0.03% of total weight (acid-soluble Cl^-) and 0.4% (acid-soluble SO_4).

The absorption rate of coarse aggregates shall not exceed 2.5% (TS 706 EN 12620+A1). The flatness and elongation indices shall not exceed 25% (TS 706 EN 12620+A1).

Coarse aggregates shall not contain more than 5% soft particles (ASTM C235). In the magnesium sulfate durability test (ASTM C88), weight loss after five cycles shall not exceed 10%.

When tested for potential alkali reactivity (ASTM C227), expansion at three months shall be below 0.05%. Alternatively, aggregates may be tested according to ASTM C289, and their evaluation shall follow ASTM C33, Appendix XI.

Admixtures

All admixtures and chemical additives used in the concrete mixtures within the scope of the contract shall comply with TS EN 934-2+A1 and shall be approved by the Employer's Representative.

Approved admixtures shall be used in accordance with the manufacturer's recommendations and shall be dispensed using approved equipment that allows for visual inspection of each dose. The dosages, along with the manufacturer's technical data and trial mix results, shall be submitted to the Employer's Representative for approval before use.

When multiple admixtures are used in the concrete mix, their compatibility shall be verified through standard testing and certified by the manufacturer. No admixture containing chloride or nitrate shall be permitted.

Total Chloride and Sulfate Content

The total acid-soluble chloride content in the concrete mix shall be determined in accordance with TS EN 12350-8, and the chloride amount from all sources shall be included in the calculations.

For concrete produced with sulfate-resistant cement, the maximum total acid-soluble chloride content shall not exceed 0.200% of the cement weight (expressed as chloride ions).

The total acid-soluble sulfate content in the concrete mix, regardless of its source, shall not exceed 4.0% of the cement weight, expressed as SO₄.

Liquid Membrane – Curing Compound

Unless an alternative type is approved by the Employer's Representative, the liquid membrane curing compound shall comply with ASTM C 309-19, Type 1 classification.

Concrete Cutting / Core Sampling

Concrete cutting or core sampling shall be carried out as necessary for the installation of mechanical and electrical components and for structural modifications or rehabilitation works specified in the project list.

Before commencing work, the Contractor shall submit a detailed methodology for these works to the Employer's Representative. Works shall only begin upon approval.

During these works, the Contractor shall ensure the protection of all electrical and mechanical installations to the greatest extent possible. Necessary safety precautions shall be taken, and any damaged installations shall be fully restored by the Contractor.

All debris generated during these activities shall be removed from the construction site and transported to a designated disposal area approved by the Employer's Representative. The Contractor shall also be responsible for thorough cleaning of the work area upon completion of the tasks.

2.5.7.2. Sealing Gaskets

2.5.7.2.1. General

Waterstop bands shall be used in all construction joints. The thickness of the web section of the material shall not be less than 5 mm, and the bands shall be made of rubber or polyvinyl chloride (PVC) with properties suitable for both horizontal and vertical applications.

All gaskets delivered to the construction site shall be stored in a cool place, protected from direct sunlight, and kept free from oil and grease contamination.

For inspection and testing, every 500 meters of the same class, type, and kind of gasket material shall be considered one batch. From each batch, four pieces shall be randomly selected to form four test samples. Each test sample shall consist of a 1-meter-long piece. If the remaining material in a batch is less than 500 meters, it shall still be considered a separate batch.

If the material is to be used more than one year after the inspection date, it shall be retested in accordance with this technical specification and submitted for approval by the Employer's Representative.

- Rubber gaskets shall fully comply with TS 2810-2 series standards.
- Plastic gaskets shall fully comply with TS 3078-2 series standards.

Plastic and rubber gaskets shall be used in expansion and contraction joints of concrete and reinforced concrete structural elements, ensuring that the structure is not damaged by horizontal and vertical movements and maintaining water tightness in critical structures.

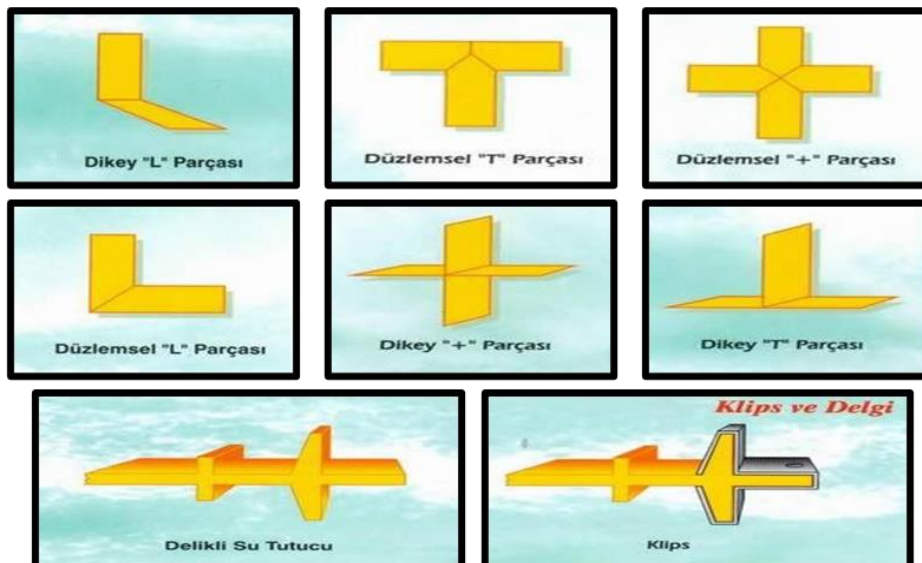
Tensile Strength (σ_0)	Average value	min. 140 (daN/cm ²) kgf/cm ²
	Lowest value	min. 120 (daN/cm ²) kgf/cm ²
Elongation at break	Average value	min. % 225
	Lowest value	min. % 200
Hardness (H0)		75 Shore "A" $\pm$ 5 Shore "A"
Density (d)		1.27 g/cm ³ 0.04 g/cm ³
Water Absorption Rate (s)		max. %1.5 (m/m)

Properties After Aging	Tensile Strength	σ_1	min. 0,80 (σ_0) kgf/cm ² (daN/cm ²)
		Maximum percentage change	max. % 20
	Elongation at break)		min. 0,80
		Maximum percentage change	max. % 20
	Hardness	(H1)	H0 ± 5 shore “A”
		Amount change	of ± 5 shore “A”
Permanent Deformation (ss)			max. % 5,0 (m/m)

In terms of dimensions and tolerances, the dimensions of plastic waterstop gaskets shall comply with the values specified in TS 3078-2.

2.5.7.2.2. Special Parts for PVC Plastic Waterstop Bands

In addition to providing the necessary clips for securing the waterstop bands to the reinforcement, it is also possible, upon special request, to manufacture any type of waterstop band with perforations at 50 cm intervals on both sides.



2.5.7.3. Installation of PVC Plastic Waterstop Bands

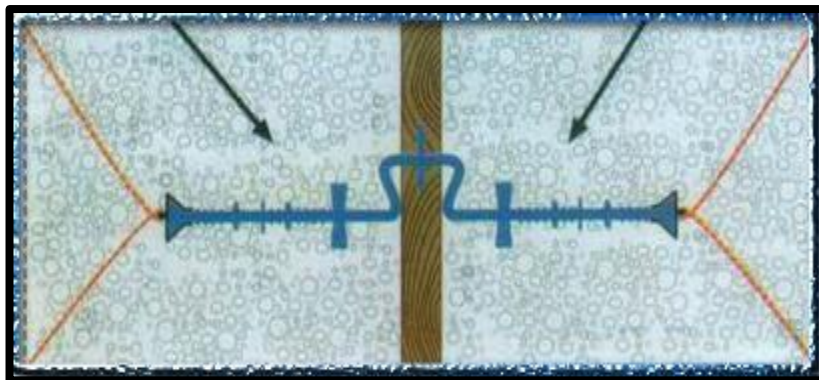
The construction joints for pouring the first-stage concrete shall be made using two-piece formwork, and the waterstop band shall be installed between the formwork and the joint as shown in the specified method.

In cases where the use of one-piece formwork is unavoidable, the portion of the waterstop band that shall remain embedded in the second-stage concrete shall be folded inward toward the inner surface of the formwork. When the second-stage concrete is poured, this folded section shall be properly positioned within the concrete to ensure full waterproofing.

For complete waterproofing, the waterstop band shall be fully encased by the concrete. The concrete mix used in this stage shall have an appropriate consistency. To eliminate air voids around the waterstop band, concrete shall be poured in layers and vibrated adequately.

The surface of the waterstop band shall be free of mortar dust or any external materials. Otherwise, bonding between the band and concrete may weaken.

Particularly before pouring the second-stage concrete, it is necessary to check whether the opposite wing of the waterstop band has been contaminated with mortar or other debris during the first-stage concrete pour. If contamination is detected, the surface shall be cleaned using a brass wire brush and, if necessary, washed with a water jet to ensure proper adhesion.



2.5.7.4. Joining of PVC Plastic Waterstop Bands

Since PVC plastic waterstop bands are made of thermoplastic material, they shall be joined using a heat welding system. For small-scale and simple applications, a special PVC adhesive may also be used.

During the joining and placement of the waterstop bands at the construction site, nailing, drilling, or threading wires through the bands—or any other methods that could damage the band and compromise its waterproofing properties—shall be strictly prohibited.

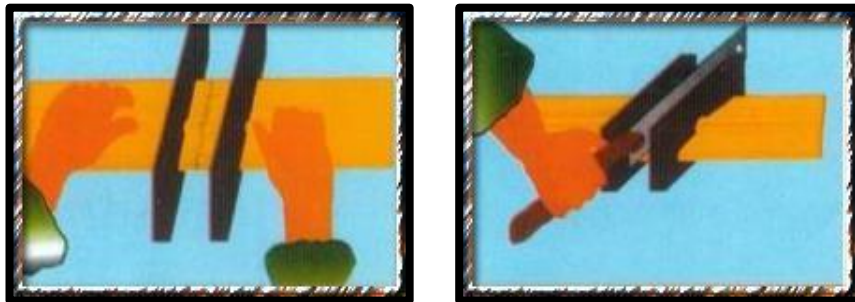
However, to ensure that the bands are installed at the specified depth and dimensions as indicated in the project design, additional reinforcement may be incorporated if necessary. In cases where the waterstop bands have perforated fastening flanges, binding wire or nails may be used. When there are no fastening flanges, clamps (clips) shall be used for securing the bands in place.

2.5.7.5. Equipment

- Welding device: Made of copper or brass with a minimum thickness of 5 mm, suitable for thermostatic electric heating or butane gas burner heating.
- Wire brush and sharp knife for cleaning and preparing the surfaces before welding.
- Welding mold, made of wood or aluminum, to ensure proper alignment and positioning during the welding process.

2.5.7.6. Execution

The ends of the waterstop bands to be welded shall be precisely and smoothly cut using a sharp knife to ensure a perfect joint.



Thermostat-controlled welding plates and wooden welding molds shall be provided for each type of waterstop band. The two pieces to be joined shall be positioned in the welding mold, ensuring that their facing surfaces are in full contact.

The welding plate shall be thoroughly cleaned using a wire brush before heating. If the plate is thermostatically controlled and electrically heated, it shall be heated to 160°C – 170°C. If it is heated with a butane gas burner, it shall be heated to approximately 200°C – 230°C.

Once the welding plate reaches the appropriate temperature, it shall be inserted between the facing ends of the two waterstop bands. The bands shall remain in the mold until their contact surfaces melt sufficiently.

After achieving the necessary level of melting, the mold shall be opened, and the welding plate shall be removed immediately. The mold shall then be quickly closed again, pressing the melted ends of the waterstop bands firmly together to ensure a strong bond.

The joint shall be left to cool for a sufficient period, after which the mold shall be opened. Any excess material at the joint shall be trimmed using a knife to create a smooth surface.

During the welding process, care shall be taken to avoid overheating, as excessive temperatures can cause charring of the PVC waterstop bands, which would compromise the quality and integrity of the joint.

2.5.7.7. Concrete Workmanship Requirements

2.5.7.7.1. Installation of Reinforced Concrete Column and Shear Wall Formwork

All formwork used under this contract shall be made of durable and approved materials, and shall conform to the specified dimensions and shapes. Prior to construction, the formwork design shall be approved by the Employer's Representative, and all materials delivered to the worksite, including formwork panels, props, supports, clamps, etc., shall be new.

The surface of the formwork in contact with concrete shall be free from adhesive residue, nail protrusions, cracks, or other defects. Joints shall be tight enough to prevent cement slurry leakage, visible formwork marks, and other surface imperfections. Defective joints shall be caulked.

For concrete elements, external corners shall have 30 mm × 30 mm chamfers, and internal corners shall have similar 30 mm fillets.

Formwork panels for exterior surfaces shall be laid in an aligned and uniform manner along their full length, ensuring that all joints are properly aligned. If water drainage openings are provided in the formwork, it shall be ensured that these openings are securely closed before concrete placement.

Connections shall be strong enough to allow smooth removal of the formwork and to ensure that the concrete retains its intended shape without deformation during curing.

Special attention shall be paid to the installation of embedded metal ties and anchors within the formwork. These shall be removable from the surface without damaging the concrete, with a minimum depth of 50 mm. After removing metal connection clamps, the resulting recesses shall be as small as possible. The diameter of spacing cones or ties shall not exceed 25 mm. Any surface voids in the concrete shall be filled with suitable repair mortar, ensuring a solid, smooth, uniform, and evenly colored surface.

The formwork shall comply with the project dimensions, and during concrete placement, it shall be adequately supported to bear the weight and pressure of the poured concrete, construction loads, and wind or other environmental factors without deformation.

For beams longer than 3 meters, an upward camber of 1½ mm per meter shall be provided.

During concrete pouring using a crane, elevator chutes deeper than 3.00 meters shall not be used. If concrete placement requires chutes higher than 3.00 meters, placement hoppers shall be designed to prevent segregation of the concrete mix.

All formwork materials removed from the site shall belong to the Contractor. Plywood and steel formwork materials shall be replaced at intervals specified by the Employer's Representative, particularly if they become deformed.

2.5.7.7.2. Concrete Pouring in Reinforced Concrete Column and Shear Wall Formwork

Before concrete pouring, the formwork surfaces shall be cleaned of dust and debris using an appropriate wire brush to prevent adhesion of the concrete. After cleaning, the surfaces shall be coated with an approved form release agent.

The form release agents used shall be water-insoluble, ensuring that they do not cause stains or damage to the concrete. Retarding liquids that delay the setting of concrete may only be used with the approval of the Employer's Representative. Form release agents, retarding liquids, and similar coating materials shall not come into contact with reinforcement elements or previously poured concrete.

Before concrete placement, the formwork shall be washed with water and/or cleaned with compressed air to remove sawdust, shavings, metal residues, or any external materials. Any water used for cleaning shall be removed from the formwork, and the formwork shall be dried before pouring concrete.

Concrete shall never be placed in formwork that has not been approved by the Employer's Representative. However, approval from the Employer's Representative does not absolve the Contractor of their responsibility for the formwork quality and safety.

Concrete shall be poured from a maximum height of 1.5 meters to prevent segregation and ensure uniform compaction. If the pump hose is too short, the Contractor shall provide additional equipment such as an elephant trunk hose to facilitate proper placement. Failure to provide the necessary equipment shall result in the suspension of concrete pouring operations.

2.5.7.7.3. Removal of Reinforced Concrete Column and Shear Wall Formwork

Before formwork removal, the specified removal times for columns and shear walls shall be observed, concrete strength shall be checked, and approval shall be obtained from the Employer's Representative.

Formwork removal shall only be carried out when the concrete has reached sufficient strength to prevent physical damage (such as deflection, cracking, or spalling) and ensure that the structural capacity of the reinforced concrete element is not compromised.

The required concrete strength for formwork removal shall be determined through sample compression tests conducted by an approved control laboratory or by using TSE-defined methods for in-situ concrete strength measurement with properly calibrated equipment.

The removal sequence for column and shear wall formwork shall proceed as follows:

- Tie rods: After formwork removal, casing pipes in tie rod holes shall be removed, holes shall be cleaned of dust using compressed air, washed, and then sealed to ensure waterproofing.
- Braces: To be removed without compromising the stability of the system.
- Panels: Formwork panels supporting the removed braces shall be dismantled.
- Final cleaning: After formwork removal, any remaining debris on the concrete surface shall be scraped off, and residual form release agents shall be cleaned using pressurized water.

2.5.7.7.4. Formwork Scaffolding

Before starting the installation of formwork scaffolding, the scaffolding project, user manual, and installation control form shall be approved and made available by the safety officer and the Employer's Representative.

The materials to be used in the assembly shall be inspected to ensure they are undamaged, functional, and compliant with standards for load-bearing capacity. Damaged components shall not be used and shall be replaced with components that meet the structural load-bearing calculations.

Load calculations shall be performed considering both vertical loads and horizontal loads as defined in the relevant regulations. Horizontal loads include:

- Wind loads,
- Loads generated during concrete pouring,
- Additional loads due to installation defects,
- Eccentric loads caused by misalignment.

During concrete placement, it shall be verified that the scaffolding system safely transfers the load to the ground without settlement. If necessary, additional load-bearing elements or ground reinforcement measures shall be implemented to prevent excessive settlement.

For scaffolding systems installed on soil surfaces, to ensure an even load distribution and prevent ground settlement, the following measures may be applied:

- Installation of ground grating elements,
- Application of soil compaction techniques.

During installation and work on scaffolds higher than 2.00 meters, the use of safety harnesses is mandatory. Personnel responsible for installation shall hold professional competency certificates.

2.5.7.7.5. Installation of Formwork Scaffolding

For the vertical installation of free-standing scaffolding and table formwork systems, adjustable base jacks shall be placed in their designated locations according to the project specifications. After that, starting bases shall be fitted onto the adjustable jacks, and their height shall be adjusted to match the specified project dimensions. The portion of the jack inserted into the leg tube shall be adjusted according to the project specifications.

Scaffolding systems can be assembled horizontally in a different location and then transported to the designated work area using a crane. In such cases, proper lifting equipment shall be used to ensure that the scaffolding system is lifted without causing any permanent deformation or damage. All accessories shall be secured properly to prevent falling during transportation.

At the first level of the scaffolding, cross braces and/or horizontal braces shall be connected to the legs in accordance with the project specifications or the safety guidelines outlined in the user manual. Once the system's static stability is ensured, the installation of the upper modules may proceed.

If scaffolding legs are connected using a welded pipe or a jointing element, all necessary pins or bolts shall be securely installed.

Scaffolding usage and information signs shall be prepared and posted in visible locations, particularly those detailing loading capacities.

2.5.7.7.6. Transportation of Formwork Scaffolding

During the installation of table-type scaffolding systems, scaffolding transportation can be carried out using the following methods:

- **Transportation using a wheel system:**
 - Table formwork systems (integrated scaffolding and formwork systems) can be moved using a detachable wheel system.
 - Manual force is usually sufficient for transportation, but for larger and heavier scaffolding, motorized or cable-drawn pulling systems may be used, provided they comply with the project specifications.

- Before moving the scaffolding, all obstacles along the path shall be removed, and any barriers that need to be crossed shall be accounted for in advance.
- Two wheeled push/pull car systems shall be mounted on either side of the scaffolding to lift and transport it.
- **Transportation using a forklift:**
 - Table formwork systems can be transported in horizontal sections at specified heights using appropriate forklift attachments in accordance with the scaffolding and handling accessory usage guidelines.
 - For free-standing scaffolding and post-supported slabs, the system may be transported using proper handling equipment or manual labor.
 - If materials are transported in bundles using a crane, all materials and accessories shall be inspected before lifting to prevent any falling hazards during transportation.

2.5.7.7.7. Dismantling of Formwork Scaffolding

The dismantling of scaffolding and posts shall be planned separately for each level/module. Dismantling shall begin from the top, and the scaffolding on a lower level shall not be removed until the upper level is fully dismantled.

The scaffolding components shall be removed in reverse order of installation, as follows:

- Guardrails
- Connection elements attached to the existing structure
- Consoles and other auxiliary elements
- Horizontal and diagonal braces
- Scaffolding legs without platforms
- Platforms
- Remaining scaffolding legs

2.5.7.7.8. Deviation Tolerances of Reinforced Concrete Elements (mm)

- Plan Position: ± 20 mm
- Volume and Shapes:

- Wall and slab thickness: ± 6 mm
 - Columns and beams: ± 6 mm
- Foundation dimensions: $+50$ mm / -0 mm
- Deviation from Plumb: (vertically – max. 5 m) ± 12 mm
- Slab and beam levels: ± 10 mm
- Openings:
 - Placement: ± 10 mm
 - Dimensions: ± 3 mm
- Cast-in parts:
 - Placement: ± 10 mm
 - Distance between composite parts: ± 2 mm

The Contractor is responsible for ensuring that the deviations in the completed reinforced concrete structure remain within the specified limits. Any work that needs to be corrected due to exceeding the tolerance limits shall be carried out at the Contractor's expense without any additional payment.

2.5.7.7.9. Removal of Concrete Formwork

The concrete formwork shall be removed slowly and gently without causing any vibrations. Before removing the formwork, the concrete shall be tested, and the removal process shall be carried out under the supervision of the Employer's Representative, ensuring that the concrete has gained sufficient strength to support its own weight and the applied loads.

Formwork shall not be removed before the minimum setting times specified below have been completed. However, if site-cured samples of concrete, whether produced with special chemicals or without chemical additives, reach 70% of the 28-day standard specimen strength (determined by testing cube or cylinder specimens kept under site conditions), the formwork may be removed with the approval of the Employer's Representative.

These timeframes do not apply to concrete poured at temperatures below 5°C unless an accelerator admixture has been added to the mix.

When determining the formwork removal time, the Employer's Representative shall consider the following parameters:

- Ambient temperature
- Initial concrete temperature
- Water/cement ratio
- Type and content of chemical admixtures
- Type and content of mineral admixtures
- Type, quantity, chemical properties, and fineness of cement
- Volume of the poured concrete

The formwork removal times for concrete with cement type 32.5 N/R are as follows:

Underside of beams and slabs	For spans greater than 3 meters	21 days
	or spans less than 3 meters	14 days
Columns		7 days
Shearwall formwork and beam side formwork		1 day

The formwork removal times for concrete with cement type 42.5 N/R and/or higher are as follows.

Underside of beams and slabs	For spans greater than 3 meters	14 days
	or spans less than 3 meters	7 days
Columns		3 days
Shearwall formwork and beam side formwork		1 day

These are the timelines specified in the relevant tables, and they shall be followed accordingly.

2.5.7.7.10. Concrete Surface Finishes

- **1st Type Finish – Standard Textured Surface Finish**

Unless otherwise specified in the contract or detailed drawings, all formwork-cast concrete surfaces that shall remain concealed at the end of the project shall be finished with a standard textured surface finish. In this finish type:

- The texture of the formwork material shall be imprinted on the concrete surface.
- Defective areas shall be repaired and restored as specified.
- Protrusions exceeding 5 mm in height shall be rubbed down with hard blocks to achieve a uniform surface.

- **2nd Type Finish – Standard Troweled Surface Finish**

All visible concrete surfaces or surfaces in contact with wastewater shall receive a troweled surface finish. In this finish type:

- The concrete surface shall be leveled with appropriate finishing tools.
- Defective areas shall be repaired and patched.
- All ridges and other protrusions shall be completely removed and smoothed.
- Unformed attached surfaces, such as the tops of walls or horizontal projections, shall be troweled and textured to match the adjacent surfaces.
- Floating or troweling techniques shall be used to achieve smooth and uniform surfaces.
- Air voids or holes larger than 5 mm shall be filled with mortar or repair compound.
- For air voids between 1 mm and 5 mm, their count shall not exceed 50 per 10 m² of concrete surface.

- **3rd Type Finish – Monolithic Slab Finish**

This finish applies to monolithic slab surfaces that are not intended to be covered with flooring materials. In this system:

- The concrete surface shall be leveled so that deviations do not exceed 6 mm over a 3.00 m span when tested with a straightedge.
- After leveling, the concrete surface shall be textured using a stiff brush, broom, or rake.

- The surface shall be leveled and troweled in a single operation during placement to ensure uniformity.
- **4th Type Finish – Monolithic Pumped Screed**

This type of surface finish involves applying a pumped screed over a monolithic floor slab. In this system:

- The pumped screed shall be used on seamless, edge-free, and step-free surfaces over concrete.
- The concrete surface shall be uniform, smooth, glossy, and free from trowel marks and other defects.
- Once finishing is completed, the concrete surface shall be carefully protected.
- The surface tolerance shall not exceed 5 mm over a 3.00 m span when tested with a straightedge.

2.5.7.8.Reinforcement Steel

2.5.7.8.1. General

All reinforcement steel used under this contract shall comply with TS EN 10080:2005, which corresponds to TS 708 (Steel Concrete Bars) under Turkish Standards. All reinforcing steel bars shall be of high-strength steel and shall have a minimum characteristic yield strength of 420 N/mm².

All reinforcement steel shall be kept clean and free from any materials that could deteriorate the bond between concrete and steel or lead to corrosion, thereby affecting the quality of the concrete. This includes but is not limited to:

- Deposit corrosion
- Paint
- Gasoline
- Grease
- Adhesive soil

The Contractor shall notify the Employer's Representative in advance when reinforcement work is ready for inspection. Additionally, the Contractor shall maintain detailed records regarding the planning and control of reinforcement works.

2.5.7.8.2. Transportation, Storage, and Handling of Reinforcement Steel

Before the commencement of manufacturing works, reinforcement steel shall be transported to the construction site according to the work schedule. Upon arrival at the site, the reinforcement steel shall be counted and inspected before unloading, and the Employer's Representative shall be notified.

If the steel is corroded, rusted, deformed, or unsuitable for use, it shall be rejected and returned without unloading. All associated costs for this process shall be borne by the Contractor.

Reinforcement steel shall be stored at least 30 cm above ground level. Cutting, bending, and processing shall be carried out on a drained concrete platform. The storage method shall be designed to prevent contamination, damage due to weather conditions, and accidents. Additionally, reinforcement steel shall be protected from moisture during storage.

Reinforcing steel bars shall be transported in appropriate lengths and weights as per project specifications.

- The transportation of product bundles shall be carried out without causing any damage that may hinder their usability.
- Binding wires wrapped around the product bundles shall be of appropriate diameter to prevent breakage during transportation.
- Lifting and handling wires/loops shall be made from durable materials to ensure safe transportation.

2.5.7.8.3. Use of Reinforcement Steel (Wire Mesh Reinforcement)

Wire mesh reinforcement shall be manufactured using the cold-drawing method, ribbed, and made of high-strength reinforcing steel. The Contractor shall ensure that any uneven or deformed areas are straightened before use.

Wire mesh reinforcement shall not be supplied in rolls or standard sheets. All transportation and delivery of the materials to the construction site shall be the responsibility of the Contractor. The wire mesh reinforcement details shall comply with the approved detailed project design.

During project implementation, for all types of wire mesh reinforcement, overlapping shall be executed with a minimum of three mesh openings in both horizontal and vertical directions, subject to the approval of the Employer's Representative.

2.5.7.8.4. Processing of Reinforcement Steel (Cutting and Bending)

All reinforcement steel arriving at the construction site shall be cleaned from dirt, rust, concrete residues, scaling, paint, gasoline, grease, salt, and other contaminants using the sandblasting method.

Reinforcement steel shall be bent in a cold state, either manually or using a powered machine. During the bending process:

- The steel shall be held under constant and uniform pressure and not subjected to impact loads.
- Welding of reinforcement steel shall only be allowed with prior approval from the Employer's Representative.
- The appropriate welding procedure shall be submitted for approval before work begins.

Incorrectly bent reinforcement bars shall only be used if the correction and re-bending process does not cause damage to the steel.

- No reinforcement bar shall be bent after placement, even if it is partially embedded in hardened concrete, unless approved by the Employer's Representative.
- Bending dimensions shall comply with TS EN 1992-1-1.

2.5.7.8.5. Installation/Placement of Reinforcement Steel

The reinforcement bars used shall be tied with an approved binding wire or a suitable type of clamp approved by the Employer's Representative. The binding wire shall be soft copper with a 16-18 mm diameter, and it shall be free from rust and dirt.

Reinforcement steel shall be securely fixed in place within the formwork, ensuring it remains in the correct position so that the poured concrete fully encapsulates the reinforcement. It shall be ensured that the reinforcement is firmly positioned to prevent displacement during concrete pouring or other related operations.

Concrete spacers used for covering reinforcement steel shall be machine-pressed or, if produced on-site, made from a 1:2 cement-sand mixture. On-site produced spacers shall be cured for at least 7 days after casting and shall have a water absorption rate of less than 3.2% within 10 minutes.

- Any wire used in concrete spacers shall be kept away from the surface and galvanized.
- Spacers attached to parallel reinforcement bars shall not be aligned in a single row within a section.
- Timber, stone, or metal spacers shall not be used.

The top layer of reinforcement bars in reinforced concrete slabs shall be firmly supported by steel chairs, which shall be anchored to the bottom reinforcement layer. The maximum spacing of steel chairs shall be 150 cm in both directions.

Starter bars in walls shall be securely fixed to the main reinforcement in the concrete and correctly positioned to maintain the specified concrete cover. Reinforcement embedded in hardened concrete shall not be bent under any circumstances.

Reinforcement cages that are pre-assembled before installation in concrete shall be protected from weather conditions and stored and transported in a manner that prevents contamination or rust formation.

2.5.7.8.6. Lapping and Connections

Laps shall be arranged so that only one-third of the reinforcement bars overlap within the same section. Otherwise, the lap length shall be increased by 50%.

Lap lengths shall be as specified in the structural project details.

2.5.7.8.7. Reinforcement Bar Anchorage (Chemical Anchoring)

The chemical anchoring process, which involves retrofitting deformed reinforcing bars into an existing reinforced concrete structure, shall be carried out using chemical anchors that meet the requirements of:

- TS EN 1992-1-1 (EC2) for post-installed reinforcement bars in concrete-to-concrete connections
- European Technical Approvals (ETA) according to ETAG TR-023 or an equivalent National Technical Approval (UTO) for such applications

Additionally, the anchorage of reinforcement bars shall comply with:

- Turkish Standards (TS)
- The General Technical Specifications of the Ministry of Environment and Urbanization
- The Construction Products Regulation published in the Official Gazette No. 28703, dated 10.07.2013
- The Regulation on the Criteria for Construction Products published in the Official Gazette No. 30003, dated 10.03.2017

In accordance with TS EN 1992-1-1 (EC2) and TS EN 1992-4, the following steps shall be followed for post-installed reinforcement bars:

- Static calculations shall be performed.
- Rebar diameters and embedment depths shall be determined.
- Deformed reinforcement bars of the required diameter and length shall be supplied.

- The bars shall be installed into the concrete structure using approved chemical anchors.

Based on the static calculation results, the installation requirements specified in the European Technical Approval (ETA) or National Technical Approval (UTO) shall be followed. Holes drilled to the specified diameter and depth shall be cleaned according to the product information sheets of the chemical anchor in use.

For example:

1. Holes shall be cleaned using a compressor to remove dust and debris.
2. A brush shall be used to further clean the hole and remove any remaining fine particles.
3. Compressed air shall be used again to ensure no dust or debris remains at the bottom of the hole.
4. The chemical anchor shall be injected from the bottom of the hole while ensuring even distribution.
5. The deformed reinforcement bar shall be inserted while rotating, ensuring full contact with the chemical anchor and eliminating air gaps between the bar and the anchoring material.

All completed installations shall be evaluated in accordance with:

- Guidelines and technical reports published by EOTA (ETAG/TR)
- Relevant ETA (European Technical Approvals) and/or UTO (National Technical Approvals)
- Turkish Standards (TS) and applicable European Union standards

The chemical anchor material to be used shall be certified as free from harmful solvents and shall be documented with appropriate certificates, such as the VOC (Volatile Organic Compounds) certificate.

2.5.7.8.8. Concrete Strength

The concrete strength grades used in this contract shall comply with TS EN 206+A2. For a maximum nominal aggregate size of 32 mm, the specified concrete classifications are as follows:

Concrete Class	Minimum Cement Content (kg/m ³)	Maximum Free Water/Cement Ratio	Target Average Free Water/Cement Ratio	Characteristic Cylinder Strength at 28 Days (N/mm ²)
C30/37	325 kg/m ³	0.45	0.45	30 N/mm ²
C25/30	300 kg/m ³	0.50	0.50	25 N/mm ²
C16/20	225 kg/m ³	-	-	16 N/mm ²

Concrete shall be suitable for transportation and shall be prepared in a way that allows easy consolidation using internal vibrators. The mix shall achieve a dense, watertight mass without segregation, leakage, or cracking. Concrete shall also be resistant to cracking caused by temperature fluctuations and shrinkage.

Slump shall be kept at the lowest level possible, while ensuring compliance with the approved placement and compaction conditions. However, under no circumstances shall the slump exceed 160 mm or be less than 40 mm, as specified in TS EN 12390-3.

Concrete mixes shall contain sufficient cement to meet the specified water-cement ratio, workability, and compaction strength requirements. However, the maximum cement content shall not exceed 400 kg/m³.

The air content of concrete mixes shall be maintained within 4% to 8%, and the concrete density shall be well compacted, achieving at least 98% of the test cube density.

2.5.7.9. Concrete Mixes

2.5.7.9.1. Mix Design

The Contractor shall be responsible for the latest mix design submitted for each concrete class. No later than six weeks before the commencement of concrete production, the Contractor shall provide the Employer's Representative with approval samples and test reports.

These samples and reports shall include:

- The mix design
- The proposed weights of all components to be used in different mix variations
- Documentation of all materials used in the mix

2.5.7.9.2. Trial Mixes

The Contractor shall prepare trial batches of different concrete classes in the presence of the Employer's Representative using the proposed equipment and mixing methods. No structural concrete work shall commence until the relevant mix is approved by the Employer's Representative.

Before any concrete is used on-site, three trial mixes shall be prepared. For each mix:

- Six test specimens shall be taken according to TS EN 12390-3.
- Three specimens shall be tested at 7 days.
- Three specimens shall be tested at 28 days in a laboratory approved by the Employer's Representative.

The Employer's Representative may reconsider these requirements based on their assessment of previous trial mixes made with the same materials and proportions.

For concrete mixes with a specified water/cement ratio, preliminary tests shall be conducted to determine the relationship between water/cement ratio and slump. The maximum permissible slump value shall be established, and appropriate tolerances for production variability, sampling, and testing shall be defined.

Once the Employer's Representative approves the mix, no changes shall be made to:

- The mix proportions
- The source or type of cement and aggregates
- The volume or grading of materials

The Employer's Representative's approval of a trial mix does not release the Contractor from the responsibility of achieving the required concrete strength. Additionally, the Employer's Representative may request practical tests on-site, including filling test molds to verify the workability of the mix.

The equipment used in these tests, including test molds and mixing tools, shall have similar characteristics to those used in actual site operations.

2.5.7.9.3. Additional Trial Mixes

The Employer's Representative may require additional trial mixes during production if there is a significant change in the materials or their proportions before implementation.

2.5.7.9.4. Compliance and Quality Control

If the concrete samples fail to meet the characteristic strength requirements, the Employer's Representative may request:

The removal and replacement of the defective concrete, or

The implementation of other corrective measures.

All costs related to removal, correction, and replacement shall be borne by the Contractor. Additionally, no payment shall be made for such structures until the corrective actions are completed and approved by the Employer's Representative.

2.5.7.10. Concrete Transportation and Placement

2.5.7.10.1. General

The Contractor shall notify the Employer's Representative in writing at least 24 hours before starting concrete placement, specifying the exact time of the operation.

Concrete pouring shall not commence without written approval from the Employer's Representative regarding:

- Formwork installation
- Reinforcement steel and embedded items
- Equipment and accessories setup

Any concrete placed without such approval shall be rejected.

The Contractor shall ensure that concrete transportation and placement methods do not require manual lifting and carrying. For large-scale concrete works, appropriate equipment such as:

- Concrete pumps for direct placement from the mixer
- Cranes or material hoists for vertical transportation
- Dump trucks or wheelbarrows for horizontal transportation may be used.

Before pouring, the formwork and placement area shall be thoroughly inspected and cleaned. All necessary equipment and materials for pouring and curing shall be ready at the site before work begins.

Concrete placement shall be executed using approved methods, ensuring proper distribution and prevention of segregation. Concrete deliveries shall be rejected if:

- Ambient temperature is below 5°C or above 32°C
- Slump test results fall below 40 mm or exceed 160 mm
- Concrete is not placed within 60 minutes of mixing

Cold Weather Concrete Placement

If the average temperature over three consecutive days is below +5°C, the Contractor shall implement cold weather protection measures. The incoming concrete temperature shall be checked to minimize the effects of cold weather.

If the Contractor fails to take necessary precautions during rainy weather, especially for slab and ground concrete placements, the Employer's Representative may cancel the pour, and the Contractor shall be fully responsible for any resulting damage or material loss.

Hot Weather Concrete Placement

If the average temperature over three consecutive days exceeds +30°C, the Contractor shall take preventive measures to avoid excessive water loss in the concrete. These measures may include:

- Pre-wetting the placement surface to prevent water absorption from fresh concrete
- Moistening the formwork and reinforcement bars
- Installing windbreaks around the placement area to reduce wind impact
- Ensuring all workers and equipment are fully prepared before placement
- Scheduling placement during cooler periods of the day
- Monitoring concrete temperature continuously
- Avoiding excessive vibration during consolidation
- Placing concrete as quickly as possible
- Finishing operations immediately after bleed water disappears
- Applying curing measures immediately to prevent surface drying

During transportation and consolidation, concrete shall be maintained in a dense and watertight state, ensuring it hardens without segregation, cracking, or leakage.

Unless otherwise specified by the Employer's Representative, concrete shall be discharged in horizontal layers and shall not be poured from heights exceeding 1.5 meters to prevent

formwork damage and segregation. Concrete shall be placed as close as possible to its final position to minimize re-handling.

Concrete placement shall not be permitted in standing or flowing water.

Concrete Continuity and Stoppages

Concrete shall be placed continuously to avoid cold joints and weak layers. No concrete shall be placed on hardened concrete if it has already set, as this may cause visible seams, weak joints, and poor adhesion.

If placement is unexpectedly interrupted, the Contractor shall:

- Implement construction joint procedures
- Pause concrete placement for at least 24 hours
- Obtain the Employer's Representative's approval before resuming

No cutting, drilling, or modification of hardened concrete shall be performed without prior approval from the Employer's Representative. If modifications are necessary, the Employer's Representative shall determine the appropriate cutting method.

Embedded Items and Surface Repair

During concrete placement, the Contractor shall:

- Verify the correct positioning of embedded items such as sleeves, grooves, couplings, bolts, and anchors
- Ensure reinforcement and embedded components are properly secured
- Use removable formwork elements that prevent leakage and allow easy removal

The Contractor shall clean and moisten anchor holes before filling them with grout mortar.

If required by the Employer's Representative, any honeycombed or segregated concrete sections shall be cut and repaired to expose sound concrete, and rework shall be done in an approved manner. The Employer's Representative shall reject any concrete that is:

- Incorrectly mixed
- Visibly segregated
- No longer suitable for effective placement and consolidation

All transportation and discharge containers shall be kept clean and thoroughly washed with water after each work shift.

If the air temperature exceeds 30°C, the Contractor shall obtain the Employer's Representative's approval before proceeding with placement and shall implement all necessary precautions, such as:

- Use of admixtures
- Keeping concrete components cool
- Pre-wetting formwork
- Providing shade for the work area

Additionally, the Contractor shall ensure that the concrete temperature does not exceed 32°C at the time of placement.

A thermometer shall be installed at a designated reference point within the construction site, as approved by the Employer's Representative, to monitor concrete temperature. Placement shall only proceed upon approval if temperature readings meet the required limits.

Concrete pouring shall not be permitted during heavy rainfall.

2.5.7.10.2. Concrete Compaction

During the placement of concrete, it shall be carefully compacted to ensure that it fully encases the reinforcement, completely fills the formwork, and leaves no voids. All concrete shall be compacted using immersion vibrators. The size and type of vibrators shall be approved by the Employer's Representative and used by experienced personnel on-site. The vibration duration shall be kept to the minimum necessary to achieve full consolidation while avoiding excessive vibration that could cause segregation. Precautions shall be taken to prevent the vibrator from touching the formwork or reinforcement.

The immersion vibrators used under this contract shall have internal exciters with a minimum frequency of 3,000 rpm, ensuring sufficient concrete consolidation. The Contractor shall keep backup vibrators on-site throughout the concrete placement process. Vibrators shall never be used for moving concrete within the formwork. The vibrator shall be inserted vertically into the concrete, and the insertion spacing shall not exceed 45-50 cm, depending on the vibrator's effective radius. Vibrated areas shall overlap to ensure full consolidation. During vibration, the vibrator shall penetrate at least 10 cm into the previous layer to allow proper bonding. The immersion depth shall vary depending on the thickness of the concrete layer.

2.5.7.10.3. Concrete Surface Finishing

Vertical surfaces are generally in contact with the formwork, and the required surface quality shall depend on the type and quality of the formwork used. In some cases, additional manual or mechanical finishing may be applied after formwork removal.

Horizontal and some inclined surfaces are finished without formwork. In such cases, machine finishing methods may also be used.

In raft foundations and slabs, the surface finishing shall be carried out using steel or wooden screeds.

For shear walls, roof parapets, and areas requiring chamfers and joints at upper levels, edge finishing shall be carried out first.

In pavement and outdoor concrete applications, after screeding and troweling, the required surface texture shall be achieved by applying a broom or brush in a specified direction.

For large raft foundations, slabs, and overlays, vibrating screeds and power trowels may be used for surface finishing.

2.5.7.10.4. Concrete Curing

Freshly placed concrete shall be protected from premature drying, excessive heat and cold, and shall be maintained at a relatively stable temperature with adequate moisture to ensure proper cement hydration and concrete hardening.

The materials and methods used for curing shall be subject to the approval of the Employer's Representative. Concrete surfaces not in contact with formwork shall be cured using one of the following materials and methods before shrinkage cracking or drying occurs:

- a) Polyethylene membrane shall be laid directly over the concrete in unbroken sheets with secure overlapping joints. The sheets shall be weighted down with beams to prevent dry air currents from passing under the membrane.
- b) Spray-applied curing membranes and curing compounds shall have maximum retention properties and shall be of a type and quality approved by the Employer's Representative. The curing compounds shall have reflective properties and shall be applied in accordance with the manufacturer's recommendations. If additional concrete layers or finishing materials are to be placed on the cured surface, care shall be taken to prevent any adverse effects on the concrete.

The application of curing water shall be done in a manner that does not disturb the surface of fresh concrete during its initial setting period.

When method (a) is used, curing shall continue for at least 7 days. At the end of the curing period, rapid drying shall be prevented.

The Employer's Representative may require a combination of the above curing methods in hot and dry weather conditions.

For exposed horizontal concrete slabs, additional protection may be required in hot and windy conditions between the initial compaction and final finishing stages. In such cases, the concrete surface shall not be left unprotected for more than 20 minutes after placement.

Concrete formwork exposed to direct sunlight shall be shaded throughout the curing period. Steel formwork heated by the sun and all timber formwork in contact with the concrete shall be kept wet during curing. If formwork is removed during the curing period, one of the curing methods listed above shall be applied immediately and continued until the end of the curing period.

2.5.7.10.5. Joints

The use of any of these curing methods shall comply with the conditions set by the Employer's Representative to ensure a satisfactory curing outcome. If the applied methods do not yield satisfactory results, they shall be modified at the discretion of the Employer's Representative.

Additional joints may only be used on-site if they have been submitted to the Employer's Representative for approval at least 7 days prior to construction commencement.

Construction joints shall be formed in horizontal or vertical layers and shall be placed to accommodate structural stresses. All reinforcement steel shall continue through the construction joints.

In all joints, the concrete surface shall be smooth, and before the next pour, it shall be thoroughly cleaned using water and pressurized air, followed by the application of aggregate. Cleaned surfaces shall be fully wetted before pouring new concrete.

For joints exposed to water pressure, approved water-stopping strips shall be used, except for horizontal joints in walls. If the presence of reinforcement within the formwork prevents the proper placement of water-stopping strips, suitable reinforcement elements such as wooden blocks, diagonal reinforcement bars, or other support elements shall be used to maintain proper reinforcement cover and prevent deformation during concrete placement.

2.5.7.11. Concrete Durability

The concrete durability requirements for structures to be constructed under this contract are defined as follows:

Concrete Mix - C 30/37 (With Sulfate-Resistant Cement)

- Characteristic strength: $f_{ck} = 30 \text{ N/mm}^2$ (cylinder specimen strength)
- Cement type: Sulfate-Resistant Portland Cement
- Exposure class: Freeze-thaw resistance
- Maximum free water/cement ratio: 0.45
- Maximum nominal aggregate size: 32 mm
- Minimum cement content: 300 kg/m^3

Concrete Mix - C 25/30

- Characteristic strength: $f_{ck} = 25 \text{ N/mm}^2$ (cylinder specimen strength)
- Cement type: Normal Portland Cement
- Exposure class: Moderate environments, XC3
- Maximum free water/cement ratio: 0.50
- Maximum nominal aggregate size: 32 mm
- Applications for C 25/30 concrete:
 - Structural concrete components in buildings
 - Roads
 - Surface drainage units
 - Curbstones

Concrete Mix - C 16/20

- Characteristic strength: $f_{ck} = 20 \text{ N/mm}^2$ (cylinder specimen strength)
- Cement type: Portland Cement
- Exposure class: Passive environment, X0
- Maximum nominal aggregate size: 32 mm
- Applications for C 16/20 concrete:

Used as a blinding layer or lean concrete

2.5.7.12. Joints (Integration of Existing or Newly Constructed Structures with Additional Works)

2.5.7.12.1. General

To account for thermal effects, tensile forces, and shrinkage, the Contractor shall construct construction and shrinkage joints with these properties in mind. The Contractor shall perform design calculations in accordance with the intended locations of the joints.

2.5.7.12.2. Construction Joints

This type of joint shall pass through the reinforcement connection and is intended to divide the structure into equally manageable sections that can be formworked independently. In critical high-stress areas, joints shall be constructed with approved water-stopping strips.

The surface of the concrete shall be thoroughly cleaned. The surface layer shall be completely removed using a steel brush, preparing it for aggregate bonding. Before placing adjacent concrete, the hardened concrete surface shall be continuously wetted for at least one hour. During pouring, the hardened concrete surface shall be fully saturated but shall not have standing water.

No cement slurry or adhesive agents shall be used in the joints.

2.5.8. STEEL STRUCTURE WORKS

2.5.8.1.General

This section defines the scope and general principles of the design and construction of steel structures, listing the national and international standards, regulations, and norms that are referenced directly or indirectly in these principles.

The Contractor shall take on-site measurements and verify all dimensions provided in the drawings before starting work.

It is the Contractor's responsibility to prepare workshop details from the tender drawings.

Markings shall be placed in a manner that allows for inspection after assembly.

The interior surfaces of steel profiles shall be kept dry and clean, and before closing any ends or openings, their condition shall be checked.

2.5.8.2. Scope

These principles cover the methods, rules, and conditions for the safe design and construction of structural steel and steel-concrete composite structural elements and systems, ensuring that they are suitable for their intended use.

The rules specified herein primarily apply to steel structural systems for buildings; however, they can also be applied similarly to other steel structural systems containing vertical and horizontal load-bearing elements.

For steel and steel-concrete composite structural systems constructed in seismic zones, in addition to the rules and conditions specified in this document, the Regulation on Buildings to be Constructed in Seismic Zones shall also be followed to ensure seismic resistance.

For the design of structural steel and steel-concrete composite elements, if a specific design rule is not included in these principles or the relevant Turkish Standards, internationally recognized equivalent standards, regulations, or technical documents may be used, provided that they comply with the principles and minimum safety levels outlined in this document.

2.5.8.3.Relevant Standards and Regulations

The primary standards and regulations referenced for the design of structural steel and steel-reinforced concrete composite elements and structural systems covered in these provisions are listed below.

TS 498 – Calculation values of loads considered in the sizing of structural elements

TS 500 – Design and construction rules for reinforced concrete structures

TS 708 – Reinforcing steel for reinforced concrete

TBDY (Turkish Building Earthquake Code) – Regulation on Buildings to be Constructed in Seismic Zones

TS EN 1090-1+A1 – Execution of steel and aluminium structures – Part 1: Requirements for conformity assessment of structural components

TS EN 1090-2+A1 – Execution of steel and aluminium structures – Part 2: Technical requirements for steel structures

TS EN 1991-1-1 – Actions on structures

Hot-Rolled Weldable Structural Steel

TS EN 10025-1 – Hot-rolled structural steel products – Part 1: General technical delivery conditions

TS EN 10025-2 – Hot-rolled structural steel products – Part 2: Technical delivery conditions for non-alloy structural steels

TS EN 10025-3 – Hot-rolled structural steel products – Part 3: Technical delivery conditions for normalized/normalized-rolled weldable fine-grained structural steels

TS EN 10025-4 – Hot-rolled structural steel products – Part 4: Technical delivery conditions for thermomechanically rolled weldable fine-grained structural steels

TS EN 10025-5 – Hot-rolled structural steel products – Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance

TS EN 10025-6 – Hot-rolled structural steels – Part 6: Technical delivery conditions for flat products made of high yield strength structural steels in quenched and tempered condition

Structural Steel Pipes and Hollow Sections

TS EN 10210-1 – Hot-rolled structural hollow sections of non-alloy and fine-grain steels – Part 1: Technical delivery conditions

TS EN 10219-1 – Cold-formed welded structural hollow sections of non-alloy and fine-grain steels – Part 1: Technical delivery conditions

Structural Steel Elements – Shapes and Dimensions

TS EN 10029 – Hot-rolled steel plates of 3 mm thickness or greater – Dimensions, shape, and tolerances

TS EN 10034 – Structural steel I and H sections – Shape and dimensional tolerances

TS EN 10051 – Continuously hot-rolled, uncoated, alloyed, or non-alloyed steel sheets, plates, and wide flats – Dimensions and shape tolerances

TS EN 10056-1 – Structural steel equal and unequal angles – Part 1: Dimensions

TS EN 10056-2 – Structural steel equal and unequal angles – Part 2: Shape and dimensional tolerances

TS EN 10058-2 – Hot-rolled flat steel bars for general purposes – Dimensions and shape tolerances

TS EN 10210-2 – Hot-rolled structural hollow sections of non-alloy and fine-grain steels – Part 2: Tolerances, dimensions, and sectional properties

TS EN 10219-2 – Cold-formed welded structural hollow sections of non-alloy and fine-grain steels – Part 2: Tolerances, dimensions, and sectional properties

TS EN 10279 – Hot-rolled steel U-sections – Shape and dimensional tolerances

Bolts, Nuts, and Washers

TS EN 14399-1 – Preloaded high-strength structural bolting assemblies – Part 1: General requirements

TS EN 14399-2 – Preloaded high-strength structural bolting assemblies – Part 2: Suitability test for preloading

TS EN 14399-3 – Preloaded high-strength structural bolting assemblies – Part 3: System HR – Hexagon bolt and nut assemblies

TS EN 14399-4 – Preloaded high-strength structural bolting assemblies – Part 4: System HV – Hexagon bolt and nut assemblies

TS EN 14399-5 – Preloaded high-strength structural bolting assemblies – Part 5: Plain washers

TS EN 14399-6 – Preloaded high-strength structural bolting assemblies – Part 6: Plain chamfered washers

TS EN 14399-7 – Preloaded high-strength structural bolting assemblies – Part 7: System HR – Countersunk head bolt and nut assemblies

TS EN 14399-8 – Preloaded high-strength structural bolting assemblies – Part 8: System HV – Hexagon bolt and nut assemblies

TS EN 14399-9 – Preloaded high-strength structural bolting assemblies – Part 9: System HV or HR – Load-indicating washers

TS EN 14399-10 – Preloaded high-strength structural bolting assemblies – Part 10: System HRC – Bolt and nut assemblies for preloading

TS EN ISO 898-1 – Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws, and studs

TS EN ISO 4014 – Hexagon head bolts – Product grade A and B

TS EN ISO 4016 – Hexagon head bolts – Product grade C

TS EN ISO 4017 – Hexagon head screws – Product grade A and B

TS EN ISO 4018 – Hexagon head screws – Product grade C

TS EN ISO 4032 – Hexagon regular nuts (Style 1) – Product grade A and B

TS EN ISO 4033 – Hexagon nuts – Product grade A and B

TS EN ISO 4034 – Hexagon nuts – Product grade C

Welding Materials and Welding Standards

TS EN ISO 2560 – Welding consumables – Covered electrodes for manual metal arc welding of non-alloy and fine-grain steels – Classification

TS EN ISO 4063 – Welding and allied processes – Nomenclature of processes and reference numbers

TS EN ISO 9692-1 – Welding and allied processes – Recommendations for welding joint preparation – Part 1: Manual metal arc welding, gas welding, TIG welding, and beam welding of steels

TS EN ISO 14171 – Welding consumables – Wire electrodes, tubular cored electrodes, and electrode/flux combinations for submerged arc welding of non-alloy and fine-grain steels – Classification

TS EN ISO 14341 – Welding consumables – Wire electrodes and deposits for gas-shielded metal arc welding of non-alloy and fine-grain steels – Classification

Steel Stud Anchors and Welding

TS EN ISO 13918 – Welding – Studs and ceramic ferrules for arc stud welding

TS EN ISO 14555 – Welding – Arc stud welding of metallic materials

Fire Protection

ROFPOB – Regulation on Fire Protection of Buildings

TS EN 13501-1 – Fire classification of construction products and building elements – Part 1: Classification using data from reaction-to-fire tests

TS EN 13501-2 – Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests (excluding ventilation systems)

TS EN ISO 11925-1 – Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 1: Guidance on ignitability testing

TS EN ISO 1716 – Reaction to fire tests for building products – Determination of the gross heat of combustion

TS EN 1365-1 – Fire resistance tests for load-bearing elements – Part 1: Walls

TS EN 1365-2 – Fire resistance tests for load-bearing elements – Part 2: Floors and roofs

TS EN 1365-3 – Fire resistance tests for load-bearing elements – Part 3: Beams

TS EN 1365-4 – Fire resistance tests for load-bearing elements – Part 4: Columns

2.5.8.4.Materials

This section includes the specifications, standards, norms, and regulations related to structural steel, connection components, and other steel structure materials. The material characteristic values provided in this section represent the minimum values specified in production standards.

For concrete, the material properties specified in TS 500, and for reinforcement steel, those specified in TS 708, shall be applicable.

On-Site Storage

All structural steel components and assemblies shall be stored at least 50 cm above the ground.

Fastening materials and related components shall be stored in lockable shelters with wooden flooring. The storage and/or assembly areas, including their surroundings, shall be cleared of weeds and debris.

During the on-site storage of bolts, nuts, washers, and other materials, care shall be taken to prevent damage to threads and ensure that they remain clean.

2.5.8.5.Design Report and Implementation Drawings

The rules outlined in this section shall be taken as the basis for the design report, implementation drawings, fabrication, and assembly (on-site installation) works.

General

The fabrication and assembly of structural steel elements in steel structural systems and steel-concrete composite structures shall comply with the relevant conditions specified in TS EN 1090-2+A1.

The minimum requirements for the submission of design reports and implementation drawings of steel and steel-concrete composite structures are explained below.

2.5.8.5.1. Design Report

The design principles of the project shall be presented at the beginning of the design report. The design principles shall include at least the following information:

- (a) Drawings explaining the structural system of the building.
- (b) Standards, regulations, and other relevant documents used in the design.
- (c) Load data used in the design, including:
 - Dead loads
 - Live loads
 - Roof loads
 - Vehicle loads
 - Effects of temperature variations
 - Snow and wind loads
 - Soil pressure
 - Other loads
- (d) Seismic parameters for the design of buildings under earthquake effects.
- (e) Design method applied, either:
 - LRFD (Load and Resistance Factor Design)
 - ASD (Allowable Stress Design)

Relevant load combinations (f) Material and bolt grades, their characteristic strengths, and weld metal strength data. (g) Soil parameters used in the foundation design.

In addition to structural analysis, sizing calculations, and stability checks, the design report shall provide detailed, clear, and traceable calculations for connections, splices, and related details.

2.5.8.5.2. Rules for Implementation Project Drawings

Implementation project drawings covering fabrication and assembly stages may be prepared in phases. Fabrication drawings shall be completed before production and shall include all necessary information related to structural component production, including positioning details,

bolt and weld types, and dimensions. Assembly drawings shall be completed before installation and shall include all necessary assembly information.

- a) The following drawings shall be included in the steel implementation project:
 - 1. General construction plans, including geometric dimensions and elevations of roof slabs and floor slabs.
 - 2. Column layout (placement) plans.
 - 3. Anchor plan and details.
 - 4. Sufficient number of elevation views and sections.
 - 5. Implementation drawings for all structural elements, including beams, columns, braces, etc.
 - 6. Principle details of connections and joints.
- b) The implementation project drawings shall include at least the following information:
 - 1. Structural execution class.
 - 2. Sheet scales and measurement units.
 - 3. Seismic parameters considered in the design, included in all general construction plans.
 - 4. Material specifications for profiles and steel plates, including joint and connection materials, bolt grades, their characteristic strengths, and weld metal specifications.
 - 5. Details of bolted connections and joints, including bolt grade, bolt and hole diameters, washer and nut specifications, and pre-tensioning forces applied to bolts.
 - 6. For bolted connections under shear force, the position of the threaded bolt shank relative to the shear (connection) plane shall be specified.
 - 7. For welded connections and joints, the type of weld, weld thickness and length, and for full penetration groove welds, the geometric dimensions of the weld preparation shall be specified.
 - 8. In cases where pre-cambering is required, information shall be provided on the location, direction, method, and magnitude of the applied pre-cambering.
 - 9. Coating details, including elements to be painted, areas where painting is not required.
 - 10. Information regarding friction surface applications.

2.5.8.6. Installation and On-Site Works

The preparation of site conditions, installation of structural steel elements, and other on-site works shall comply with the relevant conditions specified in TS EN 1090-2+A1.

The vertical deviation limits for structural steel elements and systems shall not exceed the threshold values specified in TS EN 1090-2+A1, Annex D. Throughout the installation process, the structure shall remain stable and secure under self-weight, erection loads, and other expected loads. If any equipment or procedure imposes additional loads on the structure, temporary supports shall be used in accordance with TS EN 1090-2+A1. These supports shall remain in place as long as necessary to ensure safety.

The installation of structural steel components shall be performed in accordance with the project drawings, which are prepared based on the design requirements.

At every stage of installation, all cutting, drilling, shaping (pre-deformation, bending, and straightening), transportation, storage, and marking operations applied to structural steel elements shall comply with the requirements of TS EN 1090-2+A1.

Cuts shall be made with smooth transitions. A surface where two straight cuts meet at a point shall not be considered a curved surface.

For welded built-up sections and rolled profiles, the weld access holes and cut regions of girders shall be preheated before cutting, as defined in TS EN 1090-2+A1.

The curved portion of weld access holes, which are thermally cut, and any cut surfaces in girders shall be ground smooth. Additionally, weld access hole surfaces in welded built-up sections and rolled profiles shall be polished to remove irregularities.

2.5.8.6.1. Nodes Under Compression

At nodes where compression force is intended to be transferred through contact, the contact surfaces shall be formed from machined components to ensure proper load transfer.

2.5.8.6.2. Preparation of Column Bases

Column bases and base plates shall be processed in accordance with the following conditions:

- a) If proper bearing contact is achieved, the use of base plates up to 50 mm thick without milling is permitted. For bearing plates thicker than 50 mm and thinner than 100 mm, flattening under compression is preferred to ensure proper contact. If applying compression is not possible, milling of the surface is allowed, except in cases specified in (b) and (c).

For plates exceeding 100 mm in thickness, the bearing contact surfaces shall be milled, except for the conditions specified in (b) and (c).

- b) (b) In foundations, milling of the bearing plate and the underside of the column base plate is not required if full contact is achieved using mortar.
- c) (c) When full penetration groove welds are used to connect the column to the base plate, milling of the top surface of these plates is not required.

2.5.8.6.3. Preparation of Holes for Anchor Rods

Anchor rod holes shall be drilled in compliance with the rules specified in TS EN 1090-2+A1.

2.5.8.6.4. Drainage Holes

For hollow sections with pipe or box profiles, if water accumulation is expected during installation or service, the ends of the elements shall be sealed, and drainage holes shall be provided at the bottom to prevent water retention.

2.5.8.6.5. Verification of Installation

Final welding and bolting operations shall not be carried out until all connected elements of the structure are properly aligned and positioned in their exact locations.

2.5.8.7. Quality Control

This section establishes the minimum requirements for the quality control and assurance of structural steel and steel-concrete composite structural systems and components.

The quality control of work during both manufacturing and installation phases shall be carried out by the manufacturer and the Contractor in compliance with TS EN 1090-2+A1. The transportation of completed structural steel components to the construction site shall be permitted only after verifying that they are free of defects and within the specified tolerances, and upon approval by the Employer's Representative.

The manufacturer and the Contractor shall establish and maintain a quality control plan and documentation in accordance with TS EN 1090-2+A1, ensuring that factory manufacturing and on-site installation inspections and certifications are properly conducted. The inspection of materials, manufacturing, and installation, along with testing and any necessary corrective actions, shall be performed in accordance with the provisions specified in TS EN 1090-2+A1.

The quality control inspectors of the manufacturer and the Contractor shall ensure that the following operations comply with TS EN 1090-2+A1:

- (a) Compliance of all materials with the specified material properties and conditions in the project.
- (b) Manufacturing and on-site conditions.
- (c) Welding and high strength bolting procedures and details.
- (d) Cutting operations and surface preparation during manufacturing.
- (e) Local heat treatment for straightening, bending, or pre-deformation processes.
- (f) Positioning and securing of profiled steel deck sheets and headed anchors.
- (g) Painting application conditions and methods.
- (h) Permissible tolerance limits for materials, manufacturing, and installation in both factory and site conditions.

2.5.8.7.1. Documentation for Structural Steel

The manufacturer and the Contractor shall document the following items in compliance with TS EN 1090-2+A1:

- (a) Design report and implementation drawings prepared in accordance with Section 9.5.
- (b) Inspection and testing plan for steel manufacturing.
- (c) Material test reports and production certificates for structural steel elements.
- (d) Production certificates for bolts and welding materials.
- (e) Production certificates for shaped steel sheets and headed steel anchors.
- (f) Production certificates for anchor rods.
- (g) Welding procedure specifications (WPS).
- (h) Qualification certificates of welding personnel.
- (i) Evaluation reports of both non-destructive and destructive testing of welds.
- (j) Painting application and corrosion protection procedures.
- (k) Non-conformity and corrective action reports.
- (l) Revision reports.

This ensures that all materials, processes, and personnel qualifications are properly documented and meet the required technical standards.

2.5.8.8. Structural Steel

Material Properties

These provisions cover the design principles of steel and steel-concrete composite structures composed of hot-rolled steel profiles and plates manufactured in compliance with TS EN 10025-1, as well as structural pipes and box sections produced in accordance with TS EN 10210 and TS EN 10219.

Toughness

Toughness requirements shall comply with the conditions specified in TS EN 1993-1-10 (Design of steel structures – Part 1-10: Material toughness and properties perpendicular to the fibers) and TS EN 10164 (Improved deformation properties perpendicular to the product surface – Technical delivery conditions).

Structural Steel Works

Materials, bolts, rivets, etc., shall comply with the permissible design stresses specified in TS 648. Rolled structural steel profiles shall be mild steel conforming to TS EN 10025 and TS EN 10029. The dimensions, tolerances, and properties of structural sections shall comply with TS EN 10034 or TS EN 10067.

Manufacturing and Pre-Assembly

Structures and components required for stairs, tanks, etc., shall be manufactured in the workshop as the largest practical subassemblies, ensuring suitability for transportation, handling, and installation. Before starting manufacturing, the Contractor shall submit drawings

and structural calculations for prefabricated building frames to the Project Employer's Representative for approval.

2.5.8.9. Welding Works

Welding materials (weld metal) shall comply with the standards specified in Section 9.3.

All welds performed during manufacturing or installation shall comply with the requirements of TS EN 1011 and be executed as shown in the approved detailed drawings. The details of the proposed welding procedures shall be submitted to the Employer's Representative for approval. All joints shall be welded in a manner that results in smooth and visually uniform finished connections, suitable for painting. All slag shall be removed, and sharp protrusions shall be rounded and smoothed.

Before welding begins in workshops or on-site, welding procedure tests shall be conducted at locations directed by the Employer's Representative, in accordance with TS EN 15614.

All welders working in the factory or on-site shall pass qualification tests related to the welding procedures being used, in compliance with TS EN ISO 9606-1. Welders shall provide satisfactory evidence that they have worked as welders for at least nine months within the previous 12 months. If the work of any contracted welder is deemed unsatisfactory, the Contractor shall conduct additional welder qualification tests to verify the welder's competence.

Welds shall be subjected to non-destructive testing (NDT) using radiographic, ultrasonic, magnetic particle, or dye penetrant methods, depending on the weld type and its location in the structure. Acceptance standards shall be as defined in TS EN ISO 5579, TS EN ISO 16823, TS EN ISO 23277, and TS EN ISO 11666, unless otherwise agreed upon with the Employer's Representative. If any work exhibits defects or fails to comply with detailed drawings or specification requirements, it shall be repaired or rejected, even if it was performed by qualified welders following approved procedures.

All welding consumables (electrodes, wire, filler rods, flux, shielding gas, etc.) shall comply with the requirements of TS EN 1011. Welding electrodes for metal arc welding shall conform to TS 6062 EN 25184 and the requirements of the appropriate welding procedure.

Surfaces to be welded on-site shall be prepared to ensure welding quality. This preparation shall include cleaning any contamination from prior production processes and repairing any surface damage before welding.

In addition to the provisions stated here, all requirements mentioned in the relevant section of the Mechanical Specification shall also apply to welding works.

2.5.8.10. Anchor Rods

The material properties of all steel anchor rods shall comply with the standards specified in Section 9.3.

Anchors of sufficient length shall be provided and securely fixed in place to ensure their proper integration into the reinforced concrete structure.

Chemical anchors shall be supplied in a quality suitable for continuous exposure to water. Alternatively, an injection technique may be applied.

The fixing of mechanical equipment to concrete structures may be carried out using anchors embedded during the concrete pouring process or post-installed anchors drilled into the hardened concrete. No anchor shall come into contact with reinforcement bars within the concrete structure.

For the installation of stainless-steel equipment, the anchors used shall also be made of stainless steel of equivalent quality.

For all other purposes, hot-dip galvanized anchors may be used.

2.5.8.11. Bolted Construction

The application conditions and quality acceptance criteria for bolts and rivets used in the connections of steel elements during manufacturing and installation shall comply with the provisions specified in TS EN 1090-2, Section 8.

The use of wedges during the alignment of bolt holes shall not be permitted if they enlarge the holes or cause deformation of the metal. If there is a significant misalignment between holes, the affected elements shall not be used.

Unless otherwise specified, connections may be made using standard bolts and snug-tightened high-strength bolts.

The following connections shall be made using pre-tensioned high-strength bolts or welding:

- a) Column splices in all multi-story buildings exceeding 40 meters in height.
- b) In buildings exceeding 40 meters in height, all beam-to-column connections and connections of other beams providing lateral support to columns.
- c) In structures containing cranes with a capacity exceeding 5 tons (50 kN), the following connections:
 - Truss splices
 - Truss-to-column connections
 - Column splices
 - Stability element connections
 - Crane supports
- d) Machine supports and connections subjected to repeated or impact loads.

2.5.8.12. Bolts

Shall comply with the requirements defined in Employer's Requirements II – Design – Build Requirement Part 2 – Material and Equipment – I Mechanical Works, Clause 2.4.2.12.

2.5.8.13. Chemical Anchors

Shall comply with the requirements defined in Employer's Requirements II – Design – Build Requirement Part 2 – Material and Equipment – I Mechanical Works, Clause 2.4.2.12.(A).

2.5.8.14. Manufacturing/Installation Tolerances

The general tolerance for all dimensions shall be ± 2 mm. Holes shall be aligned so that the fastening elements can be freely inserted at right angles to the contact surface of the elements. If the holes in the elements cannot be aligned without damaging or altering the structure, no modifications shall be made unless the Employer's Representative permits reaming of the holes.

A structural element shall not deviate from flatness (or the specified shape) by more than:

- 1/1000 of the span between lateral restraints for compression elements and beams.
- 1/500 of the total length for other members, with a maximum deviation of 25 mm.

A structural element shall not deviate from its intended length by more than:

- 1 mm for compression elements with bearing surfaces at both ends.
- +0 mm to -4 mm for other members.

The lengths of components shall be such that cumulative variations do not compromise the correct alignment of the completed structure.

Where two steel surfaces shall be in direct contact to ensure bearing or friction, the surfaces shall be prepared so that at least 90% of the contact area is in full contact before any compression force is applied.

2.5.8.15. Dissimilar Metals

When dissimilar metals are used near structural steel elements or their connections, the Contractor shall ensure that contact between different metals does not cause galvanic corrosion to the satisfaction of the Employer's Representative. If this cannot be demonstrated, contact between such metals and steel shall be avoided.

Contact between aluminium or aluminium alloys and galvanized mild steel shall be permitted. Bolts, nuts, washers, and screws used to fasten aluminium to steel structures shall be galvanized.

2.5.8.16. Stainless Steel

Shall comply with the requirements defined in Employer's Requirements II – Design – Build Requirement Part 2 – Material and Equipment – I Mechanical Works, Clause 2.4.2.8.(D).

2.5.8.17. Aluminum and Aluminum Alloys

Shall comply with the requirements defined in Employer's Requirements II – Design – Build Requirement Part 2 – Material and Equipment – I Mechanical Works, Clause 2.4.2.8.(E).

2.5.8.18. Protection of Steel

2.5.8.18.1. General

Dry surfaces, such as external surfaces of valves, shall be classified as C3 according to TS EN ISO 12944-1 and shall be protected against corrosion accordingly. Wet or submerged surfaces, such as the internal surfaces of valves, shall be classified as IM12944 according to TS EN ISO 1-1-2 and shall be protected against corrosion in compliance with this classification.

2.5.8.18.2. Corrosion Protection

Mechanical equipment shall be adequately protected against corrosion using coatings and other suitable treatments to ensure proper functionality and durability.

All exposed metal parts shall be coated with an approved protective material before transportation to ensure proper protection during shipment to the installation site. After installation, these parts shall be cleaned.

If the Contractor wishes to select different paint types than those specified in the technical specifications, the paint with the least possible impact on worker health and safety shall be chosen. Documentation related to the selected paint shall be submitted to the Employer's Representative for approval.

Before the end of the defect liability period, all coated structural components and elements shall be subjected to a visual inspection. If rust or blistering appears and these defects cannot be attributed to normal wear or impact damage, the Contractor shall repair the defects at no cost to the Employer, following a repair procedure approved by the Employer's Representative.

2.5.8.18.3. Galvanization

Steel or untreated iron shall be hot dip galvanized as required by the Employer's Representative. Galvanizing shall only be carried out after all manufacturing processes have been completed and approved by the Employer's Representative. Metal parts to be hot dip galvanized shall not be sandblasted.

All cutting, welding, and drilling operations shall be completed before galvanization. Ventilation/drainage holes shall be approved and shall be sealed after galvanization.

Materials shall be fully cleaned and polished using diluted sulfuric acid or hydraulic acid, rinsed in water, and then polished with phosphoric acid. Following this process, the materials shall be thoroughly washed, baked, immersed in molten zinc, and brushed to ensure uniform coating. Edges shall be clean, and surfaces shall be smooth and glossy. Generally, hot-dip galvanization shall comply with the requirements specified in DIN 50976.

Worn or damaged galvanized surfaces shall be cleaned with wire brushes and rotary milling tools, and damaged or cracked coatings shall be removed. The repaired areas shall then be recoated with two layers of inorganic zinc-rich epoxy paint.

When steel or wrought iron is hot dip galvanized, the process shall fully comply with TS EN ISO 1461. The details of components shall be considered in accordance with TS EN ISO 14713-2. For hollow sections, appropriate precautions shall be taken for filling, ventilation, and drainage openings. Ventilation ducts shall be properly sealed after galvanization.

All surface defects in steel, such as cracks, delaminations, folds, and bends, shall be repaired in compliance with TS EN 10025. All drilling, cutting, welding, and forming operations on components to be galvanized shall be completed before galvanization. The surface of the steel to be galvanized shall be free of welding slag, paint, oil, grease, and other contaminants.

In hot-dip galvanization, molten zinc at a minimum temperature of 450°C shall react with the steel surface to form a durable iron-zinc alloy, creating a highly corrosion-resistant product.

To prevent damage to the galvanized surfaces, extreme care shall be taken during the lowering and assembly of components. Galvanized components in storage shall be stacked with proper ventilation to prevent moisture-related storage stains.

If small areas of the galvanized coating are damaged, the issue shall be addressed as follows, in accordance with the agreement with the Employer's Representative:

- Any welding slag in the area shall be thoroughly brushed off to achieve a clean surface.
- The cleaned area shall be painted with a zinc-rich galvanizing spray.
- In areas where galvanized steel is exposed to aggressive solutions and/or corrosive atmospheres, the galvanized surface shall be further protected with a coating of paint that meets the specified protection standards.
- The geometric structures of galvanized steel parts shall be carefully inspected after galvanization. Any deformations shall be corrected without damaging the zinc coating.

Inspection and Documentation of Hot-Dip Galvanization

The inspection and quality assurance of the hot-dip galvanization process performed by the Contractor shall comply with TS EN ISO 1461.

After the components have been hot-dip galvanized, no further processing or machining of the parts shall be permitted.

2.5.8.19. Painting Works

Piping works, tanks, and gutters shall be fully painted according to a color-coding system with colors proposed by the Contractor and approved by the Employer's Representative.

Spray application equipment used for painting shall be designed for the intended purpose, capable of accurately spraying the specified paint, and shall be equipped with an appropriate pressure regulator and gauge. Air caps, nozzles, and needles shall be selected according to the

manufacturer's recommendations for the sprayed material. The equipment shall be maintained in proper working conditions for effective paint application. Filters and separators shall be provided to remove oil and water from compressed air. These filters and separators shall be of appropriate size and shall be emptied at regular intervals during operation. The air exiting the spray gun and reaching the surface shall be free of water and oil. A spray agitation tank shall be used to ensure thorough mixing of the paint. Air brushes, brushes, tools, and equipment shall be kept clean and in proper condition.

All coatings in a complete protective system, including primers, compatible undercoats, and topcoats, shall be compatible with each other. When applying any protective and/or decorative system for permanent works, materials from a single manufacturer shall be used whenever possible.

Painting shall consist of at least two coats (primer and topcoat). The Contractor shall submit painting documents for approval to the Employer's Representative. No painting work shall commence without prior approval.

The paints shall be polyamide-cured, high-strength, epoxy-based, and anti-corrosive. The total thickness of all coats shall be a minimum of 300 microns. All paints shall be new and unused, and obtained from approved manufacturers.

All paints shall be supplied in sealed containers, labeled with the following information, in addition to any legal requirements:

- Manufacturer's name, initials, or trademark
- Indication of whether it is a primer, undercoat, or topcoat
- Specification for indoor or outdoor use
- Color reference number
- Application method (e.g., brush, spray)
- Batch number and retest date
- Shelf life

Containers of other materials (e.g., thinners) shall carry as much of the above information as applicable. Paint, thinner, etc., shall be stored in sealed containers in locked storage rooms at temperatures not below 4°C and not above 27°C. Any special storage conditions recommended by the manufacturer shall be observed.

The Contractor shall ensure that paint is supplied and ready for application. The addition of thinner to the paint shall be carried out under supervision in storage areas and shall not exceed the limits specified in the manufacturer's technical data sheet.

Cleaning/Surface Preparation

- Surfaces shall be cleaned using scrapers, sanding, and grinding.

- Oils shall be removed, and if water-based cleaners are used, measures shall be taken to prevent flash rusting.
- Priming shall be applied immediately after cleaning.
- If abrasive blasting is used, appropriate materials and pressure shall be selected for surface cleaning.
- Oil and grease shall be removed from steel surfaces.
- Abrasive blasting shall be performed under dry conditions using properly sized and moisture-free abrasive material.
- Existing coatings shall be removed during the blasting process.
- Residual abrasives from blasting shall be cleaned off, and the surface shall be primed as soon as possible.

Workmanship

The Contractor shall be responsible for the complete cleaning, preparation, priming, painting, and protection works.

Unless otherwise permitted by the Employer's Representative, all painting shall be done by spray application, except for minor touch-ups on stripe coatings and primers, which may be done by brush.

The applicator shall have the manufacturer's application instructions and material safety data sheets (MSDS) on-site for each paint. Copies shall be submitted to the Employer's Representative. Unless stated otherwise, applications shall be carried out in accordance with the manufacturer's instructions.

No painting applications shall be performed until the paint materials have been approved by the Employer's Representative.

Painting shall be executed with clean workmanship. The paint shall be applied in an even layer, overlapping at spray pattern edges to ensure uniform thickness. Spray patterns shall be adjusted to provide consistent coverage across the entire painted surface. The application shall ensure strong adhesion to the metal surface or previous coat, free from streaks, ridges, sags, or other defects, and shall meet the specified thickness requirements.

Each coat of paint or coating shall reach full dryness and curing before the next coat is applied.

Successive coats shall be in slightly different shades for easier inspection and differentiation. The Employer's Representative may mark primer coats to ensure full compliance with specifications.

For iron surfaces, two coats of solvent-based epoxy paint shall be applied as follows:

- Iron fabrication surfaces shall be cleaned using sanding and wire brushing.
- First coat: 0.092 L of two-component solvent-based epoxy primer.

- Second coat: 0.092 L of two-component solvent-based epoxy primer.
- First topcoat: 0.098 L of solvent-based epoxy paint in the required color.
- Second topcoat: 0.098 L of solvent-based epoxy paint in the required color.

2.5.8.20.Cathodic Protection (CP)

Applicable Standards for Cathodic Protection:

- ASTM B 418 – Cast or wrought galvanized zinc anodes
- ASTM A 518 – Corrosion-resistant high-silicon iron casings
- ASTM B 843 – Magnesium alloy anodes for cathodic protection
- DIN 30676 – Design and application of cathodic corrosion protection systems for external surfaces
- DIN 50927 – Design and application of cathodic corrosion protection systems for internal surfaces of equipment, tanks, and pipes
- DNV RP B401 – Cathodic protection design
- EN 12954 – Cathodic protection of buried or submerged metal structures: pipelines
- EN 12068 – Corrosion protection for buried or submerged steel pipelines within the framework of cathodic protection – Tapes and retractable materials
- NACE RP 0169 – External corrosion control of underground or submerged metallic piping systems
- NACE RP 0285 – Cathodic protection for underground storage tank systems
- NACE RP 0387 – Metallurgical and inspection requirements for offshore cast anodes
- NACE RP 0492 – Metallurgical and inspection requirements for offshore pipeline bracelet anodes
- TS EN 12954 – Cathodic protection
- U.S. Mil A 18001J – Galvanized zinc anodes

General

The design, inspection, installation, and testing of the Cathodic Protection (CP) system shall be carried out by a qualified, experienced, and certified company. The Contractor shall submit the names, references, and certifications of the proposed companies for approval by the Employer's Representative. The Contractor shall arrange for the execution of the CP system through one or more approved firms.

The Contractor shall assign experienced personnel for the inspection, supervision, and testing of the Cathodic Protection system installation.

Required Investigations – Resistivity Measurements

During inspection, the soil resistivity shall be measured using the Wenner method at four-electrode distances at maximum 500-meter intervals, unless otherwise agreed upon or dictated by geological conditions, soil characteristics, or local requirements.

For determining locations of external current electrodes, measurements shall be taken at anode system sites where anodes are planned to be installed, ensuring sufficient number and frequency of measurements.

The measured resistivity values shall be plotted on a semi-logarithmic diagram along the pipeline route. Based on the soil resistivity, the arrangement and extent of the CP system shall be defined.

In addition to soil resistivity, the Contractor shall determine the current demand for cathodic protection and conduct tests to assess the conductivity of the protective coating used. Furthermore, the Contractor shall:

- Identify the locations of isolation flanges
- Select appropriate anode bed locations
- Evaluate power supply feasibility for feed points

Design

Based on the data obtained, the Contractor shall prepare a detailed construction design and submit it to the Employer's Representative for approval along with a design report.

After completion of the CP system installation, adjustment, measurement, and acceptance tests shall be performed and documented in comprehensive files.

The Contractor shall submit all design calculations, reports, and drawings for the CP system to the Employer's Representative for timely approval.

The design of the Cathodic Protection system shall consider the following factors:

- Measured or calculated soil resistivity
- Presence of external metal structures
- Accessibility and suitability of the power source

The CP system design shall include:

- Classification of the anode bed type (shallow vertical, shallow horizontal, or deep well)
- Anode material, combination, number, and spacing
- Artificial backfill
- For impressed current systems:
 - Voltage ratio of the rectifier

- Optimal and most economical locations for supplying power to T/R (transformer-rectifier) stations
- Locations of high-voltage (HV) lines for pipeline sections outside the construction site

Service Life of the Cathodic Protection System

The service life of the Cathodic Protection (CP) system shall be considered as the minimum lifespan of all materials and equipment used in the cathodic protection application. However, aside from failures, the CP system's lifespan shall be determined based solely on the depletion of the anode material.

The CP system's service life shall be defined as the time at which 85% of the anode material has been consumed.

The anode lifespan shall be calculated based on the design values, current output, and current density, using the following formula:

Anode Life(years)= (Anode Mass(kg) X Reduction Factor (0.85) / (Current Output from the Anode(A) X Anode Consumption Rate(kg/A.year))

In the design phase, the CP system or anode lifespan shall be selected as a minimum of 20 years.

2.5.8.20.1. Cathodic Protection Inspection

Measurement Line Potentials

After the backfilling of the anodes for the pipeline or tank has been completed, but before the anodes are connected to the pipeline or tank, the static potential-to-earth value of the pipeline or tank shall be measured. The locations of these measurements shall be the same as those specified for pipeline or tank reference electrode potential measurements. The initial measurements shall be recorded.

Insulation Tests

Before connecting the anode system to the pipeline or tank, insulation tests shall be conducted at each joint or fitting. This test shall verify that there is no metal contact or short circuit between the insulated sections of the pipeline or tank. Any defective insulation fittings found during the installation shall be reported to the Employer's Representative and replaced.

Anode Output

When anodes or anode groups are connected to the pipeline or tank, current output measurements shall be taken using an approved low-resistance ammeter. The measured values, along with the date, time, and location, shall be recorded.

Pipeline or Tank Reference Electrode Potential Measurements

After the installation and full operation of the cathodic protection system, electrode potential measurements shall be conducted using a copper sulfate reference electrode and a

potentiometer-voltmeter or a direct current voltmeter with an internal resistance (sensitivity) of at least 100,000 Ω/V and a full-scale range of 1 or 2 V. The locations for these measurements shall be the same as those used for the measurement line potentials. The recorded values, along with the date, time, and location of the measurements, shall be documented.

Measurement Locations

For coated pipelines or cable casing pipes, measurements shall be taken directly from a reference electrode in direct contact with the ground above the pipeline.

At pipeline connections, measurements shall be conducted at service risers, valves, test leads, or other suitable test points. Measurements shall be taken at intervals not exceeding 120 meters, and under no circumstances shall fewer than three measurements be taken on any pipeline segment.

For each distribution service riser, additional measurements shall be taken using a reference electrode placed directly on the service line.

For underground tanks, measurements shall be taken from reference electrodes placed at:

- a) Directly above the center of the tank
- b) At the midpoint between each pair of anodes above the tank
- c) At each end of the tank

In all cases, a minimum of three measurements shall be performed.

Casing Tests

The electrical isolation of the carrier pipe from its casings shall be tested, and any short circuits shall be corrected.

Interference Testing

Before final acceptance of the installation, interference testing shall be conducted in cooperation with entities responsible for these external pipelines or tanks. A comprehensive report containing all test details shall be prepared.

Recorded Measurements

All pipeline or tank-to-soil potential measurements, including initial potential values where required, shall be recorded. The Contractor shall identify, correct, and report to the Employer's Representative any short circuits encountered between the installed cathodic protection system and external pipelines or tanks.

For multiple pipelines or tanks, pipeline or tank-to-soil potential measurements shall be necessary to determine the extent of protection or the locations of short circuits.

Electrical Continuity

Buried pipelines shall have electrical continuity, except at locations where insulating joints are specified. Pipelines connected by means other than welding shall meet the electrical continuity requirements.

Specified mechanical joints not designed to provide electrical continuity shall be bonded with metallic straps at the joint. These bond connections shall be made using exothermic welding.

Mechanical joints that are designed to ensure electrical continuity shall meet the manufacturer's published standards.

Coating

Mechanically connected fittings, whether electrically conductive or insulated, shall be coated using an underground dielectric coating system.

For mechanical joints where external electrical continuity connections are installed, all exposed or externally affected metals, including welds, bare wires, and exposed coupling parts, shall be covered with a protective coating system.

Couplings and fittings with a low-profile exterior suitable for tape wrapping shall be primed following the coupling or fitting manufacturer's recommendations and wrapped with an underground pipe tape.

Couplings and fittings that cannot be properly wrapped shall be placed in a specially manufactured cavity mold or covered with reinforced kraft paper wrapping and then filled with either polyurethane foam of non-water-absorbent cellular structure, cold-applied dielectric compound, or hot-applied bituminous compound.

Underwater Structures

The purpose of the corrosion control system for underwater steel pipelines is to verify the effectiveness of the cathodic protection system.

The cathodic protection of critical elements exposed to seawater shall be controlled based on electrochemical potential measurements taken at different locations on the steel surfaces.

Monitored Anodes

Monitored anodes shall have the same shape as other anodes in the area and shall be designed to allow for recording current output. The support for the monitored anode shall be welded to the structure.

2.5.8.21. Special Steel Works

2.5.8.21.1. Steel Stairs

Steel stairs required by the Employer's Representative shall be made of 304 stainless steel, including beams supporting open tread stair steps and shall be provided complete with handrails

and braces. They shall be detailed, manufactured, and installed according to the required dimensions and shall be capable of carrying a live load of 7.5 kPa.

The treads shall be open-grate type, attached directly to the beams, rather than being fixed to concrete.

2.5.8.21.2. Step Irons

Step irons shall comply with DIN 1211-2.

2.5.8.21.3. Stair Handrails (Steel)

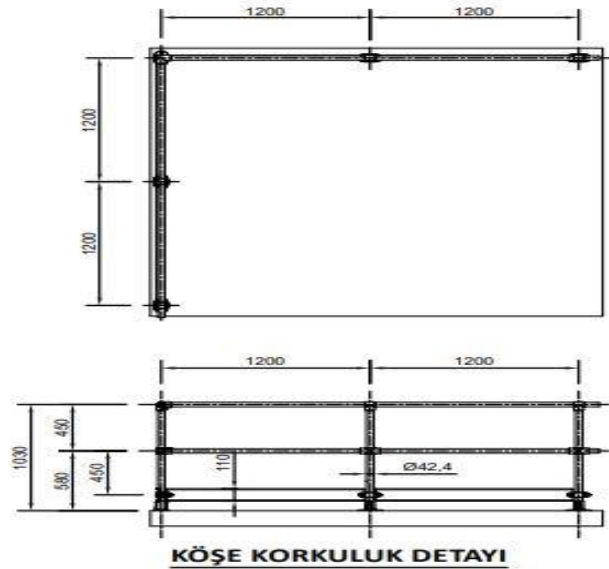
Unless otherwise specified, steel handrails shall generally conform to DIN 3620. The handrails shall be made of St37 steel, hot-dip galvanized, and manufactured according to the detailed application project.

2.5.8.21.4. Handrail (Euroklemp) Bars

The handrail bars shall be made of hot-dip galvanized steel, including handrails and posts designed to withstand a horizontal load of 740 N/m at the handrail level. The deflection of the handrails shall not exceed 1% of the span between the posts, and the deflection of the posts shall not exceed 1% of their height.

The specifications for the components shall be as follows:

- Pipe outer diameter: 42.4 mm (1 1/4")
- Pipe wall thickness: minimum 3.2 mm
- Bent kick plate height: 110 mm
- Kick plate thickness: minimum 5 mm
- Kick plate material: St 37 + hot-dip galvanized
- Clamps (pipe connection elements): Ductile cast iron + hot-dip galvanized



The inclined handrails shall be similar to the horizontal handrails, but the top handrail bar shall be positioned parallel to the stair slope line at a perpendicular distance of 900 mm from it. The spacing of the posts shall not exceed 1.5 m along the slope line.

During the manufacturing and installation of the handrail and staircase groups, all connections shall be bolted, without welding or painting. For this purpose, clamps (pipe connection elements) shall be used in pipe connections, as specified in the detailed project.

Flanges mounted horizontally shall be drilled with at least three bolts, with two bolts parallel to the handrail bar line and positioned over the walking path. Flanges mounted vertically shall be drilled with at least two bolts, with the axis passing through the bolts aligned vertically. Fittings shall be threaded or secured with stud bolts. Posts shall be positioned no more than 1.5 m from the center. The handrail bars shall be supplied as profiled sections, along with pre-assembled fittings secured with screws or stud bolts. The handrails shall be assembled using **Euro-Klemp** connections.

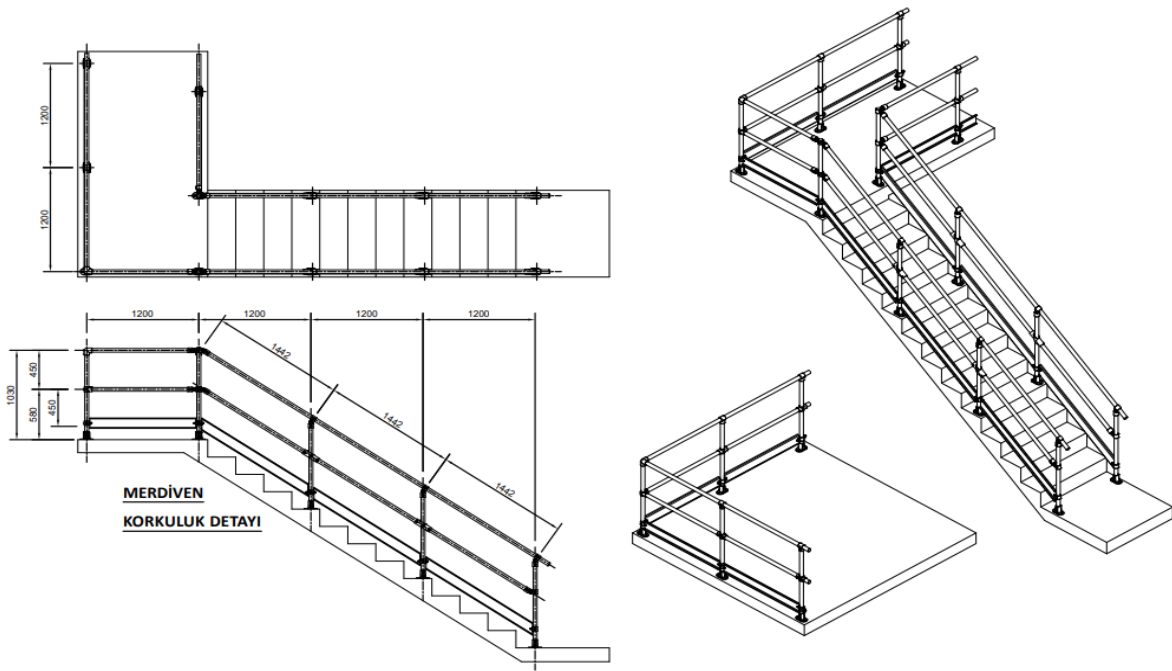


The stairs and other openings shall be closed off using two steel suspension chains, with one end fixed and the other end movable.

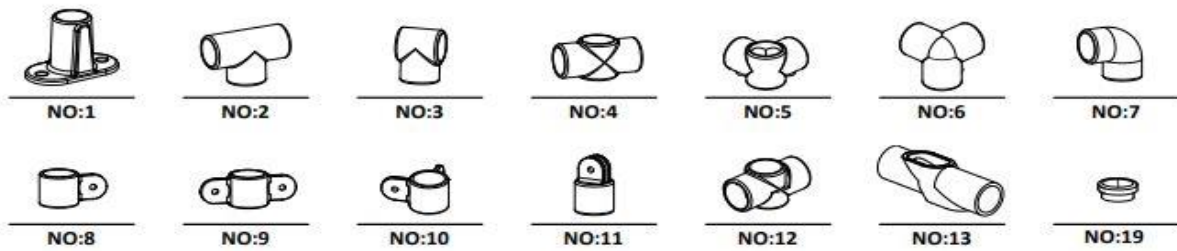
Nuts, bolts, and washers shall be made of stainless steel.

Unless otherwise specified, the Contractor shall ensure that all handrail bars have a uniform appearance and fabrication.

The detailed drawings of the handrail bars shall be submitted by the Contractor for approval by the Employer's Representative.



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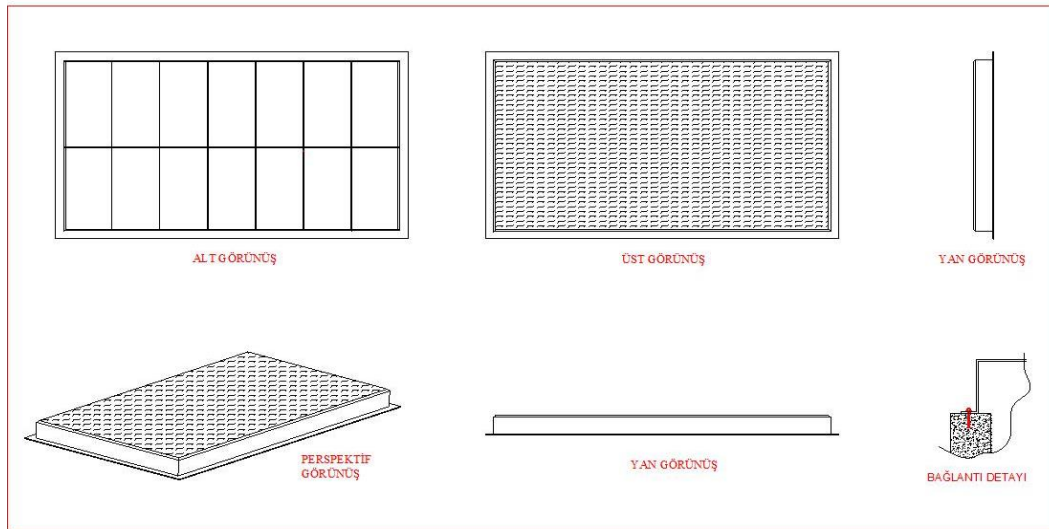


2.5.8.21.5. GFRP Flat Cover Systems

- Emission gases and unpleasant odors spreading from various structures, which cause discomfort to people, reduce the lifespan of equipment in the facility, and pose a threat to worker health, shall be controlled by enclosing and isolating gas and odor-emitting sources in different sections.

- Flat cover systems shall be made of Glass Fiber Reinforced Plastic (GFRP) and manufactured using monoblock molds with an open molding method.
- The walking surfaces of the flat covers shall be produced with a non-slip teardrop pattern and UV-resistant isophthalic gelcoat in a color chosen by the Employer's Representative. The Employer's Representative may select a different color to match the regional and facility aesthetics.
- The surfaces of the flat covers exposed to wastewater shall be coated with isophthalic topcoat.
- The materials used in the production of flat covers shall be resistant to chemicals, gases, and corrosion commonly found in treatment plants.
- For all horizontal and vertical GFRP (Glass Fiber Reinforced Plastic) covering elements, unless otherwise specified by the Employer's Representative, the minimum thickness of the flat cover elements shall be 10 mm.

Sample Flat Cover Type Detail Project Made of GFRP



- If vacuuming, fresh air inlet pipes, fresh air fans, process pipes, etc., are installed on the flat covers, all existing equipment and pipes shall be coupled to the covers in a way that allows the removal of the covers. (Coupling shall be done using methods such as flanged or necked connections.)
- Flat covers shall be manufactured in **monoblock forms** to be suitable for **modular assembly**.
- All metal mounting components and accessories used in flat covers shall be made of **304L stainless steel**.

- Cover systems shall be designed to **minimize personnel contact with wastewater**, thereby **enhancing occupational health and safety measures**.
- Observation covers shall be installed at sections specified by the **Employer's Representative**. Yellow warning stripes shall be applied around these covers to **ensure visibility when open**.
- Flat cover systems shall be installed at the **closest possible height to the wastewater level** (in compliance with the **Regulation No. 28712RG, dated 19 July 2013**).
- Flat cover systems shall be designed to withstand a **minimum load of 250kg/m²**. The **minimum sheet thickness for flat covers shall be 10mm**, and for arched covers, it shall be 6mm.
- The **maximum deflection** for flat cover systems shall be **L/200**. If deemed necessary by the **Employer's Representative**, loading tests may be conducted after installation.
- Samples produced according to the specified requirements shall be **submitted for approval** to the **Employer's Representative** before mass production begins. The **Employer's Representative** may take additional samples before or after installation and have them tested for compliance by **independent organizations at the Contractor's expense**. If non-compliance is detected, the **Employer's Representative** may require the **Contractor to re-manufacture** the materials in accordance with the specifications.
- The **minimum mechanical properties** of the **open-molded method** used in the production of **flat and arched cover systems** shall be as specified in the following table.

Mechanical Properties of Open Molding			
Property	Unit	Test Method	Minimum Value
Glass Content	%	Burn Test	35
Tensile Strength	MPa	EN ISO 527-4	55
Compressive Strength	MPa	EN ISO 527-4	140

Manufacturing of Special GFRP Monoblock Molded Structures, GFRP Structural Profiles, GFRP Supports, GFRP Revision and Modification Works (GFRP Structural Profile Properties)

- In cases where suitable connection points are not available in the sections where the flat covering manufacturing specified in the relevant article shall be installed within the facility, or when the opening to be covered is too large, all types of GFRP molded manufacturing, structural profiles, and GFRP support elements required to create a load-bearing platform for flat covering elements shall be manufactured according to the Covering Application Projects prepared by the Contractor and approved by the

Employer's Representative. These elements shall be fixed to their connection points and covering elements as part of the work scope.

- Composite structural profiles used as structural construction materials shall be made of Glass Fiber Reinforced Plastic (GFRP) and manufactured using the pultrusion method.
- Structural construction materials shall be produced from materials resistant to chemicals, gases, and corrosion that may be found in treatment plants.
- The chemical resistance table and factory analysis report of the resin and fiberglass raw materials used in the production of materials, along with quality and test certificates, shall be submitted to the Employer's Representative.
- Structural construction materials shall be used for all types of pipe supports and carrier feet and in locations indicated in the application projects prepared by the Contractor and approved by the Employer's Representative, as per the typical project details.
- The maximum distance between pipe carrier feet should not exceed 8 meters. The locations of the pipe carrier feet shall be determined based on field conditions and submitted for approval by the Employer's Representative.
- The minimum mechanical properties of pipe carrier feet, pipe supports, and structural profiles used where necessary are specified below:

Pultruded Profile Mechanical Properties			
Property	Unit	Test Method	Minimum Value
Tensile Modulus (Longitudinal)	GPa	EN ISO 527-4	23
Tensile Modulus (Transverse)	GPa	EN ISO 527-4	7
Tensile Strength (Longitudinal)	MPa	EN ISO 527-4	240
Tensile Strength (Transverse)	MPa	EN ISO 527-4	50
Flexural Strength (Longitudinal)	MPa	EN ISO 14125	240
Flexural Strength (Transverse)	MPa	EN ISO 14125	100

- Samples produced according to the specified properties shall be submitted for approval to the Employer's Representative, and production shall commence upon approval. Before or after installation, the Employer's Representative may take additional samples from the materials and have them tested for compliance by independent organizations at the Contractor's expense. If any non-conformity is detected in the material, the Employer's Representative may require the Contractor to re-manufacture the materials in accordance with the specifications.

- All metal equipment and metal accessories used to connect structural composite profiles shall be of 304L stainless steel quality.
- Metal fasteners used for mounting structural profiles onto the existing walls/slabs shall be insulated to prevent exposure to air and corrosion. No metal component shall be directly exposed to waste air.

2.5.9. WALL CONSTRUCTIONS

2.5.9.1. General

The Contractor shall submit samples of all types of wall materials used in the works and obtain approval from the Employer's Representative before placing orders with suppliers. If requested by the Employer's Representative, the Contractor shall also provide test certificates in accordance with the relevant Turkish standards.

The scope of the wall constructions to be carried out includes the following:

- Exterior walls
- Interior walls
- Guard walls
- Application of damp-proof coating
- Installation of thresholds, architraves, lintels, jambs, special masonry features, and other elements that are typically part of the built structure
- Plaster coating

References:

- TS 825 Thermal Insulation in Buildings (Thermal conductivity and resistance values for construction materials)
- ANSI A42.3 for Portland cement plaster
- TS EN 13914-2 Internal Plastering

2.5.9.2. Materials

2.5.9.2.1. Construction Bricks

Bricks shall be locally sourced as either:

- Clay-faced bricks or
- Concrete block bricks

The bricks shall be hard, durable, well-formed with four sharp corners, and properly defined edges. The Contractor shall submit samples of each type of brick to be used in the works and obtain approval from the Employer's Representative before placing orders with suppliers. Upon request, strength test certificates based on relevant standards shall also be provided to the Employer's Representative.

Handmade Bricks

Handmade bricks are produced by shaping prepared clay mixture using primitive molding techniques, drying naturally, and firing in open kilns at temperatures between 600–800°C. Due to the primitive kiln technology, these bricks exhibit variability in compressive strength and lower quality, making them less commonly used today. They are typically manufactured as solid bricks, either without holes or with vertical perforations, and their standard dimensions are 5x9x19 cm.

Pressed Bricks

The production process of pressed bricks consists of raw material preparation, shaping, drying, firing, packaging, and dispatching. The required clay is extracted from natural clay-rich soils and undergoes various processing methods to become suitable for production. After being shaped using various techniques, the raw clay brick is formed. The drying process is then carried out to remove moisture and harden the brick. The final stage involves firing in tunnel kiln systems. Pressed bricks shall be TSE EN 1344 certified and shall have dimensions of 215 mm x 65 mm x 15 mm.

Factory-Made Bricks

Factory-made bricks are formed using machinery, dried through artificial methods, and fired in factory kilns. They have a more uniform shape and higher resistance to compression, water, and frost compared to handmade bricks. Factory-made bricks are classified into three groups: normal bricks, modular bricks, and block bricks.

- Normal bricks are manufactured as solid or vertically perforated, with standard dimensions of 5x9x19 cm, and are used for load-bearing walls.
- Modular bricks, produced with vertical perforations, have dimensions of 8.5x9x19 cm and are also used for load-bearing walls.
- Block bricks are produced in various sizes, with horizontal or vertical perforations.
 - Horizontally perforated block bricks are used for non-load-bearing partition and infill walls.
 - Vertically perforated block bricks are used for load-bearing walls.

Refractory Bricks

Refractory bricks used under this contract shall primarily comply with TS 5410 and TS 5028 standards. Other refractory materials used shall adhere to the most up-to-date applicable TS standards.

Autoclaved Aerated Concrete (AAC) Walls

All materials and construction techniques for autoclaved aerated concrete (AAC) wall installations under this contract shall comply with the most recent TS standards.

Other Wall Types

Industrial-type wall materials and construction techniques, as designed by the Contractor and approved by the Employer's Representative, shall conform to the most up-to-date TS standards.

2.5.9.2.2. Sand

The sand shall be clean and well-graded, sourced from river sand, pit sand, or bedding sand. If the silt, soil, or clay content exceeds the limits specified in the relevant standards, the sand shall be rewashed on-site. The sand shall be obtained from a source approved by the Employer's Representative.

2.5.9.2.3. Portland Cement

The cement shall be sulfate-resistant Portland cement, as specified in the relevant sections of this Specification. The source of the cement is subject to approval by the Employer's Representative and shall not be changed without their authorization.

2.5.9.2.4. Hydrated Lime

The hydrated lime shall comply with ASTM C207, Type S or other equivalent standards.

2.5.9.2.5. Quicklime

The quicklime shall comply with ASTM C5, enriched type or other equivalent standards.

2.5.9.2.6. Lime Putty

The lime putty shall be fully slaked and stored for at least one day before use. It shall be kept moist until ready for application.

2.5.9.2.7. White Cement

The white cement shall comply with DIN Standards or other equivalent standards.

2.5.9.2.8. Wall Mortar

Wall mortar shall comply with ASTM C270 and DIN Standards, except where modified in this Specification.

2.5.9.2.9. Water

The water used shall be clean and potable, preferably sourced directly from water service providers or other sources of similar quality.

2.5.9.2.10. Plaster

Plaster applied to exterior walls shall contain a waterproofing admixture. The waterproofing admixture shall be a commercially manufactured product from a recognized manufacturer and shall be approved by the Employer's Representative.

The mortar mix for scratch coats shall consist of 1 part Portland cement and 1.5 parts sand.

Workmanship

The mortar used for plastering shall comply with the specified requirements. Similarly, the sand shall meet the specifications outlined in its respective section. Medium sand (1-3 mm) shall be used for rough plastering, while fine sand shall be used for finishing plaster and joint works. Before use, this sand shall be spread out to dry completely and then sieved through 1 mm swing sieves.

Before commencing plastering, any protruding mortar residues and contaminants on the surface shall be scraped off and cleaned. The wall surfaces and ceiling joints shall be thoroughly dampened with water and, if necessary, washed. To prevent excessive absorption of water by the wall, plaster shall be applied in intervals and moistened as needed. Plastering of exterior surfaces shall not be performed under intense sunlight or strong windy conditions.

If the wall material has deteriorated over time due to frost or other external factors, necessary repairs shall be made before plastering begins.

During the construction of the wall, the joint areas shall be left untooled and not troweled. Plastering shall begin only after the wall mortar has completely dried.

Wall plaster shall generally be applied in two layers: rough and fine plaster. After the first rough plaster coat, the surface shall be scored frequently using a trowel to enhance adhesion for the fine plaster layer. If the wall material and construction method allow, a single-layer plaster application may be used.

To ensure that plaster surfaces are level and aligned, leveling strips (analar) shall be installed at intervals not exceeding 2 meters. The wall surface shall be plastered in alignment with these leveling strips and frames.

The fine plaster shall only be applied once the rough plaster has fully hardened. The plastered surfaces shall then be finished using a straight edge, wooden or steel trowel, until a smooth, crack-free finish is achieved.

If metal or wooden surfaces need to be plastered, these surfaces shall first be covered with materials such as wire mesh or metal lath before proceeding with plastering.

The corners formed by plastered surfaces shall be sharp, rounded, or chamfered as specified in the plans or special specifications.

If plaster extends under a cladding or architrave, it shall have a minimum overlap of 2 cm. For door frames without architraves, a control joint (fuga) or another preventive measure shall be applied at the junctions between plaster and the frame to prevent cracking at the connection points.

1- Lime Plaster

Lime plaster shall be made using well-slaked lime that has been stored for at least three weeks. Only high-quality fat lime shall be used. The lime putty used in the mortar shall be free from foreign materials, especially those found in sieve residues, well bottoms, or side surfaces.

Lime plaster shall be applied in two layers:

- The first (coarse) layer shall use medium sand.
- The second (fine) layer shall use fine finishing sand (silt sand).

Once the coarse layer has sufficiently hardened, it shall be moistened before applying the fine plaster layer with great care. The surface shall be leveled with a straight edge and wooden trowel. Once the plaster surface has sufficiently hardened, it shall be troweled using a polishing trowel until it achieves the required smoothness and hardness.

2 - Cement Plaster

Cement plaster shall be applied only to well-wetted surfaces, which shall remain moist for an adequate period depending on the location and season.

Plastering shall not be carried out when freezing conditions are expected. For high-strength cement plaster in areas exposed to water or moisture, the sand granulometry shall be selected to maximize the strength of the mortar. The plaster surface shall be carefully and continuously troweled under pressure.

Where the plaster surface shall be covered, only the rough coat shall be applied, and the surface shall be roughened with a trowel for better adhesion. Where waterproofing or adhesive bonding is required, the second (fine) layer shall not be polished with a steel trowel. Care shall be taken to avoid visible trowel marks during this finishing process.

3 - Metal Lath (Rabitz) Plaster

Existing or newly installed wood or metal carrier structures shall comply with the applicable specifications.

The metal lath shall be attached to the supporting structure using galvanized wires at 15 cm intervals. The metal sheets shall overlap by 1.5 cm horizontally and 2.5 cm vertically, ensuring that their ends rest on a support.

In areas where the metal lath meets other plastered surfaces, the lath shall overlap by at least 5 cm. Alternatively, a control joint with a leveling strip or metal profile shall be used to separate the lath surface from other plastered surfaces, ensuring adequate fixation.

Before securing the metal lath, all necessary installations shall be completed, and care shall be taken to avoid damaging the installations during lath installation and plastering.

Plaster shall be applied in three layers:

1. The first layer (base coat) shall be a bonding mortar forcibly thrown onto the lath and pressed firmly with a trowel to ensure full adhesion.
2. Once the base coat has sufficiently hardened and dried, the second (coarse) layer shall be applied and leveled with a straight edge.
3. The third (fine) layer shall then be applied for a smooth finish.

No gypsum shall be used in the first (base) layer. The second and third layers shall be applied following the general plastering requirements.

4- Lath (Bağdadi) Plaster

Existing or newly installed wooden frameworks shall comply with the applicable standards. Before fixing Bağdadi slats (20x20 mm or 25x15 mm cross-sections), all necessary installations shall be completed.

Plaster shall be applied in three layers:

1. The first layer shall be a lime putty mortar with hair fiber reinforcement or a lime-gypsum mix. The mortar shall be thrown onto the slats and pressed with a trowel to ensure penetration into the gaps.
2. Once the first layer has hardened and dried, the second (coarse) layer shall be applied and leveled.
3. The third (fine) layer shall then be applied to achieve a smooth finish.

The second and third layers shall follow the general plastering requirements.

5 - Gypsum Plaster

Gypsum plaster shall be applied using materials that comply with relevant standards. Water shall be added to the gypsum, not the other way around. To maintain strength, the water content shall not exceed 80% of the weight of the gypsum.

Only quick-setting gypsum shall be used. If a setting retarder is required, it shall comply with the technical specifications for gypsum materials.

Gypsum plaster shall be applied in 5-7 mm thickness over the existing rough plaster using a wooden trowel and leveled with a straight edge.

For smooth concrete ceilings, wall surfaces, or column surfaces, gypsum plaster shall be applied at an average thickness of 1.2 cm without an underlying rough plaster. However, before direct application to concrete surfaces, the surface shall be thoroughly cleaned with a wire brush, and all grease and dirt shall be removed.

If a glossy finish is required, the plaster surface shall be smoothed with a galvanized trowel. For a higher gloss, a felt-covered trowel shall be used.

6 - Reed Plaster

Pre-assembled reed panels, bound together with wires, shall be securely attached to the supporting structure with galvanized wires, similar to metal lath applications. If the reeds are not in panel form, they shall be secured individually using forklails or horizontal battens.

Plastering shall follow the three-layer method, as specified for metal lath plastering.

7 - Sand-Lime-Gypsum Plaster

The lime, gypsum, and sand used in this plaster shall comply with the material specifications. To ensure strength, the water content shall not exceed 80% of the gypsum weight and 25% of the sand weight. Lime water shall not be added to the gypsum-sand mixture; instead, the sand-gypsum mix shall be slowly added to lime water.

As with gypsum plaster, only quick-setting gypsum shall be used. If a setting retarder is needed, it shall comply with technical specifications.

This plaster shall be applied as a fine coat (5-7 mm thick) over various rough plaster surfaces. For coarse sand-lime-gypsum plaster, thickness shall not exceed 1.5 cm. It shall be applied in multiple layers using a wooden trowel and leveled.

For a glossy finish, the surface shall be troweled with a galvanized trowel. For a higher gloss, a felt-covered trowel shall be used.

8 - Spray Plaster

Spray plaster shall be applied to exterior plaster surfaces using a specialized spraying tool at an average thickness of 3 mm. The surface shall be thoroughly cleaned and washed before application. Any existing paint or coatings shall be scraped off.

To ensure consistent color and texture, the entire batch of mortar for one surface shall be prepared at once. The final color and texture shall be selected from pre-approved samples.

Surrounding areas such as windows, doors, base courses, and eaves shall be protected from overspray.

9- Dash Plaster (Splatter Plaster):

This type of plaster is applied as a single layer on properly prepared rough plaster, existing plaster, or masonry surfaces, in accordance with the relevant specifications. Generally, splatter plaster consists of high-strength cement mortar, applied at an average thickness of 1 cm by forcefully throwing it with a broom or the edge of a trowel. The surfaces to be plastered shall be thoroughly cleaned and washed, with any existing whitewash or similar coatings removed.

If a coloring additive is to be used, the entire dry mixture shall be prepared in one batch and gradually mixed with water in a metallic container as needed. The granulometry of the aggregate and the consistency of the mortar shall be carefully maintained across different batches. This type of plaster shall be applied only by experienced craftsmen.

Upon request or according to the design specifications, certain areas may be left unplastered, and decorative grooves may be created using the edge of a trowel.

10- Artificial (Pierre Artificiel) Plaster:

This category includes chiseled and grooved textured plasters. Artificial stone plaster is applied in two layers: a rough coat and a finishing coat. The rough plaster consists of cement-based mortar, while the second layer is prepared using a mixture of various materials according to the unit price definitions, either normal or white cement-based, colored or uncolored.

The first layer shall be a cement mortar plaster. Once the rough coat is completed, scratches shall be made on the surface to ensure better adhesion of the second layer. The second coat shall be carefully mixed in a single batch to prevent variations in color and texture.

For colored mortar, mineral pigments shall be used. The mineral pigment and cement shall be chemically compatible, preventing undesirable reactions.

If specified in the project, artificial stone plaster may include decorative joints of various dimensions and shapes. Wooden strips shall be nailed according to the project design, and

panels shall be plastered in an alternating pattern. Once the second layer has dried, the wooden strips shall be carefully removed without damaging the joints, and any rough edges shall be cleaned.

Once sufficiently hardened, the top coat shall be chiseled or grooved using specialized tools, creating a coarse or fine texture. Additional decorative elements may be incorporated into the surface to achieve a uniform aesthetic appearance. These textured patterns shall be pre-tested on a small-scale sample, and the Employer's Representative shall select the final pattern for application.

11- Marble Plaster:

This plaster shall consist of two layers: a rough coat and a fine coat. The rough coat shall be prepared by mixing 550 kg of cement with 1 m³ of sand. The surface shall be thoroughly wetted before applying a 2 cm-thick layer of plaster with a trowel.

Before the rough coat fully dries, a fine coat shall be applied using a mixture of 550 kg of cement and 1 m³ of finely ground marble dust, at a thickness of 1 cm. The fine coat shall be troweled and polished with a cloth to remove any imperfections. After 3-4 days, the final polishing shall be done using a buffing stone.

Marble plaster shall be kept moist in hot weather to prevent premature drying. If coloring is required, 1 kg of mineral pigment and 0.040 m³ of lime shall be added per 100 kg of cement to ensure uniform color absorption.

12- Edelputz Plaster:

This type of plaster is selected based on pre-approved sample applications for both material quality and aesthetic properties.

For Edelputz plaster, the following materials shall be used:

- Specially graded and sieved crushed stone aggregate (Edelputz aggregate) of uniform color and size
- White lime putty (marble lime), aged for at least one month after slaking
- Cement of uniform color for the entire facade

Only experienced craftsmen shall be assigned to the application of Edelputz plaster. The final coat shall be applied in continuous sections, without visible joints, and scraped immediately using a specialized comb tool.

Particular attention shall be paid to ensuring uniform color between adjacent sections. Scaffold elements shall not come into contact with the plastered surfaces.

To prevent damage, all other construction work shall be completed before the application of the final coat. No corrections or touch-ups shall be allowed once the final coat has been applied. Edelputz plastering shall not be performed under direct sunlight or in strong winds. Shaded times of the day shall be preferred for application.

13- Sand-Gypsum Plaster:

Sand-gypsum plaster shall be prepared by dry mixing gypsum and silt sand, then gradually adding the mixture to pre-measured water in a wooden mixing tray until the desired consistency is achieved.

To maintain strength, the water content shall not exceed 80% of the gypsum weight and 25% of the sand weight. Water shall not be added to the sand-gypsum mix; instead, the dry mix shall be slowly added to water. As with gypsum plaster, quick-setting gypsum shall be used. If a setting retarder is needed, it shall comply with technical specifications.

Sand-gypsum plaster shall be applied in 5-7 mm thickness over the existing rough plaster. It shall be applied in multiple layers using a wooden trowel and leveled with a straight edge. If a glossy finish is required, the surface shall be troweled with a galvanized trowel. For a higher gloss, a felt-covered trowel shall be used.

PERLITE-BASED PLASTERS

Perlite-Cement Rough Plaster:

This plaster consists of expanded perlite aggregate (TS EN 14316-1) mixed with cement and special additives. It is prepared by thoroughly mixing with sufficient water using a straightedge tool until it reaches a workable mortar consistency. It can be applied up to 5 cm in thickness.

Before applying the rough plaster, a pre-coat of perlite-based bonding mortar (made from unexpanded perlite) shall be applied to the wall surface at a thickness of 1-2 mm and left to dry. The rough plaster shall be applied in layers of 0.5-1.0 cm, ensuring that each layer fully supports itself before proceeding with the next one.

Following the rough plaster application, a fine perlite-based (unexpanded) plaster layer shall be applied at a thickness of 2-3 mm. Rough plaster shall not be pressed with a trowel; instead, the surface shall be leveled using a straightedge tool.

Perlite-Gypsum Rough Plaster:

This plaster consists of expanded perlite aggregate (TS EN 14316-1) mixed with gypsum and special additives. It can be applied up to 4 cm in thickness.

The fine plaster applied on top of this rough plaster shall also be gypsum-based. Other mixing and application conditions shall remain the same as for perlite-cement rough plaster.

Perlite-Cement Fine Plaster:

This plaster is produced using unexpanded perlite, cement, and additives. Perlite-cement fine plaster can be used in two different ways:

1. Mixed with a high amount of water to form a liquid consistency and applied as a bonding coat for rough plaster using a plastering float or trowel.
2. Applied at a normal fine plaster consistency as a protective topcoat over rough plaster for external conditions.

Perlite-cement fine plaster shall be applied at a thickness of 1-3 mm on both the bottom and top layers. A minimum waiting period of 4 hours shall be observed between layers, depending on environmental conditions. It shall not be applied on gypsum surfaces.

Perlite-Gypsum Fine Plaster:

This plaster is made using expanded perlite, gypsum, and special additives and is used as a finishing layer for gypsum-based rough plaster.

Surface Smoothing Plaster:

This plaster is produced using (perlite-free) gypsum and special additives. It is applied at a thickness of 2-3 mm on interior surfaces and shall be smoothed with a stainless steel trowel. If a high-gloss surface finish is required, a felt-covered trowel shall be used.

2.5.9.2.11. Workmanship

All masonry works shall be plumb and level, ensuring uniform thickness and alignment. Masonry work shall be carried out in a consistent manner. Unless approved by the Employer's Representative, masonry sections shall not be constructed more than 1 meter ahead of adjacent sections.

For each type of brick or block construction, a 1 m² sample panel shall be prepared, including joints and bonding details. The Contractor shall not commence surface finishing work without prior approval from the Employer's Representative.

During the construction period and until completion, all surfaces shall be kept clean. In hot and dry weather conditions, bricks shall be stacked on a hard surface to prevent moisture loss. Proper shading shall be provided to prevent excessive heating of stacked bricks. Clay bricks shall be kept minimally moist to prevent premature drying of the mortar.

Solid brick walls shall be constructed using full mortar joints to ensure a fully bonded masonry structure. Wall joints shall be lightly roughened to improve plaster adhesion. Control joints in brick walls shall be formed using mortar. Joints shall not be plastered.

Newly laid bricks shall be protected from rain during interruptions in work and at the end of each working day. Throughout construction and finishing, surfaces shall be kept clean. Scaffolding shall be kept away from the building at night and during heavy rain. Scrubbing shall not be allowed for stain removal.

All bricks shall be wetted before use. Clay bricks shall not be used immediately after kiln firing; they shall be fully cooled before laying.

Bricks of different colors shall be randomly distributed throughout the work period to avoid patchy areas. Variations in brick color from different production batches shall be mixed to prevent horizontal striping.

Walls requiring a smooth surface shall be built using selected defect-free bricks, ensuring flat and aligned wall surfaces.

Double-Wythe Brick Walls

Brick walls can be constructed as either a single-wythe layer or as a double-wythe wall. Double-wythe brick walls are typically used in exterior walls to provide better thermal, sound, and moisture insulation.

In double-wythe brick walls, each wythe (brick layer) shall have a minimum thickness of $\frac{1}{2}$ a Normal Brick (9 cm). The air cavity between the wythes shall be:

- At least 5 cm for non-insulated applications.
- At least 2.5 cm for insulated applications.
- The maximum cavity width shall not exceed 10 cm.
- If the air cavity is completely filled with mortar, its width shall be at least 2.5 cm.

In structural calculations, only the inner wythe is considered for load-bearing purposes, and it is assumed to be the primary load-bearing component. The floor slab is either directly supported on this inner wythe or placed via a tie beam.

To increase the resistance of double-wythe and cavity walls against lateral loads and to prevent buckling issues, the wythes shall be connected using tie anchors (either metal ties or brick ties).

For metal tie connections, the following requirements shall be met:

- Each tie shall support a maximum area of 0.25 m².
- Ties shall be placed horizontally at a maximum of 90 cm spacing and vertically at a maximum of 50 cm spacing.

- Ties in successive rows shall be staggered.
- Each tie shall overlap into each wythe by at least 1/3 of the wythe thickness, with a minimum overlap of 5 cm.
- The distance from the outer edge of the tie to the exterior face of the wythe shall be at least 3 cm (See Figure 1).

In insulated walls, expanded polystyrene (EPS) boards with a thickness of 2.5 cm and a density of 15 kg/m³ shall be placed between the two wythes to provide thermal insulation (sandwich system).

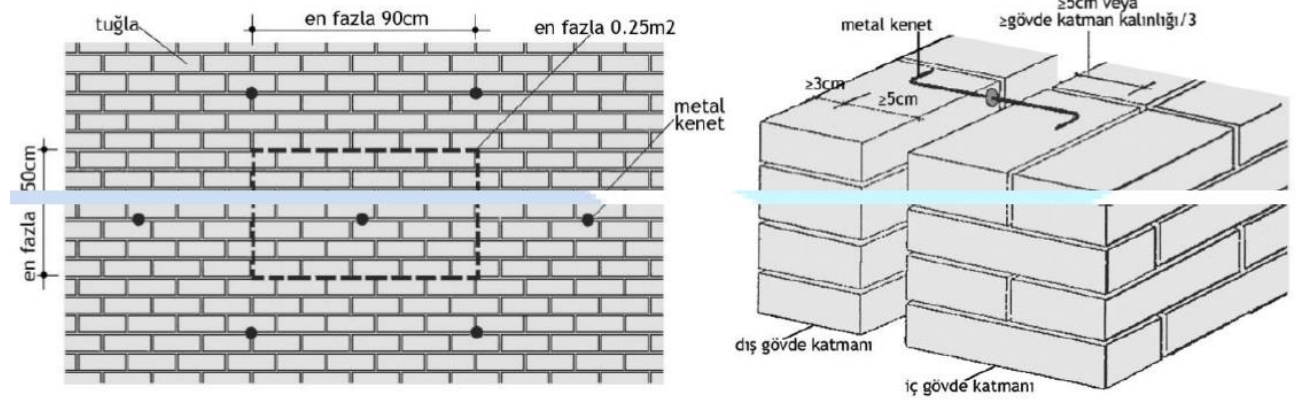


Figure 1: Principles of Embedding Metal Ties in Double-Wythe Brick Walls

In double-wythe brick walls, to enhance the connection between the wythes and increase rigidity, the cavity between them may be filled with mortar or concrete.

In mortar-filled double-wythe exterior walls, the cavity is completely filled with mortar (typically cement mortar) as the wall is constructed. Metal ties are used to connect the wythes to each other.

To further increase resistance against vertical and horizontal forces, reinforcing steel bars can be embedded into the mortar-filled cavity, strengthening the double-wythe brick wall.

Brick Wall Bonding Rules

One of the most important factors affecting the strength of a brick wall is its bonding pattern. Therefore, brick walls are constructed by arranging and interlocking bricks according to specific bonding rules.

Before being laid, bricks shall be cleaned of dust and dirt and thoroughly wetted with clean water to prevent them from absorbing water from the mortar.

In a brick bond:

- Bricks laid lengthwise along the wall direction are called stretcher courses.
- Bricks placed perpendicular to the wall direction are called header (bond) courses.

For better structural stability, brick walls shall be constructed using alternating stretcher and header courses.

In brick bonding, each brick shall be laid over at least two bricks in the row below. The contact area between bricks in consecutive rows shall be at least 4 cm, and the bond shall be offset by at least $\frac{1}{4}$ of a brick's length.

The mortar joint thickness shall remain consistent at 1 cm throughout the bonding. Sufficient mortar shall be applied, and pressure shall be exerted during laying to eliminate voids within the mortar joints.

During extremely cold weather conditions (below +4°C), bricklaying shall not be carried out, as the mortar may freeze and lose strength. If construction shall proceed under such conditions, precautions against frost shall be taken.

According to regulations, the mortar used for bonding bricks shall be either:

- Cement-reinforced lime mortar (cement: lime: sand ratio of 1:2:9), or
- Cement mortar (cement: sand ratio of 1:4).

For horizontally perforated bricks, the holes shall be oriented parallel to the wall direction.

After construction, the wall shall be protected from external influences for at least one week until the mortar gains sufficient strength.

To ensure structural stability, perpendicular intersecting walls shall be interlocked in a toothed manner to form a strong connection.

2.5.9.2.12. Tolerances

- Maximum deviation between adjacent units before sandblasting: 1 mm
- Maximum deviation from the wall plane:
 - 3 mm per 3 m
 - 6 mm per 6 m or more
- Maximum deviation from pipe installations: 3 mm, not cumulative per floor
- Deviation over two or more floors: 6 mm
- Maximum deviation in level alignment:
 - 2 mm per 1 m

- 4 mm per 3 m
- 9 mm per 10 m
- Maximum deviation in joint thickness: 2 mm per 1 m
- Maximum deviation in sectional wall thickness: 5 mm

2.5.10. WINDOWS, DOORS, AND FOLDING DOORS

2.5.10.1. General

This section includes PVC and aluminum windows and doors, steel and folding doors, and door stops.

References:

- TS EN ISO 10140-4 Acoustics – Measurement of sound insulation in buildings and building elements – Airborne sound insulation
- TS EN ISO 717-2 Acoustics – Measurement of sound insulation in buildings and building elements – Impact sound insulation
- TS EN 12608-1+A1 Unplasticized PVC window/door profiles
- BS 6376 Window design

2.5.10.2. Workmanship Requirements

This work includes:

- Supply and installation of materials such as hinges, bolts, hooks, seals, braces, weather seals, and sealing bars.
- Supply and installation of glass units.
- Exposure category to weather conditions: Window units shall withstand a pressure of 1200 Pa.
- Air permeability: Window units shall be designed to withstand a pressure of 600 Pa (DIN 18055 Group C, a-value $<0.1 \text{ m}^3/(\text{hm})$).
- Water tightness: Window units shall be designed to withstand a pressure of 600 Pa (DIN 18055 Group C, a-value $<0.1 \text{ m}^3/(\text{hm})$).
- Windows and additional units shall be supplied with hardware for inward-opening operation and all necessary accessories.

- Finish application: The frame and all related hardware of the window unit shall be of the same color. Colors shall be selected from the standard RAL color range.

Application drawings shall be submitted to the Employer's Representative before production begins. Glass stops, removable stops, door and window insulation, and other accessories shall be secured using concealed machine screws.

All hardware shall be installed carefully and properly, ensuring that each component is lubricated and adjusted for flawless operation.

All hardware shall be supplied and installed by the manufacturer, ensuring compatibility with final surface finishes. Hardware shall be replaceable without removing the external frame from the structure.

Fasteners shall be designed so that they cannot be loosened using a thin blade or simple tool from the outside.

All operable sections of the windows shall be equipped with insect screens to prevent the entry of insects and bugs.

2.5.10.3. Aluminum Doors and Windows

The types of doors to be used under the contract shall be as specified in the designs prepared by the Contractor and approved by the Employer's Representative.

All doors and both interior and exterior windows shall be fully weather-resistant and waterproof in tropical climates. Doors shall be manufactured with thermal insulation.

Before any repetitive production or the installation of prefabricated frames, the Contractor shall assemble a finished prototype of each component with all hardware details attached for approval by the Employer's Representative.

Unless otherwise specified, all openings for windows and doors in block walls shall be properly adjusted with reinforced concrete lintels to ensure appropriate clearance for the door and window wings.

Aluminum doors, windows, and frames shall be of high quality and durable.

Aluminum doors, windows, and frames shall be thermally treated and finished externally with bronze-toned anodized aluminum to match the windows.

Aluminum doors shall be designed to return to a closed position unless intentionally held open.

Doors and windows shall be equipped with efficient draft preventers.

All operable window sections shall be fitted with insect screens to prevent the entry of insects.

Aluminum joinery shall be electrostatically powder-coated and reinforced with thermal insulation.

2.5.10.4. Aluminum Doors

Frames

The main structural elements of the solid aluminium outer frame shall have a minimum thickness of 2 mm. All other structural components forming the frame shall have a minimum thickness of 1.6 mm, within minimum tolerance limits.

Frame joints shall be neatly and precisely constructed, either by welding or mechanical fastening methods (e.g., bracketing and screwing). These joints may have either flush or overlapping surfaces. Welded joints shall be cleaned and smoothed on surfaces exposed when the window or door is open or on surfaces that come into contact with glass.

Hinges shall be made of corrosion-resistant materials or, if they are not compatible with aluminium, they shall be separated from aluminium using a compatible material. Incompatible materials or coatings shall not be used unless they are isolated from aluminium with a compatible barrier material.

All screws, nuts, bolts, washers, and other fasteners shall be made of stainless steel or aluminium.

Door Leaves

The door leaves shall consist of a rectangular hollow section frame with a minimum thickness of 1.0 mm, having a sufficient cross-sectional area. The door face panels shall be made of two 1.0 mm thick metal sheets, welded at the inner face of the door leaf and supported by sufficiently spaced weld points or reinforced with U-profiles.

Air seals and glass retainers shall have a minimum thickness of 0.8 mm.

Final Coating and Air Tightness

All aluminum components shall have a matte satin finish and shall be anodized.

The air seals shall be made of materials known to be compatible with aluminum, ensuring they:

- Do not shrink or warp
- Do not adhere to sliding or closing surfaces
- Do not cause corrosion upon contact with the aluminum alloy
- Are resistant to weathering and environmental degradation

Exterior doors and frames shall have thermal breaks and shall be anodized in a bronze tone to match the windows.

2.5.10.5. Motorized Rolling Shutter Doors

Automatic Shutter

- The scope of work includes the supply and installation of aluminum rolling shutter doors with dimensions specified in the project (width × height).
- The automatic shutter slats shall be manufactured using the roll-forming method and shall be made of extruded aluminum profiles with a minimum thickness of 1.00 mm. The slat height shall be 95 mm.
- Slats shall be double-walled and insulated with polyurethane foam of at least 40 kg/m³ density between the layers (1.00 mm extruded aluminum profile + 16 mm polyurethane + 1.00 mm extruded aluminum profile). The shutter shall be painted according to the RAL color code specified by the Employer's Representative.
- The slats shall have a curved special form to increase strength and durability.
- Edge profiles shall be made of 2.00 mm thick extruded aluminum U-profiles, and double-brush sealing strips shall be applied to ensure silent operation and protection against dust.
- A rubber gasket shall be placed in a special groove at the bottom of the door to ensure a soft landing on the ground.
- The slats shall be concealed within an aluminum housing.
- If deemed necessary by the Employer's Representative, a pedestrian access door shall be integrated into the rolling shutter door.
- The Contractor shall install all necessary power cables from the most suitable location during the installation of all doors.
- The polyurethane foam filling of the shutter panels shall not contain CFCs (chlorofluorocarbons), which contribute to ozone layer depletion. The foam shall also be resistant to mold, insect, and bacterial growth.

Electric Motor

- The motor specifications shall be calculated by the Contractor using their specialized program, ensuring the correct pipe diameter and motor power are selected based on door width and weight. The automatic shutter system shall use either a reducer motor or a tubular-type electric motor, depending on the shutter dimensions.
- The upper and lower limit settings shall be adjusted using mechanical limit switches in a simple manner.
- The power supply voltage shall be 220 V / 50 Hz.

- The thermal cut-off time shall be approximately 4 minutes, and the temperature threshold shall be 150°C.
- The operating temperature range shall be -10°C to +40°C.
- The upper and lower limit adjustment capacity shall be 19 turns.
- The protection rating shall be IP44.
- In the event of a power outage or emergency, the system shall be manually operable using a gear reducer mechanism.
- A safety photocell system shall be included.
- The system shall feature a self-locking mechanism when closed, eliminating the need for an additional locking system.

2.5.10.6. Emergency Exit Doors

Emergency exit doors used within the scope of this contract shall be designed to open outward.

2.5.10.7. Windows

All windows shall be of the dual-opening type (tilt-and-turn). Both opening modes shall be controlled by a single handle.

Depending on the location, windows shall have either a 3 cm thick marble windowsill or, in solid brick walls, a sill made from the same wall material.

All windows in this section, as specified by the Employer's Representative, shall meet or exceed the following performance limits:

Aluminum Windows

- Windows shall be double-glazed, with a thermal break, in a color and design approved by the Employer's Representative.
- Any aluminum surfaces in contact with concrete or other alkaline-containing materials shall be coated with two layers of black bitumen or an equivalent approved protective material.
- While awaiting installation, all visible surfaces of the windows shall be protected using masking tape or similar methods. After installation, the tape shall be removed, leaving a clean, undamaged anodized surface.
- In accordance with the approved project, detail drawings, and sample, all supporting aluminum joinery profiles (frame, transom, and sash profiles) shall be manufactured from extruded aluminum profiles, classified per relevant standards and technical specifications in terms of chemical composition, mechanical properties, design,

dimensions, and thickness tolerances. The profiles shall be color-anodized with a matte finish.

- All window types, including dual-axis, standard opening, sliding, and glazed partitions, shall be factory-manufactured, supplied with all necessary assembly materials, including:
 - EPDM seals
 - PVC weatherstripping (bituminous foil tape) for thermal, water, and air insulation between the joinery and subframe
 - Mounting dowels
 - Complete installation at the site
 - Protection against material loss, labor, and transportation (both horizontally and vertically at the workplace)
- Polyurethane mastic shall be applied to the window edges to ensure sealing and waterproofing.
- Load-bearing aluminum profiles shall have a minimum thickness of 2 mm ($\pm 10\%$), meeting the necessary strength requirements based on static calculations.
- This requirement does not apply to non-structural elements such as glass bead profiles, T-adapter profiles, adapter profiles, and corner angles.
- Corner joints shall be reinforced with corner connectors made of aluminum profiles. If the system has thermal insulation, corner connectors shall be applied to both sides of the thermal break profiles, and the corners shall be pressed together.
- Thermal insulation aluminum profiles shall have at least three chambers for enhanced thermal efficiency.

PVC Windows

- The main frame shall be made of rigid PVC with a minimum thickness of 80 mm, featuring an integrated nailing flange, right-angle corners, and fusion-welded joints.
- The frame shall contain structural cavities and be reinforced with steel rods to prevent bending, twisting, sagging, or deformation.
- Windows shall be manufactured as an integrated system, featuring a double-gasket seal that is resistant to shrinking, cracking, or pulling away.

- Air tightness shall be ensured using double Santoprene fin gaskets.

2.5.10.8. Steel Doors and Windows

The types of doors to be used under the contract shall be as specified in the designs prepared by the Contractor and approved by the Employer's Representative.

In general, large doors that cannot be technically manufactured from aluminum in industrial facility structures shall be constructed as steel doors and shall be manufactured with thermal insulation.

Before any repetitive production or the installation of prefabricated frames, the Contractor shall assemble a finished prototype of each component, including all hardware, for approval by the Employer's Representative.

Unless otherwise specified, all openings for windows and doors in block walls shall be properly adjusted with reinforced concrete lintels to ensure appropriate clearance for the door and window wings.

2.5.10.9. Exterior Windowsills

Precast concrete, fiber concrete, and marble exterior windowsills used within the scope of this contract shall comply with the relevant provisions of BS 5642.

2.5.11. GLASS UNITS

2.5.11.1. General

Glass units used for windows and doors shall be of the double-glazed (insulating glass) type.

References:

- TS EN 572-1+A1 Glass in buildings – Basic soda-lime silicate glass products

2.5.11.2. Glass Gaskets

Materials used as glass gaskets shall be made of extruded vinyl or neoprene.

2.5.11.3. Workmanship Requirements

- All glass panes shall be either clear or frosted, as specified. Wired glass shall not be used.
- All glass shall be of a neutral color, and mirrored or tinted glass shall not be used. Only toilet and bathroom glass shall be frosted.
- Exposure to weather conditions: All glass units shall be designed to withstand a wind pressure of 1,200 Pa.

- Pre-installation protection: All materials and products shall be fully protected against transportation and storage damage.
- Before completing the work, the Contractor shall provide the manufacturer's cleaning and maintenance recommendations for the glass units and shall ensure that all glass units are cleaned in accordance with these recommendations upon project completion.

2.5.11.4. Roof Windows

- Roof windows shall be made of suitable transparent plastic.
- They shall be permanently fixed and designed to prevent unauthorized tampering.
- Installation shall be done by embedding them into the roof slab with a reverse curb cast.

2.5.12. IRONMONGERY/CONSTRUCTION HARDWARE

- Locks shall be of the cylinder type, and each building shall have its own master key that opens all room doors within the building.
- All locks shall be provided with three keys, and no key shall fit any lock other than its designated one.
- All keys shall be supplied with a keychain and a plastic tag clearly indicating the location of the corresponding door.
- All door hinges shall be stainless steel rolled hinges and shall be secured with stainless steel screws.
- All exposed parts and surfaces shall be made of stainless steel.
- The door handle plate shall be secured with stainless steel screws and aligned with the keyhole.

2.5.13. INTERIOR WALL AND CEILING FINISHES

2.5.13.1. General

All wall finishes shall be free of potentially harmful substances, hygienic, and easy to clean, requiring minimal maintenance whenever possible.

Wall finishes shall be designed to allow for movement of the underlying wall and adjacent components. Any element that is to be firmly fixed to the underlying wall shall be drillable or cuttable at a 90-degree angle for proper installation.

Wall coverings shall incorporate control joints to accommodate the expansion and contraction conditions specified in the design.

2.5.13.2. Workmanship Requirements

Wall finishes shall be perfectly smooth, without sharp edges or rough surfaces. Protruding corners shall be rounded to prevent dirt and water accumulation.

The overall wall construction, including the finishing layers, shall provide strong support for all specified fixtures and hardware. Finishes shall be easily cleanable, non-dusting, and non-porous to prevent absorption of dirt and body oils.

They shall also be resistant to heat, humidity, and potentially corrosive environments. Wall connections and perimeter floor finishes shall be detailed in a way that facilitates cleaning and prevents dirt accumulation.

Critical Dimensions and Tolerances

No additional tolerances shall be applied beyond the relevant EN standards.

Key Considerations

- Preparation of the underlying wall before applying the finish, if required.
- Allowing movement in the underlying wall to prevent stress on the finish.
- Ensuring the durability of joints and wall/block construction to prevent cracks.
- Easy cleaning of the finished surface.
- Seamless transitions between wall and floor surfaces, particularly at skirting level.
- Finishing details around door arches or window frames to allow for movement.
- Ensuring smooth, clean vertical joints between adjacent finishes.

- Avoiding moisture penetration through joints, which can affect adhesion.
- Preventing gaps behind applied finishes, as moisture accumulation behind the finish can weaken adhesion and cause detachment.
- Placing finishing joints at interior corners rather than exterior corners to achieve a proper appearance.
- Minimizing cracks in wall finishes due to movement of fixed equipment or installations.
- Applying the correct mix and finish in accordance with the manufacturer's instructions to ensure long-term durability.

2.5.14. PAINTS AND COATINGS

2.5.14.1. General

This section covers the supply of all necessary labor, equipment, and materials for painting and coating systems as specified. If the Contractor has the option to select different types of paint in compliance with the technical specifications, the paint with the least possible impact on workers' health and safety shall be preferred and may be used only upon approval by the Employer's Representative.

The Contractor shall ensure that the proposed product range is suitable for use in the wastewater treatment plant environment and shall share the technical data of the proposed manufacturer with the Employer's Representative.

Production Data

For the proposed products, the manufacturer's technical data shall include the following information:

- Type of paint
- Application areas
- Finish
- Available color range
- Volume expansion
- Coverage capacity
- Application temperature
- Drying time

- Hazard level
- Flammability

The Contractor shall submit the detailed product range of the proposed paint manufacturer to the Employer's Representative. All coating materials shall be supplied by an approved manufacturer unless otherwise agreed.

The Contractor shall inform the Employer's Representative before starting any coating work and obtain written approval for the proposed manufacturer.

Paints shall not contain substances classified as Prohibited Materials.

2.5.14.2. Pressed Brick Cladding

All specified products shall comply with one of the acceptable relevant standards. The cladding bricks shall be certified according to TS EN 1344.

Application Conditions for Pressed Brick Cladding

Storage of Materials

- Cladding bricks shall be supplied in nylon-wrapped pallets.
- In the factory, pallets shall be loaded using a forklift, and at the site, they shall be unloaded using a forklift, crane, or manually.
- Within the construction site, materials from the pallets shall be transported manually or using hand carts.
- Care shall be taken during transportation to prevent chipping of the edges, and the bricks shall be stacked properly.
- Cladding bricks shall be protected from rain and water exposure in the storage area.

Surface Preparation

- Cladding bricks can be applied to rigid and stable surfaces, such as reinforced concrete walls, columns, beams, perforated bricks, filler bricks, aerated concrete, or rough plaster.
- Any coatings that hinder adhesion, such as paint residues, insulation material remnants, burrs, mortar residues, oil, dust, or non-adhering plaster layers, shall be removed. For rough surfaces, the coatings shall be scraped off; if this is not possible, the surface shall be re-plastered and leveled.

- If the application surface is damp, the wall body and surface shall be dried completely.
- A waterproofing material, as specified in the related section, shall be applied to the surface before the cladding installation.
- A 5 cm thick corrugated XPS insulation board shall be mounted onto the waterproofed surface using adhesive and dowels. The corrugated grooves shall be prepared for the installation of the cladding bricks.

Protection of Walls During Application

- Cladding bricks shall be protected during installation and for at least the first day after completion, until the adhesive gains strength.
- Protection against external weather conditions, such as rain, construction wastewater, moisture, frost, and excessive sunlight, shall be ensured by covering the surface with nylon or tarpaulin sheets, leaving a gap between the cladding and the cover.

Weather Conditions, Additional Considerations, and Cleaning

- Cladding bricks shall not be applied at temperatures below +4°C.
- During winter applications, particularly in areas exposed to frost, the drying time of the adhesive shall be extended, and grout filling shall only begin 4-5 days after installation. Since the joints remain open during this period, the cladded surface shall be protected from rain, snow, and water accumulation using nylon or tarpaulin covers.
- During hot weather, the cladding bricks shall be moistened to prevent them from absorbing the adhesive's water content, which could weaken the bond. This can be done by briefly immersing the bricks in a clean water container just before use.
- Due to variations in soil composition, color differences may occur in bricks during firing. To avoid noticeable color inconsistencies, bricks from different pallets shall be mixed during application.
- Special care shall be taken to prevent adhesive mortar and grout from contaminating the brick surfaces.
- If any material gets on the brick surface, it shall be left to dry and then removed using a stiff plastic brush.
- For heavily soiled surfaces, a specialized surface cleaner shall be used.
- Paint, varnish, vinegar, hydrochloric acid, or similar chemicals shall not be applied to the brick surface after installation.

Installation of Cladding Bricks

- The surface shall be prepared according to the conditions specified above.
- The adhesive material shall be prepared according to the manufacturer's usage instructions.
- The adhesive shall be applied to the surface using an 8-10 mm notched trowel.
- The back of the cladding brick shall also be coated with adhesive and installed using a metal guide, string line, plastic tile spacers, or wedges with a 1 cm joint spacing.
- During installation, horizontal and vertical joints shall be carefully aligned to ensure the wall is level and plumb.
- After the adhesive has dried (24 hours), spacers shall be removed, and grouting shall commence.
- Grout joints shall be a minimum of 10 mm wide.
- Grout shall be applied using a grout gun, ensuring no excess material spreads onto the brick surface.
- Once the grout is partially set (not sticky to the touch), it shall be shaped using a jointing trowel.

2.5.14.3. Plastic Paint

Plastic paint shall comply with TS 13227 and the manufacturer's instructions. The color of the paint shall be subject to approval by the Employer's Representative.

2.5.14.4. Acrylic Paint

Acrylic paint shall comply with TS 13227 and the manufacturer's instructions. The color of the paint shall be subject to approval by the Employer's Representative.

2.5.14.5. Paint Protection

The paint protection system for structural steel works shall comply with the following standards or an equivalent approved by the Employer's Representative:

- TS 11590 – Epoxy Resin-Based Paints for Steel Structures
- TS EN ISO 12944 – Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems
- TS 4359 – Protective Coatings for Steel Structures Exposed to Atmospheric Conditions

2.5.14.6. Bitumen Coating

Surface Preparation

Cement-based surfaces of structures in contact with water shall be solid, load-bearing, non-porous, and free of cracks. The surface shall be cleaned of bitumen, paint, formwork oil, and curing materials that may reduce adhesion. Metal and wooden wedges on the surface shall be removed.

Cone-shaped voids and other holes on the wall surfaces shall be tightly filled with polyethylene cord, while the first 2 cm of tie-rod holes, active water leaks, and any existing gaps shall be filled with fiber-reinforced structural repair mortar. Corners and edges shall be rounded with plaster mesh to a minimum radius of 4 cm. Additionally, in areas where different materials meet (such as over tie-rod holes covered with repair mortar, in sections of 20x20 cm), plaster mesh shall be used.

The application surface shall be thoroughly wetted and left until it reaches a wet/dry state. The material shall be applied on a primed dry concrete surface.

Mixing Process

The powder component (B) shall be slowly added into the liquid component (A) (in its original packaging) and mixed with a 400-600 rpm mechanical mixer for 3-5 minutes until a homogeneous and lump-free mixture is achieved. The mixture shall be left to rest for 3-5 minutes, then mixed again for 30 seconds before it is ready for use. The prepared mixture shall be used within 1 hour.

Application of Brush-On Waterproofing

The material shall be mixed as specified. From the prepared mixture, 1 kg of material shall be taken, and 2-4 liters of water shall be added. The mixture shall be stirred with a 400-600 rpm mechanical mixer for 3-5 minutes until it becomes homogeneous.

The material shall be applied using a suitable brush, ensuring even distribution and preventing pooling on horizontal surfaces. The primer shall be left to dry completely before proceeding with the application. Based on the environmental conditions, the required amount of material shall be applied according to the consumption table, using a brush.

The bitumen coating application shall comply with approved detail drawings.

Protection of Coating

The foundation pit backfilling shall not be carried out until the coating has completely dried. Before backfilling, the coating shall be protected from impacts during the filling process using suitable thermal insulation boards.

Precautions

During application, if the ambient and surface temperature is below +5°C or above +30°C, the process shall be postponed until the appropriate temperatures are reached. Application shall not be performed under extreme heat, rainy, or windy conditions.

For exterior surfaces, the applied coating shall be protected from direct sunlight, wind, rain, and frost for the first 24 hours. After 2 days, it gains mechanical strength, after 7 days, it becomes waterproof, and it reaches full strength in 14 days.

The working and reaction times of cement- and bitumen-based systems are affected by ambient temperature, surface temperature, and relative humidity. Lower temperatures slow down the reaction, extending the pot life and working time, while higher temperatures accelerate the reaction, shortening the specified times.

The material shall not be applied if the ambient or surface temperature falls below the minimum allowable temperature during curing. The material shall be used within 1 hour after mixing.

2.5.14.7. Workmanship Requirements

This section covers the painting and similar coating applications for all areas specified in the specifications/drawings, including walls, ceilings, openings, columns, beams, conduit pipes, valve openings, niches, and other relevant surfaces.

The Contractor shall prepare sample areas that include surface preparation and painting in designated locations, as agreed upon with the Employer's Representative, to serve as reference samples for the painting process.

If a final finishing coat is to be applied to the floor and no skirting board is present, the floor paint shall extend approximately 100 mm up the base of the wall.

The sealing of threshold openings, skirting boards, joints, and ceiling or wall surfaces shall be achieved using acrylic insulation material. Painting of doors shall include door leaves and all edges.

Uncoated Concrete

Formwork release agents shall be removed using detergent/emulsion solutions. The main surface defects shall be fully repaired before painting.

Uncoated Walls/Plaster

Loose or peeling materials shall be removed using a stiff brush. The main surface defects shall be fully repaired.

Uncoated Plaster

Minor protrusions, trowel marks, and plaster splashes shall be removed. Over-troweled "glossy" areas shall be lightly sanded.

Uncoated Drywall

Gaps around fixed fixtures shall be filled before painting.

Unsuitable Conditions

During working hours, temporary protection measures and additional drying time shall be ensured to prevent coatings from being affected by climatic conditions during and after application.

Personnel shall be protected from exposure to solvent vapors exceeding occupational exposure limits, as defined in the applicable Health and Safety Regulations.

Unless explicitly permitted by the paint manufacturer, coatings shall not be applied under the following conditions:

- * On surfaces affected by moisture or airborne dust
- * When air or substrate temperature is below 5°C
- * When relative humidity exceeds 80%
- * In conditions where heat may cause blistering or wrinkling of the coating

Precautions During Application

Brushes and equipment used during the work shall be kept clean at all times. Cleaning materials and waste shall be disposed of safely and shall never be poured into drainage pipes or toilets.

When applying multiple coats of the same pigmented material, a slightly different shade shall be used for each coat to ensure full coverage. Paints shall be applied to clean and dry surfaces, adhering to the manufacturer's recommended waiting time between coats. The paint shall be applied uniformly, without visible brush marks, drips, seepage, or other defects, ensuring a consistent single-color finish.

Necessary measures shall be taken to protect dried and finished work from potential damage.

Preparation of Joinery for Coating

Before treating pre-protected wood, it shall be ensured that all cut surfaces are re-treated with a protective coating and that all protective treatments are completely dry. End grain areas shall be heavily coated, allowing the wood to absorb the treatment before applying a second coat.

Hidden Joinery Surfaces

In areas where one or more coats are expected to be factory-applied, all surfaces, including those that shall be hidden after installation, shall be treated with a protective coating.

Polishing / Glazed Lacquer

During application, the first thin coat shall be applied with white alcohol in accordance with the manufacturer's recommendations. The application surface shall be thoroughly brushed to prevent air pockets and drips. Between each coating of polish, additional varnish or glaze layers shall be lightly rubbed along the direction of the wood grain.

Cleaning and Maintenance

The Contractor shall submit to the Employer's Representative all cleaning and maintenance recommendations provided by the manufacturer for ongoing painting and coating works.

2.5.15. FLOOR COVERINGS / FINISHES

2.5.15.1. General

All floor coverings shall include the necessary control joints as required by the flooring manufacturer/supplier and building consultant and shall be compatible with all underlying structures.

The materials used shall be durable, aesthetically pleasing, and color-retaining, meaning they shall not fade due to continuous cleaning and foot traffic. The selected flooring shall be easy to clean and resistant to daily manual or machine-based cleaning methods.

All floor coverings shall provide a safe walking surface, especially in areas where surfaces may become wet due to water drainage or weather conditions. The floor-to-wall transitions shall be designed to facilitate easy cleaning and prevent dirt accumulation.

2.5.15.2. Levelling and Protective Concrete

The levelling concrete in structures shall be applied with a minimum thickness of 5 cm. The surface shall be set at the specified level and plane.

Before applying levelling concrete to concrete floors, all cement laitance shall be removed, and the concrete slab shall be thoroughly washed with water, ensuring the removal of all loose materials, dust, and dirt.

The characteristics of the pre-mixed levelling concrete shall be as follows:

- Density: 2.4 t/m³
- 28-day characteristic compressive strength: >16 MPa
- 28-day characteristic tensile strength: >1.4 MPa

The levelling concrete mix shall be prepared using appropriate cement, water, and aggregates and shall be thoroughly dry-mixed using mechanical methods before adding water to ensure uniform distribution. The water content shall be kept as low as possible while maintaining the necessary workability for placement and compaction. Hand mixing shall only be permitted on a waterproof surface, and only in small quantities, with prior approval from the Employer's Representative.

The levelling concrete mixture shall be spread between formworks and properly placed around orifices, pipe covers, manhole covers, gutters, railing posts, pipes, and other embedded elements. It shall be compacted using a levelling board to ensure it is placed within a ± 3 mm tolerance range and to prevent the cement slurry from rising to the surface. The surface shall be compacted with a wooden trowel and finished with a steel trowel to achieve a smooth final surface.

The final floor levelling concrete shall be applied over the screed base and shall have the following properties:

- Self-levelling,
- Resistant to gasoline, oil, and solvents,
- Highly resistant to all types of mechanical stress,
- Waterproof and suitable for wet areas,
- Non-slip even in the presence of oil spills and in wet areas,
- Electrostatically neutral.

All expansion joints in the floor levelling concrete shall be simple butt joints without filler material. Where the levelling concrete is placed over construction joints in the underlying concrete, it shall be separated using 10 cm-wide unsaturated fabric strips or similar materials.

The finished levelling of the concrete surface shall be free from defects. Any surface exhibiting poor adhesion, void patches, streaking, cracks, or other imperfections shall be rejected and removed at the Contractor's expense, replacing it with an acceptable finish.

The scope of removal and the method for demolition and replacement shall be subject to approval by the Employer's Representative.

Before proceeding with further works, the Employer's Representative shall inspect and approve all surfaces.

2.5.15.3. 200 Kg Cement-Based Levelling Layer

The levelling layer in structures shall be applied with a minimum thickness of 3 cm. The surface shall be set at the specified level and plane.

Before applying the levelling layer to concrete floors, all cement laitance shall be removed, and the concrete slab shall be thoroughly washed with water, ensuring the removal of all loose materials, dust, and dirt.

The levelling layer mixture shall be prepared using appropriate cement, water, and sand and shall be thoroughly dry-mixed using mechanical methods before adding water to ensure uniform distribution. The water content shall be kept as low as possible while maintaining the necessary workability for placement and compaction. Hand mixing shall only be permitted on a waterproof surface and only in small quantities, with prior approval from the Employer's Representative.

The levelling layer shall be executed under flooring materials in interior spaces, ensuring the appropriate slope and elevation as required.

Before proceeding with the levelling layer application, the Contractor shall complete elevation studies and obtain approval from the Employer's Representative before finalizing the work.

2.5.15.4. Materials

Terrazzo Tiles

The mosaic tiles to be used under this contract shall comply with TS 213-1 EN 13748-1 for interior building applications and TS 213-2 EN 13748-2 for exterior applications.

Ceramic Tiles

Ceramic tiles shall conform to TS EN 14411 and TS EN ISO 10545-11.

Granite Tiles

Granite tiles shall comply with TS EN 12057. The color and quality of the tiles shall be subject to approval by the Employer's Representative.

Cladding Bricks

The cladding bricks to be used under this contract shall have a minimum thickness of 15 mm and a surface area greater than 0.04 m².

2.5.15.5. Workmanship Requirements

All floor coverings under this contract shall be slip-resistant, free from sharp edges, and shall not contain abrasive protective coatings. The flooring shall be dirt-free, easy to clean with warm water or chemical cleaning agents, waterproof, and resistant to warm chemical water, irrigation, or mechanical cleaning. It shall also be stain-resistant against chlorine-based chemicals and metal corrosion.

All flooring within the structures shall be crack-free and resistant to industrial impact. Floor finishes shall be detailed to integrate properly with floor drainage channels or outlets.

All floor coverings in wet areas shall be installed with a minimum slope of 1%, ensuring that no water accumulates on the surface and allowing surface water drainage where required.

Critical Dimensions and Tolerances

- The flooring shall comply with the manufacturer's requirements.
- A 1% slope is required for all wet area floors.
- The flooring shall comply with the current EN standards.

Key Considerations

- Construction details, foundation, screed, and floor covering specifications, including:
 - Ground conditions (e.g., bearing capacity and water level).
 - The position of the damp-proof membrane. Depending on the specified floor finish and water level, an additional membrane between the sub-slab and screed may be required.
- Slope: All wet areas shall be installed in a way that allows water runoff and hose-down water drainage.
- Drainage: The drainage method for all wet areas, including floor and outlet design, shall be specified.
- Expansion joints: Structural expansion joint placement shall depend on the floor finish type, manufacturer's recommendations, and structural consultant requirements. The inclusion of expansion joints may or may not be required based on these factors.

Wall-to-Floor Finish Connections

At wall and floor connections, special care shall be taken to avoid protrusions or depressions that could lead to water accumulation in wet areas. Corrosion-resistant metal components shall be used at junctions between different flooring materials, ensuring compatibility between the basement surface finish and the floor covering.

Floor Drain Outlets

- The drainage outlet shall be designed to ensure rapid water flow and prevent clogging due to waste materials.
- No sharp edges or hazardous details shall be present at the finished outlet.
- The drainage outlet shall be resistant to hot, chemically treated water and cleaning agents.

2.5.16. ROOF FINISHES

2.5.16.1. Aluminum Roofing

For fixing elements of aluminum sheets, aluminum and hot-dip galvanized steel shall be used. Corrugated (trapezoidal) aluminum sheets complying with standards shall be overlapped by at least 15 cm in the longitudinal direction. They shall be fixed to purlins and wooden battens using self-drilling screws of at least metric 7 diameter, and silicone sealant shall be applied to longitudinal overlaps, accessory connection points, and pop rivet holes to ensure waterproofing. The accessories to be used shall be compatible with the material thickness and shall have a minimum thickness of 0.70 mm.

If a heat-insulated roof covering is to be installed using corrugated (trapezoidal) aluminum sheets filled with glass wool, in addition to the above procedures, wooden battens of a width of at least 10 cm and a height suitable for the glass wool thickness shall be placed between the top and bottom sheets and shall be fixed to the existing purlins using flat bars and self-drilling screws.

For a heat-insulated roof covering using polyurethane-injected aluminum sheets, polyurethane (with a minimum density of 35 kg/m³) shall be injected in factory or workshop conditions between aluminum sheets manufactured from the same alloy and quality as trapezoidal aluminum sheets.

Aluminum sheets shall be manufactured in single pieces for spans up to 12 m. For larger spans, they shall be produced with minimum necessary joints, and longitudinal joints shall overlap by at least 15 cm, ensuring polyurethane-filled sections are properly aligned and bonded.

Aluminum panel surfaces shall be clean, seamless, and smooth, without cracks, holes, stains, or scratches. Transverse edges shall fully contact each other when overlapped. To prevent dust

and air infiltration, a continuous foam strip shall be placed in these areas, avoiding thermal bridging. Ridge caps shall be used as two separate elements (top and bottom), and polyurethane shall be injected into these sections to ensure thermal insulation continuity.

Polyurethane panels shall be secured to purlins with self-drilling screws at four points along their horizontal axis. Corrugated aluminum sheets shall be installed on the existing roof according to the Employer Representative's approved project, with profiles positioned in the direction of water flow. Silicone sealant shall be applied beneath fixing elements, at perforation points, and in pop rivet holes for waterproofing.

Thermal expansion can cause roof coverings to tear when fixed with self-drilling screws. To prevent this, the screw connection shall allow for movement. An elastic washer resistant to external conditions shall be placed between the screw and sheet to absorb expansion movements. Holes beneath washers shall be sealed with silicone sealant to ensure watertightness.

2.5.16.2. Waterproofing

2.5.16.2.1. Materials

The waterproofing system used under this contract shall be capable of withstanding climatic conditions, including high-temperature fluctuations between day and night, high humidity, and heavy rainfall.

2.5.16.2.2. Geotextile Felt/Geotextile Filter Fabric

The materials used under this contract shall be resistant to ultraviolet light and chemical effects and shall not undergo significant physical, chemical, or engineering property changes under the influence of sulfates, chlorides, acids, alkalis, and other chemical concentrations present in the soil and groundwater at the installation site. The products shall have proven resistance to bacterial and microbiological effects and shall perform their function within operating temperatures ranging from 5°C to 45°C. If exposed to temporary temperatures up to 60°C during construction, the material shall not experience permanent deformation.

The filter fabric shall be supplied in rolls with a minimum width of 200 cm and, unless otherwise specified, shall be wrapped by 30 cm in both directions. The roll lengths shall be such that the entire inclined and horizontal sections can be covered in one continuous installation without joints.

The permeability of the fabric shall be higher than the permeability of the protected soil while the pore size shall be smaller than the sieve size that allows more than 10% of the soil particles to pass through. The fabric shall have a minimum weight of 250 g/m².

The Geotextile Filter Fabric shall consist only of chain polymer fibers or polyester threads, forming a strong network with small perforations. The fabric shall be resistant to common

chemical substances and hydrocarbons, mold-proof, rot-resistant, ultraviolet light-resistant, and resistant to insects and rodents. Additionally, it shall comply with the technical properties specified below.

The fabric shall be supplied in rolls wrapped in protective packaging to prevent contamination from mud, dirt, dust, or debris. It shall be free from defects and imperfections that could significantly affect its physical properties. Each roll shall be labeled with a number or symbol indicating the production batch for shipment tracking.

The fabric shall be installed in full compliance with the manufacturer's requirements.

The complete descriptive and engineering data regarding the fabric shall be submitted to the Employer's Representative for approval, including:

1. A 300x300 mm fabric sample.
2. A manufacturer's certificate verifying chemical composition, product description, compliance with specifications, and a signature from an authorized official confirming the accuracy of the information.
3. Installation instructions, including overlap specifications for stitched joints (if pre-stitched fabric is not provided):
 - Minimum 50 cm overlap in a direction perpendicular to the trench.
 - Minimum 30 cm overlap in a direction parallel to the trench.

2.5.16.2.3. Polyurea Spray Waterproofing

Surfaces to be coated with polyurea shall be completely free of oil, dirt, and contaminants. To ensure the durability and adhesion of the coating, any loose layers on the concrete surface shall be removed to create a suitable surface for coating. An industrial vacuum cleaner shall be used to minimize dust formation during surface preparation.

All existing water leakages in the area to be coated shall be completely sealed to ensure no water infiltration occurs during the coating process. Additionally, necessary preventive measures shall be taken to prevent dust, dirt, and other contaminants from reaching the coating area.

Once these conditions are met, the floor surfaces shall be cleaned of dust and dirt before applying the polyurea coating. After the required surface conditions are ensured, a two-component epoxy-based primer shall be applied by spraying in a single direction, with an average consumption of 400 g/m².

After the waiting period specified in the product's technical application requirements, a 100% pure polyurea-based waterproofing material shall be applied as the first coat, using an average of 1100 g/m², by spraying in the same direction.

Following the waiting time specified in the product's technical application requirements, a second coat shall be applied perpendicular to the first coat, with an additional 1100 g/m² consumption.

2.5.16.2.4. Waterproofing in Wet Areas

The materials used by the Contractor shall be TSE-certified. The surface to be treated, such as leveling concrete, screed, etc., shall be cleaned of oil, dust, and dirt, washed, and excessively alkaline surfaces shall be neutralized with 1% hydrochloric acid solution. After rinsing with clean water, a two-component, cement-based, waterproof elastic coating material shall be prepared by mixing special cement-based aggregate (Component B, powder) with polymer acrylic dispersion (Component A, liquid).

The first coat shall be applied using a brush or roller in a continuous layer without gaps, with a thickness of 1.0 mm. After the first coat dries (approximately 2-6 hours later), a second coat shall be applied using a brush, roller, or trowel.

Once the total thickness reaches approximately 2.50 mm (3.5 kg/m²), the surface shall be protected for at least three days from direct sunlight, air circulation, rain, and frost to ensure proper curing.

2.5.16.2.5. Thermal Insulation Boards

The insulation boards to be used for buildings under this contract shall be manufactured from extruded closed-cell polyethylene, installed tightly with staggered joints, and not loosely laid. The thickness shall be greater than 30 mm, and the boards shall comply with the manufacturer's specifications. The boards shall be adjusted to fit the tapes used under the waterproof membrane.

For basement retaining walls, thermal insulation shall be applied over the waterproofing layer using smooth-surfaced boards with a minimum thickness of 3 cm (EPS-250 with a compressive strength of 250 kPa). The materials to be used shall be submitted for approval by the Employer's Representative.

For building or structure roofs (floor slabs, inverted terrace roofs), thermal insulation shall be installed using 5 cm thick, smooth-surfaced XPS boards with a minimum compressive strength of 300 kPa.

For building or structure facades, under pressed cladding bricks, insulation shall be applied using 5 cm thick, smooth-surfaced, grooved XPS boards with a minimum compressive strength of 200 kPa.

All insulation boards and their installation areas shall be submitted for approval by the Employer's Representative.

2.5.16.2.6. Workmanship Requirements

The waterproofing system to be installed under this contract shall be laid in accordance with the manufacturer's recommendations. Prior to installation, all surfaces shall be dry and clean, and dirt, dust, mud, oil, and foreign substances shall be removed. Oil and grease residues shall be cleaned with solvents before mechanical cleaning begins.

The waterproofing material shall be extended from the parapet wall up to any additional height above the flat roof surface. During installation, sharp right-angle corners shall not be accepted.

2.5.16.3. Installation of Aluminum Composite Panel Coping

Aluminium coping profiles for parapets with a width of 10-30 cm shall be made of 1.5 mm thick aluminium base plates and 3 mm aluminium sheets, while parapets with a width of 30-40 cm shall have 2 mm thick aluminium base plates and 4 mm aluminium sheets. The material shall be supplied and installed in accordance with the project specifications, measurements, and details.

General Specifications:

- The material shall be corrosion resistant.
- No visible fastening elements (such as screws, nails, etc.) shall be present on the exposed surface.
- The physical properties shall remain stable under temperature variations.
- The product shall comply with international standards for all its properties.
- H profiles shall be used at the joints of the profiles.
- Interior and exterior corner transitions shall be welded aluminum.
- The color shall be RAL 6024.

2.5.16.4. Installation of Parapet with Colored Marble Slabs

For cladding with colored marble slabs, the existing surfaces shall be cleaned and wetted. A base layer shall be applied using mortar with 400 kg cement dosage, upon which 3 cm thick marble slabs (excluding honed and polished surfaces but including all other surface treatments) shall be prepared and installed. Upon completion, the surface shall be cleaned and wiped.

2.5.16.5. Installation of Rainwater Downpipes for Roofs

The Contractor shall supply rigid PVC pipes with one socketed end and shall secure them to the wall using clamps. The pipes shall be installed from the gutter, including elbows, and clamps shall be tightened with galvanized nut bolts to fix the rainwater pipes to the wall.

2.5.17. HYDRAULIC TESTING OF REINFORCED CONCRETE AND STEEL WATER-RETAINING STRUCTURES AND CONCRETE/STEEL ROOFS

In accordance with EN 1992-3 – Eurocode 2: Design of Concrete Structures

Pre-Test Requirements

- All internal and external surfaces of the structure shall be thoroughly cleaned prior to the commencement of testing.
- Where feasible, testing shall be carried out prior to the placement of any backfill against the external walls.
- The structure shall be filled at a uniform rate not exceeding 2.0 meters per 24 hours.
- The Contractor shall complete the filling operation within a maximum duration of 3 calendar days.

Test Procedure and Monitoring

- Upon completion of filling, the water level shall be monitored and recorded at 24-hour intervals over a continuous 7-day test period, using methods approved by the Employer's Representative.
- The maximum permissible water level drop, after correction for evaporation and precipitation, shall not exceed the greater of 10 mm or 1/500 of the average water depth within the structure during the test.

Leakage Control and Remedial Actions

- The successful completion of the hydraulic test shall not preclude the requirement for sealing any visible leakage observed on the external faces of the structure. Such sealing works shall be executed using materials approved by the Employer's Representative.
- Wherever practicable, all sealing operations and crack repairs shall be carried out from the internal face of the structure.

Compartmental and Sequential Testing

- Each compartment within the structure shall be individually tested.

- Compartments not under test shall remain dry and empty throughout the testing of adjacent compartments.
- The hydraulic test shall not commence until the roof slab has successfully passed its designated test.
- Adjacent compartments shall be tested sequentially, with each subsequent test initiated only upon successful completion and acceptance of the preceding test.

Post-Test Measures

- Following the successful completion of the test, and unless the stored water is to be used for other construction activities, the tested structure shall be emptied at the earliest opportunity.

Open-Top Structures: Environmental Compensation Tank

- For open-top structures, the Contractor shall supply and install an open plastic or steel reference tank, with a minimum internal cross-sectional area of 1.0 m², located adjacent to the tested structure.
- The tank shall be filled to a level 50 mm below the top edge and levelled accurately.
- This tank shall serve as a reference to quantify environmental effects (rainfall and evaporation) during the testing period.

Internal Partition Testing

- Where internal partitions exist, each partition shall be tested independently and in accordance with the procedures outlined herein.

Measurement Point and Approval

- The Contractor shall identify the water level measurement point(s) and obtain approval from the Employer's Representative prior to commencing the test.
- All measurements shall be conducted under supervision and in accordance with the Employer's Representative's instructions.

2.5.18. SAMPLING, NUMBER OF SAMPLES, AND ACCEPTANCE CRITERIA FOR THE MATERIALS TO BE USED

2.5.18.1. Sampling, Number of Samples, and Acceptance Criteria for (HDPE PE 100) Pipes

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, HDPE pipes and raw materials, the technical specifications and quantities of which are specified in the specifications and/or contracts, are in accordance with national and international standards (TS EN ISO 3126, TS EN 12201-2+A1, TS EN ISO 6259-1, TS EN ISO 6259-3, TS ISO 18553, TS EN ISO 11357-1, TS EN ISO 11357-6, TS ISO 6964, TS EN ISO 1133-1 (Method A), TS EN ISO 1167-1, According to TS EN ISO 1167-2, TS EN ISO 1183-1 (Method A), TS EN 12099) for quality control tests to be carried out in the Building Materials Laboratory of the Employer; sampling frequencies and criteria, the number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

QUALITY CONTROL TESTS OF HDPE PIPE AND RAW MATERIAL

1) Physical Specifications

- HDPE pipes will be PE100 with high resistance to slow and rapid crack progression.
- When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces shall be smooth and there shall be no pits, cracks, gaps, deep scratches, marks or other similar surface defects that may interfere with the conformity of the pipe to this standard.
- Pipes; It will be resistant to external impacts and ram impact, flexible, cracking and impact resistant will be high.
- The color of the pipes will be black, and when inspected by eye, the color and appearance will be uniform all over the body. There will be blue stripes on the pipes. The lines will be made at the production stage. Subsequent painting or markings will not be accepted.
- The average outer diameters, ovality, wall thickness and other properties of the pipes **are in accordance with the TS EN 12201-2 + A1** standard, the diameter and ovality will be the same throughout the pipe.

2) Chemical Properties

- The pipes will have high UV resistance, maintain their standard properties when stored in the open air, have high resistance to alkaline earth metals, have high chemical resistance, will not be affected by moisture under the ground, are resistant to corrosion and pressure, and will comply with the Ministry of Health Foodstuffs Regulation in terms of hygiene and toxicology.

3) Raw materials

- The raw material to be used in the manufacture of the pipes will be in the original black color, in the form of granules ready for extrusion and injection, and no subsequent addition of carbon black will be made. No scrap material will be used in production. The raw material will not contain additives other than antioxidants, UV stabilizer.
- The manufacturer shall submit information and documents to the Employer indicating the source and characteristics of the raw material to be used.
- The raw material will be taken from companies that are members of the PE 100 Plus Association, will have passed through at least two reactors and will have an ISO 9080 analysis certificate. Density, Melt Flow Rate (MFR), Amount of Carbon Black and Oxidation Induction Time (OIT) values will be indicated on the certificate.

Table – 1 Raw Material Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Experiment Acceptance Criteria
a)	Determination of Carbon Black Amount by Calcination and Pyrolysis	TS ISO 6964	$2\% \leq (\% \text{ by mass}) \leq 2.5\%$, Ash content $\leq 0.1\%$ (by mass)
b)	Determination of the Degree of Pigment or Carbon Black Dispersion	TS ISO 18553	Degree of distribution; ≤ 3.0 Dominant appearance; Must be any of the A1 , A2, A3 or B views.
c)	Mass Melt Flow Rate (MFR) Determination*	TS EN ISO 1133-1 (Method A)	$0.20\text{g}/10\text{min} \leq \text{MFR} \leq 0.35\text{g}/10\text{min}$ (at 190°C, under 5 kg mass)
d)	Determination of Oxidation Induction Time (OIT)	TS EN ISO 11357-6 TS EN ISO 11357-1	$\geq 20 \text{ min}$ (200 °C, 15 ± in 2 mg sample)
e)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$p \geq 0,950 \text{ gr/cm}^3$ (23 ± 0,5 °C)
f)	Determination of Volatile Substance Content	TS EN 12099	$\leq 350 \text{ mg/kg}$
* MFR tests will be carried out separately for raw material and pipe, and the difference between the two results will be at most ± 10% according to the raw material.			

- Raw material samples; It will be kept closed, marked and unopened, and 1 piece (minimum 500g) of raw materials representing each batch will be delivered to the laboratory for quality control tests together with the pipe samples.

4) HDPE PE 100 Pipes

Table – 2 HDPE Pipe Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Acceptance Criteria
a)	Determination of Dimensions	TS EN ISO 3126	When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces will be smooth, there will be no other surface defects such as any pits, cracks, etc., and it will provide standard value ranges.
	A-1) Visual inspection	TS EN 12201-2	
	A-2) Wall Thickness	TS EN ISO 3126	
	A-3) Outer Diameter	TS EN ISO 3126	
	A-4) Ovality	TS EN ISO 3126	It will comply with TS EN 12201-2 Schedule-1.
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$p \geq 0,950 \text{ gr/cm}^3$ ($23 \pm 0,5 \text{ }^{\circ}\text{C}$)
c)	Determination of Tensile Properties (Max = 50kN)	TS EN ISO 6259-1 TS EN ISO 6259-3	$\geq 500 \%$ (To be measured with an extensometer.) In one piece, there will be no fibroids or foliations.
ç)	Determination of the Degree of Pigment or Carbon Black Dispersion	TS ISO 18553	Degree of distribution; ≤ 3.0 and Dominant Appearance; Must be any of the A1, A2, A3 or B views.
d)	Determination of Carbon Black Amount by Calcination and Pyrolysis	TS ISO 6964	$2\% \leq (\% \text{ by mass}) \leq 2.5\%$, Ash content $\leq 0.1\%$ (by mass)
e)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Method A)	$0.20 \text{ g/10min} \leq \text{MFR} \leq 0.35 \text{ g/10min}$ (190 °C, under 5 kg load) (The difference between raw material and pipe MFR value is maximum $\pm 10\%$)
f)	Determination of Oxidation Induction Time (OIT)	TS EN ISO 11357-6 TS EN ISO 11357-1	$\geq 20 \text{ min}$ (200 °C, $15 \pm 2 \text{ mg}$ sample)
g)	Determination of Volatile Substance Content	TS EN 12099	$\leq 350 \text{ mg/kg}$
ğ)	Determination of Resistance to Internal Pressure (Max d= 560 mm)	TS EN ISO 1167-1 TS EN ISO 1167-2	At 80 °C, no damage should occur during the 165-hour period.

Table – 3 Frequency of Taking Test Samples, Number of Samples and Number of Experiments

Sequence No	Experiment Name	Test Method/Standard	Sampling Frequency	Number of Samples	Number of Experiments
a)	Determination of Dimensions and Visual Inspection	TS EN 12201-2	For Every Different Party 1 time	For Every Party 1 Piece	1 Piece
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)			
c)	Determination of Tensile Properties (Max = 50kN)	TS EN ISO 6259-1 TS EN ISO 6259-3			
ç)	Determination of the Degree of Pigment or Carbon Black Dispersion	TS ISO 18553			
d)	Determination of Carbon Black Amount by Calcination and Pyrolysis	TS ISO 6964			
e)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Method A)			
f)	Determination of Oxidation Induction Time (OIT)	TS EN ISO 11357-6 TS EN ISO 11357-1			
g)	Determination of Volatile Substance Content	TS EN 12099			
ğ)	Determination of Resistance to Internal Pressure (Max d= 560 mm)	TS EN ISO 1167-1 TS EN ISO 1167-2			

- The number of samples to be taken for laboratory tests will be taken in the quantities specified in **Table-4** according to the pipe quantities supplied, regardless of diameter and pressure class.
- * **Pipes and pipe special parts of the same diameter and type and submitted for inspection at one time are counted as one batch.**

Table – 4 Number of Samples to be Taken According to the Pipe Quantity

Pipe Quantity for Each Nominal Diameter (m)	Number of Samples to be Taken (pcs) *
$\leq 5,000$	1 piece
* (1 piece = means a minimum of 3 pipe samples for each different nominal diameter.)	

Note: When the quantity of each nominal diameter in the batch exceeds 5,000m > 1 more sample will be taken up to every additional 5,000 meters of each different rated diameter received. Pipes of the same diameter and type and submitted for inspection at once are counted as one batch.

All tests specified in Table-2 on 1 (3 pipe samples) of each nominal diameter determined according to Table-4 will be carried out within the framework of the methods specified in the standards.

The minimum number of samples to be prepared for the Determination of Tensile Properties Test will be made according to the numbers taken from the relevant section of the TS EN 6259-1 standard (Part 6 - Test Pieces) and specified in Table – 5.

Table – 5 Minimum Number of Test Pieces for Determination of Tensile Properties

Nominal outer diameter dn (mm)	15 mm <DN ≤ 32 mm	32 mm <DN ≤ 63mm	DN > 63mm
Number of Test Pieces (pcs)	2	3	5

The entire batch represented by the pipes whose test results do not comply with Table-1 and Table-2 will be rejected, the pipe equal to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard pipes will be removed from the storage area following the delivery of the new lot. All responsibility and expense for this process will belong to the Contractor Company.

- 5) Quality control tests of HDPE Pipes will be carried out in the Building Materials Laboratory of the EMPLOYER.
- 6) Pipe quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.
- 7) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 8) From the samples delivered to the laboratory; In case of negative results from at least one of the tests specified in Table-1 for raw material tests and in Table-2 for HDPE Pipe tests; The Contractor acknowledges that the Employer has the right to indemnify.

2.5.18.2. (Corrugated) Sampling of Pipes, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, the technical specifications and quantities of the CORRUGATED pipes specified in the specifications and/or contracts are in accordance with national and international standards (TS EN 13476-3+A1, TS 12132, TS EN ISO 3126, TS EN ISO 1183-1 (Method A), TS EN ISO 2505, TS EN ISO 1133-1 (Method A), TS ISO 12091, TS EN ISO 9969, TS EN ISO 13968, TS EN ISO 3127) for quality control tests to be carried out in the Building Materials Laboratory of the Employer; The frequency and criteria of sampling, the number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

B. CORRUGATED PIPE QUALITY CONTROL TESTS

1) Physical Specifications

- When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces shall be smooth and there shall be no pits, cracks, gaps, deep scratches, marks or other similar surface defects that may interfere with the conformity of the pipe to this standard.
- The pipes will be double-walled and the outer color will be black, the inner color will be yellow, orange and/or blue.

2) Chemical Properties

- Pipes will have high UV resistance, maintain their standard properties when stored outdoors, have high resistance to alkaline earth metals, have high chemical resistance, will not be affected by moisture under the ground, and will be resistant to corrosion and pressure.

3) Corrugated Pipes

Table – 1 KORUGE Pipe Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Acceptance Criteria
a)	Determination of Dimensions (Visual inspection, Wall Thickness, Outer Diameter, Inner Diameter, Ovalness)	TS EN ISO 3126 TS 12132 TS EN 13476-3+A1	When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces will be smooth, there will be no other surface defects such as any pits, cracks, etc., and it will provide standard value ranges.
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$p \geq 0,930 \text{ gr/cm}^3$ ($23 \pm 0,5 \text{ }^\circ\text{C}$)
c)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Method A)	$0.20\text{g}/10\text{min} \leq \text{MFR} \leq 1.6\text{g}/10\text{min}$ (190 °C, under 5 kg load)
ç)	Oven Experiment	TS ISO 12091	At the end of the test, there should be no cracks, bubbles, wall or wall separation in the sample.
d)	Determination of Change in Length	TS EN ISO 2505	$\leq 3.0 \%$
e)	Determination of Ring Stiffness	TS EN ISO 9969	$\geq 8 \text{ kN/m}^2$
f)	Determination of Ring Flexibility	TS EN ISO 13968	As a result of the test, there should be no cracking, deterioration and bending in the wall structure of the sample.
g)	Determination of External Impact Resistance Along the Perimeter	TS EN ISO 3127	$\text{TIR} \leq 10$ (at IMP 23 °C)

Table – 2 Frequency of Taking Test Samples, Number of Samples and Number of Experiments

Sequence No	Experiment Name	Test Method/Standard	Sampling Frequency	Number of Samples	Number of Experiments
a)	Determination of Dimensions and Visual Inspection	TS EN ISO 3126 TS 12132 TS EN 13476-3+A1	For Every Different Party 1 time	For Every Party 1 Piece	1 Piece
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)			

c)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Method A)			
ç)	Oven Experiment	TS ISO 12091			
d)	Determination of Change in Length	TS EN ISO 2505			
e)	Determination of Ring Stiffness	TS EN ISO 9969			
f)	Determination of Ring Flexibility	TS EN ISO 13968			
g)	Determination of External Impact Resistance Along the Perimeter	TS EN ISO 3127			

- The number of samples to be taken for laboratory tests will be taken in the quantities specified in **Table-3** according to the pipe quantities supplied, regardless of diameter and pressure class.

Table – 3 Number of Samples to be Taken According to Pipe Quantity

Pipe Quantity for Each Nominal Diameter (m)	Number of Samples to be Taken (pcs) *
≤ 3,000	1 piece
* (1 piece = means a minimum of 3 pipe samples for each different nominal diameter.)	

Note: When the quantity of each nominal diameter in the batch exceeds 3,000> 1 more sample will be taken up to every additional 3,000 meters of each different nominal diameter received. Pipes of the same diameter and type and submitted for inspection at once are counted as one batch.

All tests specified in **Table-1** on 1 of each nominal diameter (3 pipe samples) determined according to **Table-3** will be carried out within the framework of the methods specified in the standards.

The test results will be rejected by the entire batch represented by the pipes that do not comply with **Table-1**, the pipes up to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard pipes will be removed from the storage area after the delivery of the new lot. All responsibility and expense for this process will belong to the Contractor Company.

- 4) Quality control tests of CORRUGATED Pipes will be carried out in the Building Materials Laboratory of the EMPLOYER.
- 5) Pipe quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.

- 6) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 7) **From the samples delivered to the laboratory; In case of negative results from at least one of the experiments specified in Table-1; The Contractor acknowledges that the Employer has the right to indemnify.**

2.5.18.3. (PRPC) Sampling, Number of Samples and Acceptance Criteria of Pipes

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, for the quality control tests to be carried out in the Building Materials Laboratory of the Employer according to national and international standards (TS EN ISO 15874-2, TS EN ISO 3126, TS EN ISO 1183-1 (Method A), TS EN ISO 2505, TS EN ISO 1133-1 (Method A), TS EN ISO 3127, TS EN ISO 1167-1, TS EN ISO 1167-2) **of the PPRC pipes and raw materials, the technical specifications and quantities of which are specified in the specifications and / or contracts**; sampling frequencies and criteria, The number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

B. QUALITY CONTROL TESTS OF PPRC and RAW MATERIAL

1) Physical Specifications

- When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces shall be smooth and there shall be no pits, cracks, gaps, deep scratches, marks or other similar surface defects that may interfere with the conformity of the pipe to this standard.
- Pipes; It will be resistant to external impacts and ram impact, flexible, cracking and impact resistant will be high.
- The color of the pipes will be white, and when inspected by eye, the color and appearance will be uniform all over the body.
- The average outer diameters, ovality, wall thickness and other properties of the pipes **comply with the TS EN ISO 15874-2** standard, the diameter and ovality will be the same throughout the pipe.

2) Chemical Properties

- The raw materials used for the production of the pipes and the pipes produced will be hygienic in terms of physiological and toxicological aspects, and according to the Foodstuffs Regulation of the Ministry of Health, the drinking water that will pass through it will not give odor and bad taste.
- The pipes will be resistant to corrosion and pressure, which retains its standard properties when stored outdoors, has high resistance to alkaline earth metals, has high

chemical resistance, will not be affected by moisture under the ground, and will be resistant to corrosion and pressure.

3) Raw materials

- The raw material to be used in the manufacture of the pipes will be in the form of original white color, ready for extrusion and injection, and no scrap material will be used in production. The manufacturer shall submit information and documents to the Employer indicating the source and characteristics of the raw material to be used.

Table – 1 Raw Material Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Experiment Acceptance Criteria
a)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Condition M)	$\leq 1.5\text{g}/10\text{min}$ (at 230°C, under 2.16kg mass)
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$0.900 \leq p \leq 0.910 \text{ g/cm}^3$ (23 ± 0.5 °C)

- Raw material samples will be kept closed, marked and unopened, and **1 piece (minimum 500g) representing each batch** will be delivered to the laboratory for raw material quality control tests together with pipe samples.

4) PPRC Pipes

Table – 2 PPRC Pipe Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Acceptance Criteria
a)	Determination of Dimensions (Visual inspection, Wall Thickness, Outer Diameter, Inner Diameter, Ovalness)	TS EN ISO 3126, TS EN ISO 15874-2	When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces will be smooth, there will be no other surface defects such as any pits, cracks, etc., and it will provide standard value ranges.
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$0.900 \leq p \leq 0.910 \text{ g/cm}^3$ (23 ± 0.5 °C)
c)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Condition M)	$\leq 1.5\text{g}/10\text{min}$ (at 230°C, under 2.16kg mass)
ç)	Determination of Change in Length	TS EN ISO 2505	$\leq 2.0 \%$
d)	Determination of External Impact	TS EN ISO 3127 ISO 9854	TIR ≤ 10 (at 0 °C)

	Resistance Along the Perimeter		
e)	Determination of Resistance to Internal Pressure	TS EN ISO 1167-1 TS EN ISO 1167-2	Damage should not occur in 1 hour at 20 °C.
f)	Determination of Oxidation Induction Time (OIT)	TS EN ISO 11357-6 TS EN ISO 11357-1	≥ 8 min (200 °C, 15 ± in 2 mg sample)

Table – 3 Frequency of Taking Test Samples, Number of Samples and Number of Experiments

Sequence No	Experiment Name	Test Method/Standard	Sampling Frequency	Number of Samples	Number of Experiments
a)	Determination of Dimensions and Visual Inspection	TS EN ISO 3126, TS EN ISO 15874-2	For Every Different Party 1 time	For Every Party 1 Piece	1 Piece
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)			
c)	Mass Melt Flow Rate (MFR) Determination	TS EN ISO 1133-1 (Condition M)			
ç)	Determination of Change in Length	TS EN ISO 2505			
d)	Determination of External Impact Resistance Along the Perimeter	TS EN ISO 3127 ISO 9854			
e)	Determination of Resistance to Internal Pressure	TS EN ISO 1167-1 TS EN ISO 1167-2			
f)	Determination of Oxidation Induction Time (OIT)	TS EN ISO 11357-6 TS EN ISO 11357-1			

- The number of samples to be taken for laboratory tests will be taken in the quantities specified in **Table-4** according to the pipe quantities supplied, regardless of diameter and pressure class.

Table – 4 Number of Samples to be Taken According to the Pipe Quantity

Pipe Quantity for Each Nominal Diameter (m)	Number of Samples to be Taken (pcs) *
≤ 3,000	1 piece
* (1 piece = means a minimum of 3 pipe samples for each different nominal diameter.)	

Note: When the quantity of each nominal diameter in the batch exceeds 3,000 m³ 1 more sample will be taken up to every additional 3,000 meters of each different rated diameter received. Pipes of the same diameter and type and submitted for inspection at once are counted as one batch.

All tests specified in Table-2 on 1 (3 pipe samples) of each nominal diameter determined according to Table-4 will be carried out within the framework of the methods specified in the standards.

The entire batch represented by the pipes whose test results do not comply with Table-1 and Table-2 will be rejected, the pipe equal to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard pipes will be removed from the storage area following the delivery of the new lot. All responsibility and expense for this process will belong to the Contractor Company.

- 5) Quality control tests of PPRC Pipes will be carried out in the Building Materials Laboratory of the EMPLOYER.
- 6) Pipe quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.
- 7) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 8) From the samples delivered to the laboratory; If there is a negative result from at least one of the tests specified in Table-1 for raw material tests and in Table-2 for PPRC Pipe tests; The Contractor acknowledges that the Employer has the right to indemnify.

2.5.18.4. (U-Pvc) Sampling of Pipes, Number of Samples and Acceptance Criteria

(U-Pvc) Sampling of Pipes, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, for the quality control tests to be carried out in the Building Materials Laboratory of our Institution according to national and international standards (TS EN ISO 1452-1, TS EN ISO 1452-2, TS EN ISO 3126, TS EN ISO 1183-1 (Method A), TS EN ISO 2505, TS EN ISO 3127, TS EN 1167-1, TS EN 1167-2, TS EN ISO 13968) **of U-PVC pipes, the technical specifications and quantities of which are specified in the specifications and/or contracts;** sampling frequencies and criteria, The number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

B. U-PVC PIPE QUALITY CONTROL TESTS

1) Physical Specifications

- When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces shall be smooth and there shall be no pits, cracks, gaps, deep scratches, marks or other similar surface defects that may interfere with the conformity of the pipe to this standard.
- The color of the pipes will be gray.

2) Chemical Properties

- Pipes will have high UV resistance, maintain their standard properties when stored outdoors, have high resistance to alkaline earth metals, have high chemical resistance, will not be affected by moisture under the ground, and will be resistant to corrosion and pressure.

3) U-PVC Pipes

Table – 1 U-PVC Pipe Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Acceptance Criteria
a)	Determination of Dimensions (Visual inspection, Wall Thickness, Outer Diameter, Inner Diameter, Ovalness)	TS EN ISO 1452-2 TS EN ISO 3126	When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces will be smooth, there will be no other surface defects such as any pits, cracks, etc., and it will provide standard value ranges.
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$1,350 \text{ g/cm}^3 \leq p \leq 1,460 \text{ g/cm}^3$ ($23 \pm 0.5 \text{ }^\circ\text{C}$)
c)	Determination of Change in Length	TS EN ISO 2505	$\leq 5.0 \%$
ç)	Determination of External Impact Resistance Along the Perimeter	TS EN ISO 3127	$\text{TIR} \leq 10$ (at $0 \text{ }^\circ\text{C}$)
d)	Determination of Resistance to Internal Pressure	TS EN 1167-1 TS EN 1167-2	Damage should not occur in 1 hour at 20°C.

e)	Determination of Ring Flexibility	TS EN ISO 13968	As a result of the test, there should be no cracking, distortion and bending of the sample.
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Table – 2 Frequency of Taking Test Samples, Number of Samples and Number of Experiments

Sequence No	Experiment Name	Test Method/Standard	Sampling Frequency	Number of Samples	Number of Experiments
a)	Determination of Dimensions and Visual Inspection	TS EN ISO 1452-2 TS EN ISO 3126	For Every Different Party 1 time	For Every Party 1 Piece	1 Piece
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)			
c)	Determination of Change in Length	TS EN ISO 2505			
ç)	Determination of External Impact Resistance Along the Perimeter	TS EN ISO 3127			
d)	Determination of Resistance to Internal Pressure	TS EN 1167-1 TS EN 1167-2			
e)	Determination of Ring Flexibility	TS EN ISO 13968			

- The number of samples to be taken for laboratory tests will be taken in the quantities specified in **Table-3** according to the pipe quantities supplied, regardless of diameter and pressure class.

Table – 3 Number of Samples to be Taken According to Pipe Quantity

Pipe Quantity for Each Nominal Diameter (m)	Number of Samples to be Taken (pcs) *
≤ 3,000	1 piece
* (1 piece = means a minimum of 3 pipe samples for each different nominal diameter.)	

Note: When the quantity of each nominal diameter in the batch exceeds 3,000> 1 more sample will be taken up to every additional 3,000 meters of each different nominal diameter received. Pipes of the same diameter and type and submitted for inspection at once are counted as one batch.

All tests specified in Table-1 on 1 of each nominal diameter (3 pipe samples) determined according to Table-3 will be carried out within the framework of the methods specified in the standards.

The test results will be rejected by the entire batch represented by the pipes that do not comply with Table-1, the pipes up to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard pipes will be removed from the storage area after the delivery of the new lot. All responsibility and expense for this process will belong to the Contractor Company.

- 4) Quality control tests of U-PVC Pipes will be carried out in the Building Materials Laboratory of the EMPLOYER.**
- 5) Pipe quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.**
- 6) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.**
- 7) From the samples delivered to the laboratory; In case of negative results from at least one of the experiments specified in Table-1; The Contractor acknowledges that the Employer has the right to indemnify.**

2.5.18.5. (O-Pvc) Sampling of Pipes, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, O-PVC pipes, whose technical specifications and quantities are specified in the specifications and/or contracts, comply with national and international standards (TS ISO 16422, TS EN ISO 3126, TS ISO 11922-1, TS EN ISO 1183-1 (Method A), TS EN ISO 2505, TS EN 17176-2, TS EN ISO 3127, TS EN 1167-1, TS EN 1167-2, TS EN ISO 13968, TS EN ISO 9969) Accordingly, for the quality control tests to be carried out in the Building Materials Laboratory of our institution; The frequency and criteria of sampling, the number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

B. O-PVC PIPE QUALITY CONTROL TESTS

1) Physical Specifications

- When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces shall be smooth and there shall be no pits, cracks, gaps, deep scratches, marks or other similar surface defects that may interfere with the conformity of the pipe to this standard.

2) Chemical Properties

- Pipes will have high strength, maintain their standard properties when stored in the open air, have high resistance to alkaline earth metals, have high chemical resistance, will not be affected by moisture under the ground, and will be resistant to corrosion and pressure.

3) O-PVC Pipes

Table – 1 O-PVC Pipe Tests and Acceptance Criteria

Sequence No	Experiment Name	Test Method/Standard	Acceptance Criteria
a)	Determination of Dimensions (Visual inspection, Wall Thickness, Outer Diameter, Inner Diameter, Ovalness)	TS ISO 16422 TS EN ISO 3126 ISO 11922-1	When the pipes are inspected with the naked eye without the use of any magnifying glass; Its inner and outer surfaces will be smooth, there will be no other surface defects such as any pits, cracks, etc., and it will provide standard value ranges.
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)	$1,350 \text{ g/cm}^3 \leq p \leq 1,460 \text{ g/cm}^3$ ($23 \pm 0.5 \text{ }^\circ\text{C}$)

c)	Determination of Change in Length – Axial Orientation Factors	TS ISO 16422 TS EN ISO 2505 TS EN 17176-2	According to the test time specified in the standard (60-120 min) at 150 ± 2 °C; According to TS EN 17176-2 section 5.4 Table-1 (between -5% and +15%)
c)	Determination of Change in Length - Environmental Orientation Factors	TS ISO 16422 TS EN ISO 2505 TS EN 17176-2	According to the test time specified in the standard (60-120 min) at 150 ± 2 °C; According to TS EN 17176-2 section 5.4 Table-1 (between -5% and +15%)
d)	Determination of External Impact Resistance Along the Perimeter	TS ISO 16422 TS EN ISO 3127	$TIR \leq 10$ (at 0 °C)
e)	Determination of Resistance to Internal Pressure	TS EN 1167-1 TS EN 1167-2	At 20°C, no damage should occur within a 10-hour period.
f)	Determination of Ring Stiffness	TS ISO 16422 TS EN ISO 9969	≥ 4 kN/m ²
g)	Determination of Ring Flexibility	TS EN ISO 13968	As a result of the test, there should be no cracking, distortion and bending of the sample.
h)	Determination of Tensile Properties (Max = 50kN)	TS EN ISO 6259-1 TS EN ISO 6259-2	≥ 48 Mpa ($5 \pm$ at 1 mm/min speed)

Table – 2 Frequency of Taking Test Samples, Number of Samples and Number of Experiments

Sequence No	Experiment Name	Test Method/Standard	Sampling Frequency	Number of Samples	Number of Experiments
a)	Determination of Dimensions and Visual Inspection	TS ISO 16422 TS EN ISO 3126 ISO 11922-1	For Every Different Party 1 time	For Every Party 1 Piece	1 Piece
b)	Density Determination (p)	TS EN ISO 1183-1 (Method A)			
c)	Determination of Change in Length – Axial Orientation Factors	TS ISO 16422 TS EN ISO 2505 TS EN 17176-2			
c)	Determination of Change in Length - Environmental Orientation Factors	TS ISO 16422 TS EN ISO 2505 TS EN 17176-2			
d)	Determination of External Impact	TS ISO 16422			

	Resistance Along the Perimeter	TS EN ISO 3127			
e)	Determination of Resistance to Internal Pressure	TS EN 1167-1 TS EN 1167-2			
f)	Determination of Ring Stiffness	TS ISO 16422 TS EN ISO 9969			
g)	Determination of Ring Flexibility	TS EN ISO 13968			
h)	Determination of Tensile Properties (Max = 50kN)	TS EN ISO 6259-1 TS EN ISO 6259-2			

- The number of samples to be taken for laboratory tests will be taken in the quantities specified in **Table-3** according to the pipe quantities supplied, regardless of diameter and pressure class.

Table – 3 Number of Samples to be Taken According to Pipe Quantity

Pipe Quantity for Each Nominal Diameter (m)	Number of Samples to be Taken (pcs) *
≤ 3,000	1 piece
* (1 piece = means a minimum of 3 pipe samples for each different nominal diameter.)	

Note: When the quantity of each nominal diameter in the batch exceeds 3,000> 1 more sample will be taken up to every additional 3,000 meters of each different nominal diameter received. Pipes of the same diameter and type and submitted for inspection at once are counted as one batch.

All tests specified in Table-1 on 1 of each nominal diameter (3 pipe samples) determined according to Table-3 will be carried out within the framework of the methods specified in the standards.

IMPORTANT NOTES:

- In the measurements to be made in the Determination of Dimensions test, according to the manufacturer's statement, if any, otherwise in a way that provides the minimum values in TS ISO 16422 Section 8 Table-2 and specified in TS ISO 11922-1;
Average outer diameter tolerances; Schedule-1 Grade C,
Deviation tolerances from ovality; Schedule-2 Degree M,

Wall Thickness Tolerances; Table-6 Degree W will remain within the tolerance values.

- Determination of Change in Length – Axial and Environmental Orientation Factors values will remain within the minimum acceptance values specified in TS EN 17176-2 section 5.4 Table-1 and the specified tolerances (-5% and +15%).

TS EN 17176-2 Part 5.4 Table 1- Minimum Reported Steering Factor

Minimum required power (MRS)	315	355	400	450	500
Axial	1,0				
Environmental	1,5	1,6	1,7	1,8	1,9

- The ring stress (σ) value in the calculations of the test pressure to be applied in the Determination of Internal Pressure Resistance test will be selected from the values specified from TS EN 17176-2 section 9.1 Table-5, according to the test temperature and material class (MRS).

TS EN 17176-2 Part 9.1 Table 5- Test Conditions

Charac teristic	Need	Test parameters									Test meth od
		Tempe rature °C	Circle Stretching MPa ^b					Time (h)	Typ e of test	Numbe r of test pieces	
			MRS 315	MRS 355	MRS 400	MRS 450	MRS 500				
Short- and long- term strengt h	No failure during testing	20	41	46	52	60	65	10	Wat er in Wat er	1 ^a	EN ISO 1167- 1 and EN ISO 1167- 2
		20	36	42	46	53	58	1000			
		60	20	22	25	28	31	1000			

^a The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

^b The minimum measured wall thickness will be used to calculate the test pressure of the pipes. In the case of integral sockets, it will be used the most for the calculation.

- **The minimum number of samples to be prepared for the Determination of Tensile Properties Test will be made according to the following numbers taken from the relevant section of the TS EN 6259-1 standard (Part 6 - Test Pieces).**

Minimum Number of Test Pieces for Determination of Tensile Properties

Nominal outer diameter dn (mm)	15 mm <DN ≤ 32 mm	32 mm <DN ≤ 63mm	DN> 63mm
Number of Test Pieces (pcs)	2	3	5

The test results will be rejected by the entire batch represented by the pipes that do not comply with Table-1, the pipes up to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard pipes will be removed from the storage area after the delivery of the new lot. All responsibility and expense for this process will belong to the Contractor Company.

- 4) Quality control tests of O-PVC Pipes will be carried out in the Building Materials Laboratory of the EMPLOYER.
- 5) Pipe quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.
- 6) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 7) From the samples delivered to the laboratory; In case of negative results from at least one of the experiments specified in Table-1; The Contractor acknowledges that the Employer has the right to indemnify.

2.5.18.6. (Fresh Concrete and Reinforced Concrete Steel) Sampling of Materials, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, for the quality control tests to be carried out in the Building Materials Laboratory of the Employer in accordance with national and international standards (TS EN 12350-1, TS EN 12390-2, TS 500, TS EN 206, TS 13515 Annex-B1, TS 708, TS EN ISO 6892-1, TS EN ISO 15630-1) of fresh concrete and reinforced concrete steels, the technical specifications and quantities of which are specified in the specifications and/or contracts; sampling frequencies and criteria, The number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

B. QUALITY CONTROL TESTS OF FRESH CONCRETE

According to the fresh concrete quantity specified in the contracts and/or specifications, the amount and number of concrete to be sampled according to the data specified in the standards will be made according to the table specified in Table-1.

Table – 1 Number of Samples to be Taken According to the Amount of Concrete

Criterion 1	Criterion 2				
Amount of Concrete Poured (m3)	The area of the place where concrete is poured (m3)	Number of Truck Mixers to be Sampled (Pieces)	7 Days (Pieces)	28 Days (Pieces)	Total Number of Samples (Pieces)
0-24	-	2	2	4	6
25-100	450	3	3	6	9
101-150	451-650	4	4	8	12
151-200	651-850	5	5	10	15
201-250	851-1050	6	6	12	18
251-300	1051-1250	7	7	14	21
301-400	1251-1450	8	8	16	24
401-500	1451-1650	9	9	18	27
501-600	1651-1850	10	10	20	30
> 600	> 1850	For each additional 200m3 volume or additional 200m2 area, 1 is added to the above numbers.	For each additional 200m3 volume or additional 200m2 area, 1 is added to the above numbers.	For each additional 200m3 volume or additional 200m2 area, 2 is added to the above numbers.	For each additional 200m3 volume or additional 200m2 area, 3 is added to the above numbers.

Note: If the strength class of the concrete planned to be poured will be C50/60 and above, the number of samples in the table is doubled.

Note: It is the responsibility of the Control Engineer to take and have the sample numbers and test criteria according to the standards, and to control and follow up these works

C. QUALITY CONTROL TESTS OF STEEL REINFORCEMENT

The minimum amount and number of steel samples to be taken from weldable and/or non-weldable reinforced concrete steels, whose technical specifications are specified in the contracts and/or specifications and whose quantities are specified in the projects and manufactured and delivered as bars or coils to be used in reinforced concrete structures, according to the data specified in the standards, will be made according to the following definitions.

The batch to be sampled for quality control experiments can be full casting or part of casting. The frequency of sampling and testing should be as follows:

- a) An analysis should be performed on each sampled batch to determine the chemical composition. The chemical composition (casting analysis) must be determined by the steel fabricator at each casting. For tensile tests;
- 1) A test piece shall be taken **from each batch of 30 tons** of each nominal diameter.
 - 2) For the test, a minimum of 3 test pieces will be taken **from each batch of 30 tons of each diameter**.
 - 3) Each test piece to be taken for tensile tests **will be min. 1 meter long** and care will be taken to take the length from the middle part of the reinforcing steel.
 - 4) Each test piece to be taken for tensile tests will be taken from different sizes of reinforcing steels.
 - 5) When the quantity of each nominal diameter in the lot exceeds 30 tons > 3 more samples will be taken up to **every additional 30 tons of each different nominal diameter** received. **Reinforced concrete steels of the same diameter and type and submitted for inspection at one time are counted as one batch.**

Note: Even if the tonnage of reinforced concrete steel of each different nominal diameter is less than the above-mentioned (30 tons) amount, a **minimum of 3** test samples will be delivered to the laboratory for quality control tests.

2.5.18.7. (Concrete Curb and Concrete Parquet) Materials Sampling, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, for the quality control tests to be carried out in the Building Materials Laboratory of the Employer in accordance with national and international standards (TS 436 EN 1340, TS 2824 EN 1338) **of the concrete curbs and concrete paving materials, the technical specifications and quantities of which are specified in the specifications and/or contracts;** sampling frequencies and criteria, the number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

Regardless of the place of supply of the materials, the tests specified in **Table-1 and Table-2**, the specified numbers of tests will be carried out according to the types of materials required in the contract, and the specified sampling frequencies and it will be checked whether they are within the acceptance criteria.

B. QUALITY CONTROL TESTS OF CONCRETE CURB AND CONCRETE PAVING MATERIALS

Concrete Curb Materials:

In this section, the tests to be carried out according to national and international standards (TS 436 EN 1340) **of concrete curbs made of concrete in various lengths and sections** , sampling

frequencies, number of samples to be taken, number of tests and acceptance criteria are specified in Table-1.

Curbstones of the same class, type and type and submitted for inspection at one time are counted as one batch.

Table- 1 Sampling Frequencies, Number of Samples to be Taken, Number of Experiments and Acceptance Criteria

Sampling Frequency	Number of Samples to be Taken (Pieces)	Experiments to be carried out	Acceptance Criteria			
Number of concrete curbs in the batch (Meters)	By the number of concrete curbs in the batch	Dimensional Measurements and Flexural Strength	Sample Class	Markup	Minimum Single Value in the Lot (mPa)	Minimum Average of the Party (mPa)
≤ 5,000	8	For every batch 1 time	1	S	2,8	3,5
			2	T	5,0	4,0
			3	U	6,0	4,8

Note: A separate experiment will be made for the borders of different types and sizes that come in the party.

Concrete Paving Materials:

In this section, the tests to be carried out according to national and international standards (TS 2824 EN 1338) of concrete parquets made of concrete in various lengths and sections , sampling frequencies, number of samples to be taken, number of tests and acceptance criteria are specified in Table-2.

Cobblestones of the same class, type and type and submitted for inspection at one time are counted as one batch.

**Table- 2 Sampling Frequencies, Number of Samples to be Taken, Number of
 Experiments and Acceptance Criteria**

Sampling Frequency	Number of Samples to be Taken (pcs)	Experiments to be carried out	Acceptance Criteria		
			Minimum Single Value in the Lot (mPa)	Minimum Average of the Party (mPa)	Breaking Load (F) One Value (N/mm)
Number of concrete pavers in the lot (Pieces)	By the number of concrete parquets in the lot	Dimensional Measurements and Tensile Strength in Splitting			
≤ 10,000	8	For every batch 1 time	2,9	3,6	250,0

Note: Separate tests will be made for parquets of different types and sizes that come in the party.

The acceptance criteria for the number of tests and sampling frequencies specified in this specification are taken from the relevant sections of the Technical Specifications for Highways.

The entire batch represented by the materials whose test results do not comply with the acceptance criteria specified in the tables will be rejected, the material equal to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard materials will be removed from the storage area following the delivery of the new batch. **All responsibility and expense for this process will belong to the Contractor Company.**

- 1) Quality control tests of PARQUET and BORDER materials **will be carried out** in the Building Materials Laboratory of the EMPLOYER.
- 2) **Pipe quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.**
- 3) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 4) **From the samples delivered to the laboratory; In case of negative results from at least one of the experiments specified in Table-1 and Table-2; The Contractor acknowledges that the right to indemnification arises under the Agreement.**

2.5.18.8. (Manhole Cover & Grate) Materials Sampling, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, for the quality control tests to be carried out in the Building Materials Laboratory of our Institution according to national and international standards (TS EN 124-1, TS EN 124-2) **of products such as Manhole Covers, Grates, Chimney Covers, etc., whose technical specifications and quantities are specified in the specifications and/or contracts;** sampling frequencies and criteria, the number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

Table-1 Sampling Frequencies of Materials, Number of Samples and Acceptance Criteria

Material Grade	Load Resistance (Tons)	Scope	Test Standard	Number of Samples to be Taken (pcs)
A 15	2	Light Load	TS EN 124-1 TS EN 124-2	3
B 125	13	Medium Light Load		3
C 250	25	Medium Load		3
D 400	40	Vehicular Traffic		3
E 600	60	Custom Fields		3
F 900	90	Custom Fields		3

Note: When the quantity of each different material delivered exceeds 500> an additional 3 samples will be taken for every 500 pieces.

According to Table-1, the tests specified in Table-2 will be carried out within the framework of the methods specified in the standards on every 500 test samples and 3 test samples taken for each different material production.

Table – 2 Experiments to be Performed and Acceptance Criteria

Experiment	Test Standard	Acceptance Criteria
Size and Weight Measurement	TS EN 124-1	Limits specified in the CONTRACT according to the type of cover
Compressive Strength (Load Carrying Capacity)	TS EN 124-2	Limits specified in the standard according to the type of cover

Note: Dimensional dimensions will be in the dimensions written in the standards and/or specifications and within the specified tolerances.

The entire batch represented by the materials whose test results do not comply with Table-2 will be rejected, the material up to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard materials will be removed from the storage area following the delivery of the new batch. All responsibility and expense for this process will belong to the Contractor Company.

- 1) Quality control tests of MANHOLES, RAIN GRATES and Chimney Covers will be carried out in the Building Materials Laboratory of the EMPLOYER.
- 2) The quantities of materials to be given to the laboratory for quality control tests will not be deducted from the contract quantities.
- 3) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 4) From the samples delivered to the laboratory; In case of negative results from at least one of the tests specified in Table-2; The contractor acknowledges that the right to compensation arises under the contract.

2.5.18.9. (Bitumen and Bituminous Binder, Bituminous Mixture and Aggregate) Materials Sampling, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, bitumen, bituminous binders, aggregates, produced and applied asphalt mixtures, whose technical specifications and quantities are specified in the specifications and/or contracts, comply with national and international standards (TS EN 12594, TS EN 1426, TS EN 1427, TS EN 933-1, TS EN 1097-2, ASTM D 2172 / D 2172 M, TS EN 12697-1, TS EN 12697-2, TS EN 12504-1, TS EN 12697-6) Accordingly, the sampling intervals and criteria

for the quality control tests to be carried out in the Building Materials Laboratory of our Institution, the number of batches to be sampled and the number of samples are specified in detail.

B. QUALITY CONTROL TESTS OF BITUMEN, BITUMINOUS BINDERS AND BITUMINOUS MIXTURES AND AGGREGATES

1. Physical Specifications

Bitumen and bituminous binders will be suitable for the region in terms of application, whose technical specifications are given in the standards and/or specifications. Depending on the nature of the work, modified emulsions can also be used.

If bituminous primer and/or bonding material is to be used according to the nature of the work to be done, these materials and application methods will also be in accordance with the specified provisions.

Bituminous mixtures will be asphalt mixtures to be used as asphalt concrete or maintenance material on surface-coated roads and as a surface layer on second-class roads by mixing crushed and screened fine, medium and coarse aggregates and mineral elephants in the plant with a bituminous binder in accordance with the principles of a certain mixing formula.

Aggregates and aggregate mixtures will be supplied from suitable quarries according to the gradation limits and tolerances specified in the standards and/or specifications and will have the desired properties.

2. Chemical Properties

Bitumen and bituminous binders to be used in bituminous mixtures will be suitable for the region and whose properties are specified in the technical specifications according to the application areas of the Employer (**Example: 50/70, 70/100 bitumen etc.**)

3. Bitumen and Bituminous Binders

Bitumen and bituminous binders **obtained from materials suitable for the climatic characteristics of the application regions and** providing the tests specified in Table-1 will be used.

Table – 1 Tests and Acceptance Criteria of Bitumen and Bituminous Binders

Experiment Name	Standard	Experiment Acceptance Criteria	Number of Experiments (Pieces)
Penetration Test (Determination of Needle Penetration Depth)	TS EN 1426 TS EN 12594	Minimum and Maximum Value Range of Bitumen Class	1 Piece
Softening Point Determination (Ring and Ball Method)	TS EN 1427 TS EN 12594	Minimum and Maximum Value Range of Bitumen Class	1 Piece

4. Aggregates and Mineral Fillers

Aggregates and mineral filler materials whose technical specifications are specified in the standards and/or specifications and obtained from quarries or natural areas and **providing the tests specified in Table-2** will be used.

Table – 2 Tests of Aggregate and Mineral Elephants and Acceptance Criteria

Experiment Name	Standard	Experiment Acceptance Criteria	Number of Experiments (pcs)
Determination of Grain Size Distribution (Sieve Analysis) Method	TS EN 933-1	Acceptance Limits Specified in the Standard/Specification	1 Piece
Determination of Fragmentation Resistance (Los Angeles Experiment) (500 cycles) (%)	TS EN 1097-2	≤ 25 (LA)	1 Piece

- Aggregate and mineral filler samples will be kept closed, marked and unopened and delivered to the laboratory for quality control tests **as a minimum of 10 kg** representing the aggregates used in bituminous mixtures produced monthly.

5. Bituminous Mixtures (Hot Asphalt)

Bituminous mixtures prepared in accordance with the Workplace Mixture Formula (IKF) submitted to the Employer will be used for bitumen and bituminous binders whose technical specifications are specified in the standards and/or specifications, and aggregates and mineral fillers obtained from quarries or natural areas.

Table – 3 Bituminous Mixture (Hot Asphalt) Tests and Acceptance Criteria

Experiment Name	Standard	Experiment Acceptance Criteria	Number of Experiments (pcs)
Separation of Bitumen Amount Test - Glass Extractor Method	ASTM D2172/D217 2M	$4\% \leq \text{Bitumen Amount} \leq 7\%$	1 Piece
Sieve Analysis (Washing) Test on Glass Extractor Residue	TS EN 12697-1 TS EN 12697-2	Acceptance Limits Specified in the Standard/Specification	1 Piece
Specimen Cutting with Core Barrel	TS EN 12504-1	$\geq 6.3 \text{ cm}^*$ (For 7 cm castings)	2 pcs. (Every 250 m ²)

Determination of Bulk Density Determination of Jam Percentage Ratio	TS EN 12697-6		
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- Bituminous Mixture (Hot Asphalt) samples **will be delivered to the laboratory for quality control tests** as a minimum of 15 kg representing the bituminous mixtures manufactured monthly.
- 1. **From the samples delivered to the laboratory; In case of negative results from at least one of the experiments specified in Table-1, Table-2 and Table-3; The Contractor acknowledges that the Employer has the right to indemnify.**

2.5.18.10. (Concrete & Reinforced Concrete Pipe and Concrete Chimney) Materials Sampling, Number of Samples and Acceptance Criteria

A. GENERAL

In order to carry out the tests in accordance with the terms of the Contract, the Contractor will carry out the tests in the Quality Control Laboratory of the Employer at its own expense. The Employer's Representative will be able to take samples from the material stocked on site at any time and send them to the Quality Control laboratory of the Employer for testing, and the costs will be borne by the contractor.

In this section, for the quality control tests to be carried out in the Building Materials Laboratory of our Institution according to national and international standards (TS 821 EN 1916, TS EN 12350-1, TS EN 12350-2, TS EN 206, TS EN 12390-2, TS EN 12390-3) **of concrete & reinforced concrete pipes and concrete chimney materials, the technical specifications and quantities of which are specified in the specifications and/or contracts;** sampling frequencies and criteria, The number of batches and samples to be sampled and the number of tests to be performed are specified in detail.

Regardless of the place of supply of the materials; the types of materials required in the contract and/or specification, **the tests specified in Table-1;** The specified number of tests will be carried out on the samples taken according to the specified sampling frequencies and **it will be checked whether they are within the acceptance criteria** in Table-2, Table-3 and Table-4.

B. QUALITY CONTROL TESTS OF CONCRETE & REINFORCED CONCRETE PIPE and CONCRETE CHIMNEY MATERIALS

In this section, the tests to be carried out according to national and international standards (TS 821 EN 1916) **of concrete & reinforced concrete pipes and concrete chimney materials made of concrete in various lengths and sections,** sampling frequencies, number of samples to be taken and the number of tests **are specified** in Table-1.

Table- 1 Experiments to be Performed, Sampling Frequencies, Number of Samples to be Taken and Number of Experiments

Experiment Name	Test Standard	Material Type	Number of Samples	Number of Experiments
Peak Load Resistance	TS 821 EN 1916	* Concrete Pipe * Reinforced Concrete Pipe	1 piece	1 piece
Determination of Tightness (Splice)	TS 821 EN 1916	* Concrete Pipe * Reinforced Concrete Pipe	2 pcs.	1 piece
Fresh Concrete Intake, Slump Test, Curing and Determination of Compressive Strength	TS EN 12350-1 TS EN 12350-2 TS EN 12390-2 TS EN 12390-3	* Concrete Chimney	1 piece	1 piece

Note: Separate tests will be made for materials of different types and sizes that come in the batch.

Concrete Pipe Materials:

In this section, as a result of the tests to be carried out according to **national and international standards** (TS 821 EN 1916) of **concrete pipe** materials made of concrete in various lengths and sections, **the standard acceptance criteria of the peak load strength and tightness determination tests specified in Table-2** are specified.

Table- 2 Peak Load Strength and Tightness Determination Test Acceptance Criteria of Concrete Pipes

Peak Load Strength Acceptance Criteria			Acceptance Criteria for Determination of Tightness		
Nominal Diameter (mm)	Minimum Breaking Load for each (m) length of pipe (kN/m)	Strength Class (kN/m ²)	Duration of the experiment (min)	Test Pressure (bar)	Result
DN 150	38	253	15	0,5	There should be

DN 200	45	225	15	0,5	no leakage at the joint under the specified test pressure during the test.
DN 300	48	160	15	0,5	
DN 400	54	135	15	0,5	
DN 500	60	120	15	0,5	

Concrete pipes of the same class, type and type and submitted for inspection at one time are counted as one batch.

Reinforced Concrete Pipe Materials:

In this section, reinforced concrete pipe materials **made of concrete in various lengths and sections** are subject to national and international standards.

As a result of the tests to be carried out according to (TS 821 EN 1916), the **standard acceptance criteria of the peak load strength and tightness determination tests** specified in Table-3 are specified.

Table- 3 Peak Load Strength and Tightness Determination Test Acceptance Criteria of Reinforced Concrete Pipes

Peak Load Strength Acceptance Criteria			Acceptance Criteria for Determination of Tightness		
Nominal Diameter (mm)	Minimum Breaking Load for each (m) length of the pipe (kN/m)	Strength Class (kN/m²)	Duration of the experiment (min)	Test Pressure (bar)	Result
DN 600	72	120	15	0,5	There should be no leakage at the joint under the specified test pressure during the test.
DN 800	88	110	15	0,5	
DN 1000	110	110	15	0,5	
DN 1200	132	110	15	0,5	
DN 1400	154	110	15	0,5	

Reinforced concrete pipes of the same class, type and type and submitted for inspection at one time are counted as one batch.

Concrete Chimney Materials:

In this section, as a result of the tests to be carried out according to national and international standards (TS EN 12350-1, TS EN 12350-2, TS EN 206, TS EN 12390-2, TS EN 12390-3) of concrete chimney materials **made of concrete in various lengths and sections**, the standard

acceptance criteria are specified in **Table-4** according to the concrete strength (Ex: C30-37, C 35/45, etc.) from which the material is produced.

Table- 4 Compressive Strength Test of Concrete Chimneys (28 days) Acceptance Criteria

STANDARD SAMPLE CONFORMITY CRITERIA							
Crash Classes and Values		According to TS 500, TS 13515-Annex B1 and TS 206;	CONCRETE TYPE / GRADE	CONCRETE GRADES (N/mm ²)			
				C 30/37	C 35/45	C 40/50	C 45/55
Class	Slump (mm)	28-Day Compressive Strength Test Results Acceptance Criteria (Rounds 1 and 2) Must meet the criteria at the same time.)	Fck (Cylinder)	30	35	40	45
			Fck (Cube)	37	45	50	55
S 1	10- 40		Number of Test Results " n "	Criterion 1		Criterion 2	
S 2	50- 90			"n" test results mean (Fcm) N/mm ²		Any single test result (fci) N/mm ²	
S 3	100- 150		1	N/a		≥ FCK	
S 4	160- 210		2-4	≥ FCK+1.0		≥ FCK- 4.0	
S 5	≥ 220		5 and more	≥ FCK+2.0		≥ FCK- 4.0	

Concrete chimneys of the same class, type and type and submitted for inspection at one time are counted as one batch.

Note: The desired experiments will be done separately for the different types of materials that come in the batch.

The acceptance criteria of the tests specified in this specification are taken from the relevant sections of the ILLER BANK TECHNICAL SPECIFICATION.

The entire batch represented by the materials whose test results do not comply with the acceptance criteria specified in the tables will be rejected, the material equal to the rejected batch quantity will be reproduced and delivered to the Employer, and the non-standard materials will be removed from the storage area following the delivery of the new batch. **All responsibility and expense for this process will belong to the Contractor Company.**

- 1) Quality control tests of CONCRETE & REINFORCED CONCRETE PIPE and CONCRETE CHIME materials will be carried out in the Building Materials Laboratory of the EMPLOYER.
- 2) Pipe and chimney quantities to be given to the laboratory for quality control tests will not be deducted from the contract quantities from the quantities in the contract.

- 3) The test samples required for the quality control tests will be taken under the supervision of the Control Engineers in the minimum numbers specified in the tables in the specification and delivered to the laboratory. The Employer's Representative will be able to carry out the necessary tests for the materials it deems unsuitable, as many times and as often as it wants, provided that it is not below the number of tests in the table.
- 4) From the samples delivered to the laboratory; In case of negative results from at least one of the experiments specified in Table-1; The Contractor acknowledges that the right to indemnification arises under the Agreement.

2.5.19. AUXILIARY STRUCTURES

- **Administrative Building/Unit**
- **Laboratory Building/Unit**
- **New Bio-Gas Tanks Construction and Replacement of Existing Piping**

2.5.19.1. Administrative Building/Unit

The Administrative Building / Unit shall be designed and constructed as a functional unit within the Hurma Waste-to-Energy (WTE) Facility. Subject to the Contractor's detailed design, the structure may be realized either as a standalone building or as an integrated unit comprising multiple internal sections. The structural system shall be either steel frame or reinforced concrete, in compliance with relevant national and international standards and codes.

The Administrative Building / Unit shall, at a minimum, accommodate the following functional spaces:

- SCADA Monitoring and Control Room
- Warehouse Area
- Workshop Area
- Technical Offices
- Personnel Locker Room
- Cafeteria
- WC, Showers etc.

All architectural, structural, mechanical, and electrical works related to the Administrative Building shall be executed in accordance with the applicable design codes, Employer's Representative's requirements, and relevant regulatory provisions.

2.5.19.2. Laboratory Building/Unit

Within the scope of the Hurma Waste-to-Energy (WTE) Facility, a separate Laboratory Building/Unit shall be constructed, and all architectural, mechanical, and electrical designs shall be carried out by the Contractor. During the design of the laboratory, the Contractor shall prepare detailed layout plans based on the laboratory equipment proposed in their own offer

and approved by the Employer's Representative. The laboratory building/unit shall be designed in accordance with these layout plans.

During the supply and approval process of the equipment, the Contractor shall take into consideration the operational and maintenance requirements, availability of spare parts and raw materials and conformity of relevant national and international standards.

The placement of the laboratory equipment shall be planned in an integrated manner, together with the required auxiliary systems such as ventilation, electrical connections, water and wastewater pipelines, compressed air, gas lines, etc.

During the supplying and selection of laboratory equipment, the Contractor shall ensure the accurate and reliable measurement of the input parameters defined in the Employer's Requirements document.

2.5.19.3. New Bio-Gas Tanks Construction and Replacement of Existing Piping

The Contractor shall be responsible for the design and construction of the aforementioned structures within the scope of the Contract, utilizing either reinforced concrete or steel structural systems. All designs shall comply with the latest available versions of the applicable standards listed under the 'Regulations and Standards' section. These designs, along with all other designs required under the Contract, shall form an integral part of the Contractor's technical proposal.

The existing Biogas storage tanks (2,600 m³ x 2 units) owned by the ASAT General Directorate have completed their economic lifespan.

The contractor will design a new biogas storage tank with a total capacity of 6,000 m³ and its system components (including all ground improvement, foundation details, biogas storage tank type selection, sizing of the biogas storage tanks depending on the type selection, detailed drawings, material quality selection, equipment, instruments, gas inlet lines from the existing digesters to the new biogas storage tanks, transmission lines from the new biogas storage tank to the digester heating boilers, gas feed blower connection line from the new biogas storage tank to the existing Belt-Type Thermal Drying Plant, outlet pipe transmission lines, all gas bypass lines, valves, check valves, flame arresters, moisture retention system, tank pressurization fans, gas usage blowers, service water connection line, wash water discharge line, temperature sensors, level sensors, pressure sensors, flow meters, gas analyzers, pH meters, SCADA-controlled and integrated into the existing SCADA system).

A new desulfurization unit will be designed to replace the existing one. This new unit shall be controlled by SCADA system without requiring any chemicals. The chemical analysis values of the biogas inlet and outlet shall be monitored simultaneously, as well as pH, temperature, flow, gas, and water pressure information. The unit will be integrated into the existing SCADA system. A new biological desulfurization unit shall be designed between the desulfurization unit and the new biogas storage tank, which will include a moisture retention system, an online H₂S gas measurement analyzer, as well as an online H₂S gas analyzer at the desulfurization unit's inlet, an online CH₄ gas analyzer at the outlet, and an online CO₂ gas analyzer at the outlet.

A new biogas flare and system components (flame arresters, all types of valves, check valves, collector structure, gas combustion blowers, outlet collector structure, gas combustion diffusers, gas combustion stack, gas valves, pilot flame unit, local control panel, power panel, ignition system, flame sensors, SCADA-controlled and integrated into the existing SCADA system) will be sized, designed, and equipped, with equipment, instrument selection, detailed drawings, material quality selection, and gas connection line design to the new biogas storage tank.

The design of the new desulfurization unit, biogas storage system, and biogas flare shall be prepared by the Contractor to take approval from the Employer's Representative.

Initially, the construction and installation of the new desulfurization unit will be carried out.

Secondly, the construction and installation of the new biogas storage tanks will be completed.

After the connection of the new desulfurization unit and biogas storage tanks to the existing digesters is completed, and after testing the newly installed systems, including the biogas flare, the system will be commissioned.

After the new desulfurization unit, biogas storage tanks, and gas combustion stack are commissioned and operated smoothly, the existing Biogas Storage Tanks No. 46, Desulfurization Unit, Sludge and Gas Combustion Stack will be dismantled from their current location as part of the Hurma WTE Facility construction and will be transported to the location designated by the ASAT General Directorate (within the Hurma Wastewater Treatment Plant)."

Following the successful commissioning and stable operation of the new Desulfurization Unit, Biogas Storage Tanks, and Gas Flare Stack, the existing Biogas Storage Tank No. 46, the current Desulfurization Unit, and the Sludge and Gas Flare Stack shall be dismantled by the Contractor under the scope of the "Hurma WTE Facility Construction" works. The dismantled units shall be transported by the Contractor to a location within the Hurma Wastewater Treatment Plant premises, to be designated by the ASAT General Directorate. These components shall be securely stored without reassembly. All dismantling and transportation activities shall be carried out in full compliance with relevant occupational health and safety regulations.

Biogas Storage Tank

A spherical type biogas storage tank shall be supplied and installed, the appropriate conditions for the ground where the gas storage tank will be placed (including construction of a concrete foundation, tree removal, etc.) shall be prepared by the Contractor and the installation will be carried out after the approval of the Employer's Representative.

The biogas storage tank capacity shall be at least 6000 m³.

The gas storage tank shall consist of 2 polyester-reinforced PVC membranes intertwined.

The membranes shall be joined by high-frequency welding method so that there is no leakage of gas or air. The membranes will be fixed to the concrete floor with anchor elements made of AISI 316 quality stainless steel material.

Inner biogas membrane specifications

Feature	Standard and Features		
Fabric	DIN ISO 2076		
Yarn	EN ISO 2060	1100	Dtex
Weaving	DIN 61101-1		
Coating			PVC
Total Weight	EN ISO 2286-2	1100	gr/m ²
Tensile Strength	DIN EN ISO 1421	4200/4000	Warp / Weft N / 50 mm
Tear Strength	DIN 53363	500/500	Warp / Weft N
Adhesion		20	N/cm
Cold Resistance	EN 1876-1	-20	°C
Heat Resistance		+70	°C
Light Sensitivity	DIN EN ISO 105-BO2	>6	
Crack Resistance	DIN 53359 A	After 100 000 cracks	No cracking
Flame Retardant		CL.2	

External biogas membrane specifications

Feature	Standard and Features		
Fabric	DIN ISO 2076	PES – low wick	
Yarn	EN ISO 2060	1670	Dtex
Weaving	DIN 61101-1	Basket weaving 3/3	
Coating			PVC

Total Weight	EN ISO 2286-2	1350	w/m ²
Tensile Strength	DIN EN ISO 1421	7500/6500	Warp / Weft N / 50 mm
Tear Strength	DIN 53363	1200/1200	Warp / Weft N
Adhesion		25	N/cm
Cold Resistance	EN 1876-1	-20	°C
Heat Resistance		+70	°C
Light Sensitivity	DIN EN ISO 105-BO2	>6	
Crack Resistance	DIN 53359 A	After 100 000 cracks	No cracking
Flame Retardant	DIN 4102 (B1), BS 7837	CL.2	

The gas storage tank shall be equipped with 2 air fans, 1 main and 1 spare, to keep the pressure constant. Air fans shall be ex-proof.

A weighted level measurement system shall be used to determine the amount of gas inside the gas storage tank.

The weighted level meter shall be capable of providing an output signal of 4–20 mA.

The weighted level meter shall be made of 17-4 PH stainless steel material and shall be ATEX certified.

The weighted level meter shall have a measurement range of 0–20 m, an operating temperature of -20 °C to +70 °C, and a protection class of IP68.

The level meter shall be equipped with a 4–20 mA analog level indicator, an alphanumeric IP56 display with 24 V DC power supply, two input ports, and two on/off switches.

The gas storage tank shall be equipped with an appropriate number of exhaust air valves, which shall be made of AISI 316 quality stainless steel material. The exhaust valve will be installed directly on the outside air membrane.

The exhaust valve will operate through indirect mechanical action, directly filling the valve with air pressure via a pneumatic piston.

A 230 mm diameter Plexiglas window with stainless steel flange shall be provided on the outer air membrane at 1.5 m above ground to observe the gas membrane.

The gas storage tank shall be equipped with a sufficient number of safety gas valves made of AISI 316 stainless steel. The safety gas valves shall be suitable for direct connection to the biogas pipeline.

2.5.19.4. Relocation Works

Relocation of Existing Biogas Tanks and Piping

The relocation of the existing biogas tanks and their associated piping systems shall be carried out with utmost care and with all necessary occupational safety measures in place.

During the execution of the work, all necessary precautions shall be taken to protect other infrastructure piping systems and any existing structures.

Any scrap materials resulting from the relocation work shall be transported to designated storage areas within the facility boundaries, as approved by the Employer's Representative.