MATERIAL AND WORKMANSHIP SPECIFICATIONS FOR CIVIL WORKS

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01508 DIVERSIONS OF PUBLIC UTILITY ORGANIZATION (PUO) NETWORKS

Applicable shall be the following ETEPs, namely:

- ETEP 02-05-00-00 "Management of excavation materials and exploitation of dumping sites"
- ETEP 08-01-03-01 "Trench excavations for utility networks"
- ETEP 08-01-04-01 "Trenchless utilities installation with soil displacement methods"
- ETEP 02-04-00-00 "Excavations for foundation works"
- ETEP 15-02-01-01 "Demolition of members of concrete structures by mechanical means"
- ETEP 08-10-01-00 "Work-site water pumping"
- ETEP 08-10-02-00 "Wastewater and sludge pumping"
- ETEP 08-10-03-00 "Dewatering with well points"
- ETEP 08-01-03-02 "Underground utilities trench backfilling"
- ETEP 11-02-02-00 "Retaining structures with steel-sheet piles"
- ETEP 08-03-02-00 "Underdrain filters with graded aggregates"
- ETEP 01-01-01-00 "Worksite concrete production and transportation"
- ETEP 01-01-02-00 "Concrete casting"
- ETEP 01-01-03-00 "Concrete curing"
- ETEP 01-01-04-00 "Work site concrete batching plants"
- ETEP 01-01-05-00 "Concrete compaction by vibration"
- ETEP 01-01-07-00 "Mass concrete"
- ETEP 01-03-00-00 "Scaffolding (falsework)"
- ETEP 01-04-00-00 "Concrete formwork"
- ETEP 08-05-02-02 "Waterstops for concrete joints"

- ETEP 08-05-02-05 "Concrete structures joint sealing using elastomeric materials"
- ETEP 02-07-05-00 "Lining of road embankment slopes and filling of road islands with horticultural soil"
- ETEP 08-07-01-01 "Grey cast iron gully tops"
- ETEP 08-07-01-05 "Manhole steps"
- ETEP 08-07-01-04 "Ductile iron gully tops"
- ETEP 08-06-02-02 "Pressurized u-PVC pipe networks for sewage"
- ETEP 08-06-08-01 "Warning tape above buried utilities"
- ETEP 08-06-07-02 "Cast iron gate valves"
- ETEP 08-06-07-03 "Cast iron butterfly valves"
- ETEP 08-06-07-07 "Double orifice air relief valves"
- ETEP 08-06-07-05 "Pipeline components dismantling joints"
- ETEP 08-06-08-03 "Retrofitting of concrete paving slabs along constructed underground utility**"**
- ETEP 08-06-08-04 "Retrofitting of kerbs and gutters along constructed underground utility"
- ETEP 08-06-08-06 "Prefabricated concrete manholes"

As far as Natural Gas Networks are concerned, the following shall be applicable:

- **Ministerial Decision (M.D.) Δ3/A/22925/2006** (FEK 1810/B'/12.12.2006) Regulations about the installation of overflow pipes and natural gas meter / operation pressure up to 4 bars
- **Ministerial Decision (M.D.) Δ3/A/17013/2006** (FEK 1552/B'/24.10.2006) Regulations about natural gas distribution steel networks / design pressure 19 bars
- **Ministerial Decision (M.D.) Δ3/A/14715/2006** (FEK 1552/B'/24.10.2006) Regulations about natural gas distribution poly-ethylene networks / maximum operation pressure 4 bars.

01515 TEMPORARY CONNECTIONS WITH PUO NETWORKS

1 GENERAL

1.1 Description of Works

1.1.1 Upon his installation at the worksite, the Contractor shall provide all materials and equipment while he shall also execute the works required for the supply, installation and maintenance of the temporary Public Utility Organization (PUO) networks throughout the execution of the Project.

1.1.2 The Contractor shall design, supply and install the temporary facilities related to the power supply, water supply, telecommunications and sanitation of the worksites.

1.1.3 The Contractor shall undertake all actions and shall bear all expenses for obtaining the relevant permits from the PUO Networks Organizations, including the connection and disconnection expenses, as well as for the supply, installation, maintenance and removal of the materials, as required. All expenses related to the temporary connections with the PUO networks and the consumption expenses shall be borne by the Contractor.

1.2 TEMPORARY POWER SUPPLY

Temporary power connection shall be provided throughout the duration of the Project for the operation of the electrical equipment and the temporary lighting in all worksites and facilities of the Contractor and the Service.

1.2.1 Immediately after the Project award, the necessary actions shall be undertaken towards the Public Power Corporation (PPC), so that sufficient time is given for scheduling the electrical connection at the worksite areas.

1.2.2 Power distribution systems shall be installed for temporary power supply, in line with PPC regulations, paying special attention to the requirements related to facilities in wet areas.

1.3 TEMPORARY WATER SUPPLY

1.3.1 The Contractor shall provide temporary potable water supply in the worksite areas.

1.3.2 Immediately after the Project award, the necessary actions shall be undertaken towards the Water Supply and Sewage Corporation, so that sufficient time is given for scheduling water supply to the worksite areas and to the Contractor's and the Service's facilities.

1.4 TEMPORARY SANITARY FACILITIES

1.4.1 The Contractor shall provide temporary sanitary facilities for the laborers, the other staff, the visitors and the Service's personnel in the worksite areas.

1.4.2 The type and the number of the sanitary facilities shall comply with the hygiene regulations.

1.4.3 The Contractor is obliged to ensure the cleanliness of the aforementioned facilities.

1.4.4 The Service reserves its right to instruct the Contractor – at any stage throughout the execution of the works – to provide at his own expense additional or different sanitary facilities at street or underground level, if the number of the workers increases or if unsanitary conditions emerge for any reason whatsoever.

1.4.5 Upon relocation or removal of the subject facilities, all areas shall be disinfected.

1.5 TEMPORARY TELEPHONE FACILITIES

1.5.1 Immediately after the Project award, the Contractor is obliged to proceed with all necessary actions towards telephone service providers, so that sufficient time is ensured for scheduling the telephone connection to the worksite areas before works commence in each different worksite area.

1.5.2 The Contractor shall install temporary telephone connections for the worksite offices of the Service, as specified elsewhere in the contract.

1.5.3 The Contractor shall install temporary telephone connections for his worksite offices, depending on his needs. It is clarified that no worksite area shall be equipped with available current telephone lines.

1.6 TEMPORARY CONNECTIONS WITH OTHER PUO NETWORKS

1.6.1 In the framework of his contractual obligations the Contractor shall provide for the installation of any other temporary PUO networks that become necessary for the execution of the works and shall proceed to all relevant actions towards the pertinent Organizations, at no extra charge.

1.6.2 **Relevant Standards / Specifications**

Applicable shall be the specifications of the pertinent PUOs.

1.6.3 **Submission of data to ATTIKO METRO**

The submission of data is not required.

2 PRODUCTS

2.1 Materials

The materials to be used for the temporary PUO connections shall be the ones specified in the above para. 1.6.2.

3 EXECUTION OF WORKS

Works shall be executed and measured in line with the provisions of the specifications in the above paragraph 1.6.2.

01535 TEMPORARY FENCING OF WORKSITE

1 GENERAL

1.1 Description of Work

1.1.1 The Contractor shall fence all worksites, including excavations, with temporary fences, which shall conform to the safety regulations and shall protect the surrounding areas from inconvenience caused by the execution of the works. In addition, the Contractor shall build fenced and safe pedestrian passageways at any point considered to be dangerous to the safety of pedestrians. The fencing shall consist in corrugated steel sheets fixed on structural steel framing and a base made of reinforced concrete. The pedestrian passageways shall be fenced on both sides, by means of wooden boards; they shall be covered and equipped with floors at locations specified by ATTIKO METRO (AM).

a. Upgrading of Fencing in terms of aesthetics

As regards the worksite fencing, the Contractor is obliged to implement, if so requested by ATTIKO METRO S.A. (AM), a program relating to the upgrading of fencing in terms of aesthetics, on the basis of which colored posters printed on synthetic vinyl (2.00m h x 5.00m l approximately) are placed on a metal rectangular frame bearing diagonal joints at the external surface of the fences. The Contractor shall submit relevant technical details. The patterns shall be provided in electronic format by AM.

b. Project Information Signs

The Contractor is obliged to install two information signs to be placed on metal structure at locations to be indicated by AM within the Tramway Depot.

The said signs shall be approximately 4.00m long and 3.00m wide, they shall bear the title of the Project, the names of the Project Owner and Contractor, the budget and other data according to AM suggestions and they shall adhere to the provisions of European Regulation 1303/2013 (Annex 7), Implementing Regulation 821/2014 laying down rules for the application of Regulation (EU) No 1303/2013 and L. 4314/2014 incorporating European Regulations in the Greek Law.

1.1.2 The reinforced concrete base of the fences shall be adequately sized to keep floodwater outside the excavation limits.

1.1.3 The fencing shall be equipped with reflective or illuminated signs in order to be visible by the public during night hours.

1.1.4 The Contractor shall also fence the areas outside the worksite containing plants and trees.

1.1.5 The orientation of the entrances to the Worksite areas shall be such that the entrances are facing downstream in view of reducing the risk of the Worksite being flooded from runoff of the surrounding upstream areas.

1.2 Reference Standards

Regarding timber:

- ELOT EN 14080 - Timber structures. Glued laminated timber and glued solid timber. Requirements
- ELOT EN 14081 - Timber structures. Strength graded structural timber with rectangular cross section
- ELOT EN 313 – Plywood. Classification and terminology
- ELOT EN 314 – Plywood. Bond quality
- ELOT EN 636 – Plywood. Specifications
- ELOT EN 13986 - Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking
- ELOT EN 14374 - Timber structures – Structural laminated veneer lumber – Requirements

Regarding structural steel:

- ELOT EN 10025 - Hot rolled products of structural steels
- ELOT EN 10219 - Cold formed welded structural hollow sections of non-alloy and fine grain steels

Regarding steel plates:

- ELOT EN 10346 - Continuously hot-dip coated steel flat products for cold forming
- ELOT EN 14782 - Self-supporting metal sheet for roofing, external cladding and internal lining. Product specification and requirements.

Non Pre-stressed Bolts in accordance with the European Standards:

Bolts:

- ELOT EN,ISO 4014 - Hexagon head bolts. Product grades A and B
- ELOT EN ISO 4016 - Hexagon head bolts. Product grade C
- ELOT EN ISO 4017 - Fasteners - Hexagon head screws - Product grades A and B
- ELOT EN ISO 4018 - Hexagon head screws -- Product grade C

Nuts:

- ELOT EN ISO 4032 - Hexagon regular nuts (style 1) – Product grades A and B
- ELOT EN ISO 4034 - Hexagon regular nuts (style 1) – Product grade C

Washers:

- ELOT EN ISO 7089 - Plain washers - Normal series - Product grade A
- ELOT EN ISO 7090 - Plain washers, chamfered - Normal series - Product grade A
- ELOT EN ISO 7091 - Plain washers - Normal series - Product grade C

1.3 Submittals

The Contractor shall prepare drawings regarding the fencing for submission and approval by AM. These drawings shall contain details concerning the kind and type of the fence, the location and the type of the gates, the protection measures to be taken, as well as measures for the reduction of dust and noise (see Article on Environmental Impact), the inflow of rain water deriving from upstream areas into the trench, as well as the safety of the pedestrian passageways where pavements are discontinued resulting from the installation of a worksite or due to traffic arrangements (see Article 10 for Diversions and Traffic arrangements in the Design Specifications).

Moreover, once the fencing of each worksite area has been completed, the Contractor shall submit to AM a drawing showing the boundaries of the fencing along with a measurement of the entire area that has been occupied to be used as worksites.

2 PRODUCTS

2.1 Timber

Where timber is used, the following shall apply:

Structural pine and/or laminated wood shall be used.
Laminated wood (plywood, boarding) shall be appropriate for structural use, with weatherproof construction.

Minimum wood thickness:

- Planks: 20 mm
- Timber beams: 45 mm
- Laminated wood board: 20 mm for floors and shelters
- 10 mm for walls.

2.2 Structural Steel

Structural steels (steel profiles, hot rolled bars, anchoring slabs, etc.) of the frame shall comply with the mechanical and chemical characteristics stipulated in Specification ELOT EN 10025, whereas concave cross-sections shall comply with ELOT EN 10025 for an at least S 235 quality.

2.3 Corrugated Sheets

Corrugated sheets shall be made of steel with trapezoid ribs as per ELOT EN 14782. Their thickness shall be 0.50mm as a minimum, they shall be hot dipped galvanized with at least 140gr zinc/m^2 of sheet and a mat surface without further treatment.

2.4 Concrete Base of Fencings

The bases shall be made of class C16/20 concrete, as a minimum, as per the relevant specification of this document. The concrete base shall have a minimum height of 40 cm for flood protection.

2.5 Advertising Signs

Where advertising signs are required, these shall be made of a flat steel sheet of a minimum sheet of 1mm.

3 EXECUTION

The fencing shall be constructed in accordance with the approved drawings. The worksite area should be fenced along the perimeter at ground level, except for the locations where access to the worksite is required. At the locations in question, openings should be covered through locking doors of the same height with the fencing. AM reserves the right to suggest on site the extension of the fencing, in case AM deems that this is advisable for safety reasons. Throughout the duration of the Project, the Contractor shall maintain the fencing for ensuring a flawless and continuous operation. When the fencing is no longer required due to the completion of the works of this Contract, with AM's consent, the Contractor shall remove the fencing and the area shall be reinstated in line with the provisions of the contract documents.

3.1 Steel Fencing

The steel fencing shall be made of hot dip galvanized steel corrugated panels 1.90m high, where provision has been made for openings intended for the installation of steel doors made of the same material in accordance with the approved by AM drawings. Steel fencing may be either fixed (type A) or movable (type B).

3.2 Fixed Fencing (Type A)

The base of the panels shall be made of reinforced concrete and the steel supports of the bearing structure shall be anchored in the concrete with anchoring slabs and expansion anchors or shall be

embedded inside the concrete base at a depth of 350mm minimum or as required by the Calculation Note. The base of the concrete shall offer cover the supports at the perimeter and underneath for at least 50mm. All minor fixing materials (screws, nuts, washers, bolts) shall be galvanized.

The steel frame shall be coated by two layers of anticorrosive oil paint to be selected by AM.

3.3 Movable Fencing (Type B)

Panels and metal supports shall be embedded in movable concrete bases of a size considered sufficient in order to prevent overturning. The concrete should be properly reinforced in order to avoid cracks.

3.4 Wooden Fencing (Type C)

This fencing shall protect the pedestrian passages, the points where sidewalks are interrupted, the points where protection of the preservable flora is required and any other point indicated by AM. The wooden fencing shall be appropriate for painting and decoration, approved by AM, and shall be 1.50m high towards the street. When advertising signs are required, these should be installed at the top of the fencing. The fencing frame shall be modified at the calculations and drawings stage, so that it may distribute the additional loads. Where there is risk of items falling on the passing pedestrians, passages shall be protected with wooden sheds. Wooden floors shall be made of beams or nonstick timber, without any voids, at the locations indicated by AM. All fixing minor materials (screws, nuts, washers, bolts) shall be galvanized and shall not protrude from the finished surfaces of the joint members.

3.5 Fencings for the construction of formwork adjacent to traffic (Type D)

Formwork adjacent to traffic will be protected with safe fencing. It shall be capable of bearing a 75KN/m load without permitting any contact between vehicles or safety parapets and any part of the formwork. Special solutions shall be selected according to the on site conditions. For example, type B fencing installed on concrete curbs.

3.6 Fencing for the protection of trees and planted areas

The Contractor shall protect all areas with trees or plants within the worksite area. These areas shall be enclosed by fencing of a type and height approved by AM, in order to obstruct access to unauthorized persons. Special solutions shall be selected based on the worksite area specific conditions.

4. ON SITE QUALITY CONTROLS

Fencings and doors should be checked regularly by the Contractor and any damage that may occur shall be fixed immediately after having been identified and notified by others.

The fencing shall be kept clean by the Contractor without any signs, plates, advertisements etc., unless otherwise specified by AM. It is noted that AM is exclusively entitled to hang up signs, plates, advertisements etc.

5 DISMANTLING OF FENCING

When the fencing and doors are no longer required, on condition that the works foreseen in the framework of this contract have been completed, they shall be dismantled and the area shall be reinstated, in line with the provisions of the contract documents.

01545 TEMPORARY DRAINAGE OF THE WORKSITE

1. GENERAL

1.1 Description of the works

During the project construction works, all water originating from underground water inflow and rainwater flowing in from various upstream openings must be collected and pumped out to a settlement tank and discharged to the worksite area outside the pit. There the water shall be freed of the mud, oil and other pollutants and shall be channeled to the nearest rainwater city pipe or manhole.

The drainage system ensures that the permanent works shall be constructed in dry conditions and be protected against the damaging effect of the water penetration and free flow.

1.2 Relevant standards / specifications

The Contractor shall adhere to the following relevant standards and specifications for the drainage installations, which shall be designed and constructed in accordance with the Greek Technical Specifications (ETEP):

a) ELOT TS 1501-08-01-03-01:
Trench excavation for Utility Networks

b) ELOT TS 1501-08-01-03-02:
Underground utilities trench backfilling

c) ELOT TS 1501-08-06-02-02:
Non-pressurized u-PVC pipe networks for sewage

d) ELOT TS 1501-08-06-08-03:
Retrofitting of concrete paving slabs along constructed underground utility

e) ELOT TS 1501-08-06-08-04:
Retrofitting of curbs and gutters along constructed underground utility

f) ELOT TS 1501-08-06-08-06:
Prefabricated concrete manholes

g) ELOT TS 1501-08-07-01-04:
Ductile iron gully tops

h) ELOT TS 1501-08-07-01-05:
Manhole steps

i) ELOT TS 1501-02-02-01-00:
General excavations for Road and Hydraulic works

ı) ELOT TS 1501-12-05-02-00
Geotextiles for the protection or drainage of tunnel lining waterproofing membranes

1.3 Submittals

The Contractor shall submit detailed the required DFDs for the temporary drainage, which shall include the water collection items, the piping, the manholes, pumps, tanks and any other structural or mechanical item.

The Contractor shall also submit to AM for approval Materials Submittal sheets (MSSs) for all materials to be incorporated to the structure, as well as the certificates of compliance with the respective standards. The Contractor shall submit copies of the results for all required controls and laboratory tests.

The connections with the city rainwater network shall constitute a separate design subject to approval by AM and the concerned Service, whose content is defined in article "PUO networks diversion" of the Design Specifications.

2. MATERIALS

2.1 Pipework

The type, category and diameter of the pipes, fittings and couplers to be used in the drainage of the pits shall be those indicated in the Design Specifications and typical details drawings, and as described in the above Greek Technical Specifications.

The use of plastic (U-PVC or HDPE) pipes in confined areas is not permitted for fire-safety reasons.

2.2 Geotextile

Please see paragraph 4.2 of ELOT TS 1501-12-05-02-00 - Geotextiles for the protection or drainage of tunnel lining waterproofing membranes.

2.3 Drain inlets, Drainage Manholes, Water Tanks

- Any structures made of pre-cast (or cast in situ) reinforced concrete for sumps/tanks shall be in accordance with ELOT TS 1501-08-06-08-06: Standard and with the Article entitled "Prefabricated concrete manholes".

- The formworks for the aforementioned structures shall be in conformance with the Article 03110 entitled "Formworks for Cast in situ Concrete".

- The steel reinforcement for the aforementioned structures shall be in accordance with the Article 03211 entitled "Steel reinforcement".

- Water tanks shall be watertight and shall have the proper openings for inspection and maintenance, ventilation and access ladders. Access ladders shall be made of galvanized steel and shall be equipped with a protection cage. The settlement tanks shall be cleanable.

2.4 Pumps

In addition to the pump to be used on a daily basis, the worksite shall be also equipped with a stand-by pump of the same capacity. All other materials shall be provided as necessary for the proper operation of the pumps.

The supply and installation of the pumps shall be in accordance with the respective E/M Specifications

3 WORKS

3.1 Any water penetration in the excavation shall be drained through the temporary drainage system. The water deriving from the execution of boreholes and cleaning works should be drained immediately. All rainwater ponding in the excavation pit shall also be drained.

3.2 The drainage system shall be properly constructed, so as:

a. To constrain ponding within the excavation area and to facilitate the proper execution and construction of the works

b. To avoid the uncontrollable water flow that may cause erosion

c. To secure the controllable channeling of the incoming water through the installed drainage system.

3.3 The excavation invert shall be covered with one layer 15 cm thick of gravel on a 140 gr/m^2 Geotextile for retaining the fine elements of the sub-soil beyond the gravel layer.

The invert of the excavation shall have a minimum longitudinal gradient of 0.3% and transversal gradients of 0.5%, so that rainwater can be channeled into perforated pipes and therefrom to the perforated storm water drainage manhole.

3.4 Water shall be pumped from the drainage manhole, through a combination of flexible and non-flexible pressure pipes, to the appropriate settling tank, installed at the worksite area outside the pit; silt, oils and other pollutants will be separated and clean water, as per the EYDAP's quality specification, can flow to the main drainage system of the city. The overflow from the tank shall end up with a temporary connection to a nearby rainwater drainage network of the city. If required, a pump and a discharge pipe shall be used for this connection. The connection up to the city rainwater network constitutes part of this Contract.

3.5 The settling tank shall be easily accessible for checking reasons, shall be regularly maintained and cleaned, so that its proper and unobstructed operation is ensured. The silt shall be collected and transferred to a suitable facility for further treatment and deposit.

3.6 The Contractor shall supply and maintain in the worksite area outside the pit stand-by pumps and pipes with a capacity equal to the capacity of the installed drainage scheme. Stand-by pumps and pipes shall be ready for immediate operation, so that a sudden failure or flood water penetration can be dealt with effectively.

01560 AREA CONFIGURATIONS

1 GENERAL

1.1 Description of Works

This Article determines the procedures and requirements relating to the configuration of all areas that incurred damage due to the execution of the works or that were occupied by the Contractor for all works construction needs.

1.2 Submission of Data

In the framework of the DFD, the Contractor has to submit to AM, for approval, all the data relating to the methods that will be used, the equipment, compliance certificates for the materials to be used, results of tests, as well as any other information referred to in the individual paragraphs of this Specification.

1.3 Submission of Drawings / Technical Report

The Contractor shall submit to AM for approval the Drawings and the Technical Reports regarding the reinstatement of the areas affected by the Project construction. These shall be based on the contractual drawings and/or on the Inventory of the Existing Features as required, and they shall adapted accordingly, taking into consideration the Project influence on the surface (new traffic arrangements, new curbs, sidewalks etc.).

The layout plan shall include both the external perimeter of any Project structure, the outline of any streets, sidewalks and other structures affected by the construction of the tramway corridor, as well as of the perimeter road and in general the outline of any worksite occupation. These perimeters/outlines shall be identified by means of the appropriate symbols.

2 PERFORMANCE OF WORKS

2.1 Area Reinstatement

The Contractor shall submit to AM for approval Area Reinstatement Drawings for the areas at street level at a scale of 1:200 with details, where necessary, accompanied by a Technical Report for all areas to be occupied for the execution of the foreseen works. These drawings shall include data from the respective designs and from the Inventory of Existing Features, as required (see relevant article of the "Design & Performance Specifications for Civil Works"), the elevations and co-ordinates of all features to be reinstated, as well as the new ground

morphology, new structures, new traffic arrangements, new curbs and sidewalks, street and curb elevations, etc..

2.2 Protocol of Acceptance

The Contractor, in order to obtain from AM a Code 1 Approval Status on the submitted Drawings and Technical Report, shall include in his Technical Report the Acceptance Protocol of the area in question by the Municipality or by other Authority under whose jurisdiction the section to be reinstated falls. With the above Acceptance Protocol, the Contractor shall ensure that the Municipality or any other authority accepts the trees, shrubs and other elements proposed by the Contractor as equal to those, already recorded in the Inventory of Existing Features.

2.3 Reinstatement of all provisional PUO network diversions

Prior to the commencement of the reinstatement work, the Contractor will officially inform all PUOs with networks in the area that these networks have been provisionally diverted. This update shall inform the PUOs about the dates of the proposed reinstatement works, asking confirmation by these PUOs whether their networks shall permanently remain in their temporary locations or shall be returned to their original routing. The Contractor shall present to ATTIKO METRO SA. the location of the PUO networks in a digital format as well.

2.4 Reinstatement of areas falling outside the boundaries of the works

Whenever the occupation and use of any areas, grounds or installations falling outside the worksite boundaries is no longer necessary for the execution of the works, the Contractor, unless otherwise requested by AM, shall evacuate such areas and shall remove all equipment, temporary structures, redundant materials and waste at his cost and shall reinstate them according to AM's instructions and requirements and/or suggestions.

The Contractor shall have to advise AM on the time schedule for the execution of the reinstatement works at least one month before the proposed date of the inception of works.

2.5 Reinstatement of Worksite Areas

2.5.1 Upon completion of each Project section construction and before the delivery to AM of the relevant worksite areas that have been used in the construction of the works and/or as worksite installations, the Contractor shall remove, at his cost, any temporary existing structure,

tools, scaffolds, machinery, useful and useless materials, temporary electrical and mechanical installations and shall repair or reinstate any areas, structures or other installations that have incurred damage during the execution of the Project, according to the stipulations in the contractual documents and/or initial Inventory of Existing Conditions, as required. The Contractor has to remove or demolish any auxiliary structures as directed by AM.

2.5.2 The Contractor shall point out that the reinstatement works, as described above also include any temporary works or installations under the street level. Such tools or materials shall be removed in order to clear the ground of any obstacles that might affect any future performance of works.

2.5.3 In case of any PUO networks diversions, the Contractor shall have to backfill all the areas up to the street level and reinstate same according to the Inventory of Existing Features. Moreover, the Contractor is obliged to reinstated and deliver all streets and sidewalks affected by the construction of the tramway corridor along the Tramway extension, as well as the perimeter road.

2.5.4 Where reinstatement to the previous condition is not desirable, AM retains its right to instruct the Contractor to reinstate the area in a suitable manner.

2.5.5 Upon AM's approval of the reinstatement work, the Contractor shall leave the area in question within a reasonable time, as directed by AM.

2.6 "As Built" Topographic Survey Drawings

Upon completion of the reinstatement – reconfiguration works, the Contractor shall proceed with full topographical survey of all reinstated areas and the preparation of topographical diagrams of all areas at a scale of 1:500 as these have been implemented. These drawings shall be submitted for approval in a digital form as well.

2.7 Reference System

For all measurements and drawings, use shall be made of the EGSA87 Reference System. As reference index, the basic and secondary layout and elevation reference networks shall be used, as these are described in the Article 9 of the document entitled "Design Specifications for Civil Works".

01600 PERMANENT CONNECTIONS WITH PUO NETWORKS

1 GENERAL

1.1 Description of Works

The Contractor shall be responsible for the design, supply and installation of the following PUO networks within the Depot:

- Connections of storm and surface water networks with storm drainage culverts adjacent to each structure.
- Connections between the above structures and the city's sewage network.
- Potable water supplies from the city's main water supply pipe.
- Fire extinguishing supplies from the main water supply pipe (diameter => Φ150 mm)
- Telecommunication cable ducts from OTE network to be installed by OTE.
- Power supply cable ducts from PPC network to be installed by PPC.

1.2 Relevant Standards / Specifications

The specifications of the pertinent PUOs, as well as the applicable Greek Technical Specifications (ETEP) shall be utilized, as mentioned in detail in Article 01508.

1.3 Submission of information to ATTIKO METRO S.A.

Information to be submitted to ATTIKO METRO S.A. shall be information provided for in the specifications mentioned in the above paragraph 1.2. The Contractor shall also submit to ATTIKO METRO S.A. for approval Material Submittal Sheets (MSS) for all materials to be utilized in the construction. Samples of materials shall be also submitted for approval whenever requested by ATTIKO METRO S.A.

2 PRODUCTS

2.1 Piping

The type, category and diameter of the pipes, components and couplers to be utilized shall be the ones indicated on the drawings of the relevant designs and shall comply with the provisions of paragraph 1.2.

3 EXECUTION OF WORKS

The execution and the relevant measurement of works shall be effected in accordance with the provisions of the respective specifications mentioned in the above paragraph 1.2.

01806 PERMANENT DRAINAGE

1 GENERAL

1.1 Description of Work

The Contractor shall design and install a permanent drainage system, in order to drain during the project's operation all rainwater, flowing water or any other type of water.

In the Depot and everywhere else as required, a permanent drainage system shall be installed to collect and channel the water via a permanent connection to the rainwater network of the city.

1.2 Relevant standards

The Contractor shall take into account and satisfy the relevant standards and specifications concerning the permanent drainage installations, which shall be constructed as per the following Greek Technical Specifications mentioned below:

a) ELOT TS 1501-08-01-03-01: "Trench excavations for utility networks"

b) ELOT TS 1501-08-01-03-02: "Underground utilities trench backfilling"

c) ELOT TS 1501-08-06-02-02: "u-PVC non-pressurised sewerage networks"

d) ELOT TS 1501-08-06-08-03: "Retrofitting of concrete paving slabs along constructed underground utility"

e) ELOT TS 1501-08-06-08-04: "Retrofitting of curbs and gutters along constructed underground utility"

f) ELOT TS 1501-08-06-08-06: "Prefabricated concrete manholes"

g) ELOT TS 1501-08-07-01-04: "Ductile iron gully tops"

h) ELOT TS 1501-08-07-01-05: "Manhole steps"

i) ELOT TS 1501-02-02-01-00: "General excavations for road and hydraulic works"

j) ELOT TS 1501-12-05-02-00:2009 "Geotextile protection-drainage layer

k) Specifications issued by EYDAP and Department D10 of Attiki Region.

1.3 Submittals

The Contractor shall submit the required hydraulic and mechanical DFDs for the permanent drainage of the Depot and all other required areas, which will include the water-collection arrangements, the materials of the pipes, the pits, pumps, tanks and any other structural or mechanical item, in line with the Design Specifications.

The Contractor shall also submit to AM for approval Materials Submittal sheets (MSS's), including all data for products to be used, as well as certificates of compliance with the standards mentioned above. At the same time, the Contractor shall submit copies of the results for all laboratory tests and controls required.

The connections with the rainwater network of the city shall be part of a separate design to be approved by AM and the competent Service. The contents of the design are determined in article "PUO network diversions" of the Design Specifications.

2 MATERIALS

2.1 Piping work

The type, category and diameter of the pipes, the fittings and connection fittings to be used for the drainage of the tunnels shall be inline with the Performance Specifications and the typical details drawings. For fire safety reasons, the use of plastic pipes (U-PVC or HDPE) in closed areas shall not be allowed.

2.2 Water Sump Pits/Manholes/Water Tanks

- The structures made of precast (or cast in situ) reinforced concrete for manholes/water tanks shall be in accordance with specification ELOT TS 1501-08-06-08-06 and Article "Precast Concrete Manholes".

- The formworks for these structures shall be in accordance with Article 03110 "Formworks for Cast in Situ Concrete".

- The steel reinforcement for these structures shall be in accordance with Article 03211 "Steel Reinforcement".

2.3 Manhole Covers – Pit grids

Manhole covers and pit grids shall be made of Cast-Iron, as per the requirements of ELOT EN 124. All covers shall bear the appropriate sign on their top part.

The manhole covers and pit grids shall be of the following Classes:

- Class D-400 (40-ton capacity): To be used in road pavements, street hard slopes and parking facilities for all types of vehicles.
- Class C-250 (25-ton capacity): To be used in pedestrian circulation areas, sidewalks, areas located adjacent to road pavements and parking facilities; it is applicable only to rainwater sump grids installed in hard slopes and in street gutters, which, measured from the edge of the curb, are extending up to 0.5m. as a maximum, within the road pavement area.
- Class B-125 (12.5-ton capacity): To be used on sidewalks or underneath parking sheds accessed only by passenger vehicles.
- Class A-15 (1.5-ton capacity): To be used in pedestrian circulation areas and green areas.

3. WORKS

3.1 Any water inflow due to seepage and rainfall should be drained via the drainage system of the station of the shaft to the drainage system of the city. The drainage system consists in the sump pits, piping, tanks, pits, as well as any other item necessary.

3.2 Under normal conditions, rainwater shall flow via gravity to the rainwater network of the city. If gravity discharge is unfeasible, they shall be pumped through a pressure pipe and a permanent connection. The connection up to the rainwater network of the city forms part of this Contract.

3.3 There has to be adequate provision for trial operation of all rainwater related items and the rainwater drainage pipes. The locations of the points of operational testing shall be such as to allow inspections with minimal interruptions or disconnections of the installed equipment.

3.4 Unless otherwise specified, the manhole covers, the grids of rainwater sumps and access covers, shall be recessed and should not protrude.

02062 DEMOLITION WORKS

1. The demolition works shall be executed in accordance with the requirements of the applicable legislation, of Article GS 0750 of the General Specifications, of the following ETEPs and further to the relevant permits to be issued by State Authorities, as required.

   The following valid ETEPs are applicable:

   ELOT TS 1501 02-01-01-00: Works zone grubbing and clearing

   ELOT TS 1501-15-01-03-00: " Structures demolition with mechanical means"
   ELOT TS 1501-15-02-01-01: " Demolition of members of concrete structures by mechanical means"
   ELOT TS 1501-15-02-01-03: " Hydrodemolition of members of concrete structures"
   ELOT TS 1501-15-02-02-02: "Thermic demolition of steel structures"
   ELOT TS 1501-15-03-03-00: "Demolition of slabs on the ground"
   ELOT TS 1501-15-04-01-00:"Health - Safety and Environmental Protection requirements for demolition works".

02163 PILES FOR ELECTRIFICATION MASTS SUPPORT

A. Greek Technical Specifications (GTS)

The following GTS is applicable:

- ELOT TS 11-01-01-00: "Bored piles"

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the respective Greek Technical Specification.

1. Scope

This Article is applicable to piles to be used for the safe support of the electrification masts. Reinforced concrete piles shall be used.

4. Requirements

The following paragraphs are added:

Submittals

The Contractor shall submit to ATTIKO METRO for approval a Method Statement, as per the General Specifications – GS 0200 Design Requirements, which shall include full details of the Contractor's proposed methods to be employed, the equipment, a risk analysis and safety procedures to minimize risks, the on–site testing proposals both for preliminary piles and for working piles and any other information referred to in the present Article or the above Standards.

The Contractor shall also submit to ATTIKO METRO for approval the Material Submittal Sheets (MSSs), as per the General Specifications – GS 0200 Design Requirements, which shall include all data related to the materials proposed, the conformance certificates of the materials used, the test results etc.

4.3 Concrete for piles

Any reference in the text of ELOT TS 11-01-01-00 to concrete for piles shall comply with article 03310 of the Materials and Workmanship Specifications for Civil Works of ATTIKO METRO.

Steel reinforcement

Any reference in the text of ELOT TS 11-01-01-00 to steel reinforcement for piles shall comply with article 03211 of the Materials and Workmanship Specifications for Civil Works of ATTIKO METRO.

02182 GEOTEXTILES FOR DRAINS

A. Greek Technical Specifications (GTS)

The following proposed specification is applicable:

ETEP 08-03-03-00: "Geotextiles and related products for drains"

B. Additional requirements

The following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specification.

1. Scope

This article refers to the supply and installation of geotextile for drains behind walls and pedestals.

4. Requirements

The following paragraph is added:

Submittals

Before placing an order for geotextile, the Contractor shall submit to ATTIKO METRO S.A. for approval the pertinent Material Submittal Sheet (MSS), making reference to this Material & Workmanship Specification, including the characteristics of the product based on the declaration of performance, the certificates issued by accredited laboratories, as well as ISO 9001 Certificate for the Manufacturer's Quality Management System. A catalogue from the factory must be also submitted, including Storage and Placement Instructions, also indicating the selected weight per m^2 for each use, and data showing the maximum permissible time of exposure to ultraviolet radiation. Samples of the proposed geotextile shall be also submitted along with the MSS.

02226 EXCAVATIONS

1. Scope

1.1 General

The scope of this article includes all works related to the excavations for trenches, underground networks, roadworks, railway projects and buildings of the Project.

The following works fall outside the scope of this article:

- All excavations, regardless their dimensions and area, executed under the supervision or guidance of the Archaeological Department

This work includes the provision of all required installations, equipment, materials and manpower and the execution of any related work regarding the excavation and temporary retaining of open cuts, as dictated by the safety regulations and in accordance with the approved methods and designs approved by AM, the Contractor's drawings and the technical specifications of ATTIKO METRO.

1.2 Works conditions

In all excavation areas the Contractor shall ensure the safe and uninterrupted access, as well as the required safety conditions throughout the execution of the Project.

All excavation works shall be executed at the Contractor's responsibility, whose primary concern shall be the safety of the structures, buildings and infrastructure adjacent to the excavations so as to avoid any damage to them.

1.3 Identification of underground networks

Prior to the commencement of excavation work, it shall be verified whether underground networks pass through or near the excavation area, by means of exploratory cuts. If such networks do exist and depending on their condition, the excavation works shall be appropriately planned after consultation with the pertinent PUO. Network diversions shall be executed in accordance with the requirements of Article 01508 of this document.

1.4 Archaeological finds

If any archaeological relics are unearthed during the excavation works, the works shall immediately be discontinued and AM and the responsible Archaeological Service shall be notified.

2. Normative References

The following specifications are applicable per type of excavation:

- ELOT TP 1501-02-01-02-00,: Removal of soil surface layer.
- ELOT TP 1501-02-02-01-00: General excavations for Roadworks and Hydraulic Projects.
- ELOT TP 1501-02-03-00-00: General excavations for building works.
- ELOT TP 1501-02-04-00-00: Excavation of foundations for technical projects
- ELOT TP 1501-08-01-03-01: Excavation of trenches for PUO networks

Management of the excavation spoil is governed by the following specification:

ELOT TP 1501-02-05-00-00: Management of excavation materials and exploitation of dumping sites

02227 BACKFILLING

1. Scope

This article refers to the works for the construction of embankments and backfills at any part of the Project. Embankments for the configuration of infrastructure and trackwork installation are exempted; these embankments are described in Article 02229 of this document.

2. Backfilling of excavations for foundation works

Applicable is specification ELOT TS-1501-02-07-02-00: Backfilling of excavations for foundation works for technical projects.

3. Backfilling of underground utility networks

Applicable is specification ELOT TS-1501-08-01-03-02: Underground utilities trench backfilling.

4. Road and Transition Embankments

4.1 General

The specifications referring to Road and Transition Embankments are largely based on the following texts which refer to Provisional Greek Technical Specifications (ETEP) and ETEP drawings:

- ETEP 02-07-01-00, Construction of embankments with suitable excavation or borrow materials
- ETEP 02-07-03-00, Transition embankments
- ETEP 02-07-01-00, Construction of embankments with suitable excavation or borrow materials
- ETEP 02-07-03-00, Transition embankments.

4.2 Normative References

- ELOT EN ISO 14688-2, Geotechnical investigation and testing - Identification and classification of soil - Part 2: Principles for a classification
- ELOT EN ISO 17892-12, Geotechnical investigation and testing -- Laboratory testing of soil -- Part 12: determination of liquid limit, plastic limit and plasticity index
- ELOT EN 13286-2, Unbound and hydraulically bound mixtures. Test methods for the determination of the laboratory reference density and water content. Proctor compaction
- ELOT EN 13286-47, Unbound and hydraulically bound mixtures. Test method for the determination of California bearing ratio, immediate bearing index and linear swelling

- ISO 565, Test sieves - - Metal wire cloth, perforated metal plate and electroformed sheet - - Nominal sizes of openings
- ELOT TP 1501-02-05-00-00, Management of excavation materials and exploitation of dumping sites
- E 105-86, Soil Mechanics Laboratory Test Specifications (Governments' Gazette (FEK) 955/B'/31.12.1986)
- E 106-86, Soil Mechanics on site Test Specifications (FEK 955/B'/31.12.1986)
- AASHTO T 194, Standard Method of Test for Determination of Organic Matter in Soils by Wet Combustion
- ASTM D 3282, Standard Practice for Classification of Soils and Soil-Aggregates Mixtures for Highway Construction Purposes
- ASTM D 6938, Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- DIN 18134, Soil - Testing procedures and testing equipment - Plate load test

4.3 Terms and Definitions

4.3.1 Embankment

It is formed by laying and compaction of appropriate soil materials, excavation spoil or borrow materials, in layers as thick as needed to achieve the required compaction using the available means. This work is performed in areas with suitable dimensions to facilitate the use of high performance mechanical equipment.

4.3.2 Transition Embankments

These are embankments placed behind technical works (retaining walls, sewers etc.), which are constructed using selected, non plastic, sand gravel materials. Their purpose is to minimize the embankment subsidence at the perimeter of technical works (due to subsidence), since subsidence in this zone has a direct impact on the final surface.

4.3.3 Earth Embankments

These are embankments formed by laying and compaction of earth materials from earth and semi-rock excavations of trenches or excavations of borrow areas.

4.3.4 Rock Embankments

These are embankments formed by laying and compaction of rock materials mainly from rock excavations.

There is no provision for the construction of rock embankments in the Project.

4.3.5 Improvement of Soil Materials for Embankment Foundation by Stabilizing Pozzolans

Improvement of the mechanical properties of the soil material by mixing it (in relatively small quantities) with pozzolans (cement and/or fly ash) or asbestos (in different forms, such as lime powder, or quick lime powder, or slurry lime pulp), compacting it under optimum moisture conditions and preserving it for a specific time period.

4.3.6 Loose soil

Horticultural soil, mud, turf, organic soils as well as soils from backfilling with inhomogeneous materials.

4.3.7 Cohesive soil

Soil passing through sieves (per ISO 565) of 0.063mm mesh, over 34% by weight and plasticity index PI>7.

4.3.8 Non cohesive soil – granular soil

Soil passing through sieves (per ISO 565) of 0.063mm mesh, equal or less than 34% by weight and plasticity index PI<7.

4.3.9 Loose thickness of embankment layer

Thickness of the layer to be compacted.

4.3.10 Road pavement subgrade layer

Configured and compacted soil or backfilling material placed directly below the road pavement, according to this Specification, down to a depth affected by road traffic loads.

4.3.11 Crown

This is the part of the embankment immediately beneath the pavement subgrade layer, reaching a depth of 0.8-1.0 m from the top surface of pavement subgrade layer, as per the design.

4.4. Requirements for Appropriate Materials

4.4.1 Supply and Transfer of Appropriate Materials for the Construction of Embankments

During the execution of any kind of excavation, the Contractor ought to introduce measures, so all suitable excavation spoil can be used for the construction of embankments. The suitable excavation spoil shall be provisionally stored and then it shall be transferred to the specified locations (see ELOT TP 1501-02-05-00-00).

If these materials are inappropriate, or insufficient, or coordination of works in trenches – tunnels – embankments with the approved work execution plan is not possible, then appropriate materials shall be borrowed from borrow areas following the written approval by ATTIKO METRO S.A. (AM). If, due to the Contractor's responsibility, it is not possible to utilize the suitable excavation spoil, then the Contractor ought to ensure at his own cost the respective quantities of borrow materials

4.4.2 Materials for the Crown

In order to classify the appropriate materials for the crown, the Specification per AASHTO is implemented, in accordance with ASTM D 3282 or equivalent.

Materials classified in categories A-1, A-2-4, A-2-5 and A-3 (Table 1) are preferred. If the quantities of these materials are not adequately available, materials classified in categories A-2-6, A-2-7 and A-4 can be used.

If materials classified in the aforementioned categories are not provided in sufficient quantities, then materials classified in categories A-6 or A-7 can be used.

If there are no sufficient quantities of materials classified in all the aforementioned categories, then materials from category A-5 can be also used, only under certain conditions and after a special study has been prepared specifying the conditions for this option.

4.4.3 Inappropriate Materials

It is not permitted to use the following types of materials as backfilling materials:

- Peat or organic soils containing organic materials >6% by weight (wet corrosion method per AASHTO T 194 or equivalent), or when the liquid limit of the soil, after oven drying, is 75% less than its liquid limit before drying (per).
- Fine soil with a tendency for swelling >100kPa, in combination with free swelling deformation >3%, as per CBR test (per ELOT EN ISO 13286-47 or equivalent).
- Thixotropic soils (for example, extremely sensitive clay), as well as soil containing diatomaceous earth or mica flakes at a percentage of over 20%.
- Soil containing water-soluble minerals, such as rock salt or gypsum, at a percentage of over 2%.

- Polluting materials (e.g. industrial sub-products containing pollutants).
- Man-made embankments of heterogeneous nature and origin (such as, for example, metals, building materials, plant materials, etc.).

TABLE 1 Classification of Soils and Soil-Aggregate Mixtures

Classification per AASHTO per ASTM D 3282-93												
General Classification	**Granular materials (less than 35% passing through the No. 200 sieve)**							**Silt-clay materials (more than 35% passing No. 200)**				
	A-1			A-2							A-7	
Group classification*	A-1-a	A -1-b	A -3	A -2-4	A -2-5	A -2-6	A -2-7	A -4	A -5	A -6	A -7-5	A -7-6
Sieve analysis: % passing												
No 10 (2,00mm)	50 max.											
No 40 (0,425mm)	30 max.	50 max.	51 min.									
No 200 (0,075mm)	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.	
Characteristics of fraction passing through the No. 40 (0,425mm) sieve												
Liquid Limit				40 max.	41 min.	40 max.	41 min.	40 min.	41 min.	40 max.	41 min.	
Plasticity Index	6 max.		NP	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min. †	
Group index‡	0		0	0	4 max.			8 max.	12 max.	16 max.	20 max.	
Usual types of significant constituent materials	Stone fragments, gravel and sand		Fine Sand	Silty or Clayey Gravel and Sand				Silty Soils			Clayey Soils	
General rating as subgrade	Excellent to Good							Fair to Poor				

* : Classification procedure: If test data are available, read the above table from the left to the right-hand side and find the proper group using the "rejection" method. The first group on the left-hand side to which the test fits is the correct one in the classification.

† : Plasticity index of A-7-5 sub-group is equal to or less than LL minus 30. Plasticity index of A-7-6 sub-group is greater than LL minus 30.

‡ : As regards the classification method, see the type of group classification.

4.4.4 Earth materials for the Construction of Road Pavement Subgrade Layer

Earth materials for the road pavement subgrade layer, as regards their suitability, are classified in 5 categories (E0, E1, E2, E3 and E4) presented in Table 2. These categories do not concern rocky materials.

The road pavement subgrade layer shall be constructed using select materials from categories E3 and E4.

The thickness of the road pavement is specified in the Design depending on the exerted loads and the type and properties of the material to be used for the subgrade layer.

Table 2- Categories of Soil Earth Materials for the Road Pavement Subgrade Layer

S/N	Category of Earthy Materials	Characteristics of Materials	ATTERBERG Limits	Maximum Compactness as per Amended Compactness Test KN/m^3	CBR[(1)]	Organics %	Suitable for Use in Embankments - Notes
1	2	3	4	5	6	7	8
1	E4	Max grain <80mm Passing through sieves (per ISO 565) of 0.063mm mesh - <25%	LL < 30 and PI < 10		>20 and zero swelling [(2)]	0%	Select II
2	E3	Max grain < 80mm Passing through sieves (per ISO 565) of 0.063mm mesh - <25%	LL < 30 and PI < 10		>10 and zero swelling [(2)]	0%	Select I
3	E2	Max grain < 100mm Passing through sieves (per ISO 565) of 0.063mm mesh - <35%	LL < 40	> 19.40	>5 and swelling <2% [(2)]	<1%	Suitable
4	E1	Earth material with max. grain dimension D<150mm Content in grains 150>D>100mm up to 25%	LL < 40 Or LL<65 and PI<(0.6xLL-9)	> 16.00	>3 and swelling <3% [(2)]	<3%	Acceptable
5	E0	Soil material not belonging to the other categories					Unsuitable, if there is no design for its improvement for use

Where:
(1) CBR = Californian ratio of bearing capacity
(2) Per CBR test
(3) To be determined based on the "wet corrosion" method (AASHTO T 194)
LL = Liquid Limit (ELOT EN ISO 17892-12)
PI = Plasticity Index (ELOT EN ISO 17892-12)

Sieve of 0.063mm mesh, next to sieve No. 200, per AASHTO, of 0.074mm mesh.

NOTE: The CBR value is defined in accordance with E 105-86, Method 12 () on samples compacted up to 90% of the maximum density per the Modified Compaction Test (E 105-86 Method 11), at optimum moisture conditions and after a 4-day water impregnation. By exception, in case of naturally bonded soils and in case of works executed in a trench, in order to estimate the bearing capacity of the road pavement "subgrade layer", the CBR value shall be also determined by performing "on site" tests.

4.4.5 Materials for the construction of transition embankments

The materials for the construction of transition embankments shall be granular, made of natural or crushed sand gravels, with plasticity index PI≤4.

Appropriate are also materials category E4, whose characteristics are described in Table 2 herein.

4.5 Work Methodology

The construction of embankments includes, in numerical order, the following stages/processes:

1. Preparation of the surface where the embankment shall be founded.
2. Construction of a Trial Section.
3. Laying of embankment materials.
4. Compaction per layers.

The Construction Methodology must be in accordance with the provisions of the Design.

4.5.1 Preparation of the surface where earth embankments are founded

Before laying and compacting the embankment materials, unsuitable ground materials or horticultural soil will be cleaned, grubbed and removed (bushes, roots, root-earth, horticultural soil with a high percentage of organics etc.) down to the entire required depth (see Article 02226 of this document), and a part of the embankment foundation shall be constructed using suitable materials, in accordance with this Specification.

The materials described in the above paragraph 4.4.2 are considered to be unsuitable surface materials and must be removed before laying the embankment materials.

If the construction of an embankment directly on unstable, disturbed soil or over soft clay is absolutely necessary, measures shall be implemented to stabilize, improve or remove this material, in

accordance with the special geotechnical study. If rock is encountered down to 1.0m from the embankment foundation level, then the material above the rock may be removed and the embankment can be founded directly on the rock, always upon AM's relevant approval.

In general, laying of materials on rain-soaked soil or soil softened due to traffic circulation is forbidden. In these cases, according to AM's judgment, the material shall be either replaced, or re-compacted after limiting moisture percentage to achieve maximum compaction.

The embankment foundation surface shall be diligently compacted at a density equal to at least 90% of the maximum density achieved per modified compaction test ("Modified Proctor") (ELOT EN 13286-2 or equivalent).

If there is no special provision in the geotechnical study, this compaction shall extent down to at least 50cm, in two layers of 25cm each, after compaction.

4.5.2 Laying of embankment

4.5.2.1 Laying of earth embankments

The configuration and acceptance of the excavation bottom of C/Cs or of the surface where embankments are founded is followed by the configuration of the embankment layers using suitable materials, in line with the provisions of the respective chapters herein.

The layers shall be continuous, parallel to the top surface of the embankment, with a uniform thickness that would allow achievement of the required degree of compaction, by using the existing equipment.

No other layer shall be configured unless it has been verified that the subgrade layer complies with the compaction and stability requirements. If the subgrade layer has smoothened due to excessive moisture (e.g. due to water infiltration), it shall not be permitted to place the subsequent layer before raking up, abrasion and re-compaction of the surface.

The loose thickness of the layers depends on the type of the available materials and means of compaction; in case of earth materials, it shall be $\leq$30cm.

During the execution of works, the surface of the layers shall be level and shall have the necessary transverse inclination (at least 4%) to ensure water discharge without any risk of corrosion, or excessive

soaking of the "body" of the embankment (the structure shall be partly elevated, as to the cant of the crown of the embankment).

The Contractor must implement all necessary measures concerning the embankments and C/C areas under construction, in order to avoid the effect of storm water etc. Thus, it is necessary to configure proper and sufficient trenches and ditches for drainage purposes.

In case embankment is constructed around or on top of cast concrete, this work shall be carried out after removing the formwork and after structures have acquired the designed compressive strength, unless otherwise specified in calculations to be approved by AM. Particular attention must be paid to select the proper machinery without causing any damage to structures.

Backfilling around structures shall be carried out as follows:

- The backfilling material shall be placed by hand or by the use of light mechanical means around and on top of structures up to a coverage thickness of 30cm. It is not permitted to place backfilling materials directly on top of structures.
- In areas where backfilling works are executed and the foreseen Methodology is difficult to be implemented, the Contractor must propose the appropriate methods in the Backfilling Methodology.

4.5.2.2 Laying of materials in transition embankments

Transition embankments shall be constructed once the concrete of the Technical Project acquires the required strength.

Materials shall be placed per layers of loose thickness 15 to 30cm.

4.5.3 Compaction of embankments

4.5.3.1 General principles of embankment compaction

In order to achieve the optimum results during compaction of embankments, the following preconditions must be satisfied:

1. Compaction of the material in equally thick layers for homogenous final behavior of the embankment.

2. Proper granulometry of the material (systematic removal of large grains from the material to be used before compaction of the layer).

3. Selection of the appropriate compaction equipment as to the weight, width, the option to perform vibrations and determination,

based on this data, of the number of movements required for the foreseen compaction.

In order to specify the degree of compaction, the Modified Proctor compaction test shall apply.

The compaction of the surface where the embankment will be founded shall extend down to minimum 30cm (at least). Plant materials, unsuitable materials and materials not compacted to the desired limits, should be either removed or improved, as specified in the relevant Design. The surface of the embankment's foundation will be at the healthy soil's bearing layer.

In case of unstable soil, the method of foundation of the embankment at these locations shall be specified according to the Design.

The type of machinery to be used in view of achieving the required compaction degree depends on the category of the soil to be compacted. The number of movements depends on the type of the machinery, its capacity and the thickness of the layer to be compacted.

Various methods can be used for compaction, depending on the material. For sand and gravel, compaction can be performed via vibration, sprinkling or rolling. For moderately cohesive soils, air compressors or compressors with metal teeth (grid rollers) can be used. Clay compaction is difficult, especially when natural moisture is higher than optimum moisture (near Plasticity Index limit). Compressors with metal teeth give the best results, especially when the natural moisture level is slightly higher than the plasticity level. For natural sandy non-cohesive soils, compaction can be performed using a vibratory compactor.

Compaction shall commence parallel to the Project axis; in straight sections, inwards, while in curves (with cant), from the lowest to the highest level. Each time the road roller moves, its rear wheels must fully cover the trace of their previous movement.

At the last stage of compaction of the top layer, smooth wheel rollers (compactors) are required.

The materials (cohesive or not) shall be compacted based on the percentage of the moisture content which shall be slightly lower than the optimum one. For this reason, measures shall be implemented adjusted to the climatic conditions prevailing each time.

When the moisture content of the laid material is not the optimum one for compaction, sprinkling shall follow in such a way so as to ensure uniform moistening of the material (if the moisture level must

be increased), or when moisture must be reduced, this shall be achieved either by air-drying it or through mixing with dry soil materials or through chemical additives, such as Quicklime or Hydrated lime etc., further to AM's relevant approval.

Especially in case of non-cohesive soils, if materials are laid and compacted on a dry season or when temperature is high, the material of each layer shall be racked up and uniformly sprinkled before compaction until the optimum moisture content is achieved; this moisture content must be maintained throughout compaction process.

In case of cohesive soils, if the moisture content is excessive and higher than the optimum one, then it shall be reduced to reach the optimum level by racking up and airing by the use of special machinery.

In special cases and if approved by AM, moisture content can be reduced by adding the proper materials (e.g. Lime or Hydrated Lime).

In no case is it allowed to perform compaction works when the moisture content exceeds the optimum one. In view of the above, under continuous rainfall it is forbidden to execute compaction works.

Each layer shall be compacted at least to the specified minimum compaction degree and shall be constantly monitored during construction, at the Contractor's care and in the presence of AM's representatives. When the obtained results are not satisfactory due to rain, increased moisture content of the materials, frost or machinery failure etc., works will be interrupted.

4.5.3.2 General principles of compaction of transition embankments

As regards the degree of compaction of the transition embankment, the aforementioned general requirements for embankments are applicable, in general (paragraph 4.5.3.1).

In order to achieve the optimum results during compaction, the following preconditions must be satisfied:

1. Systematic compaction of the material in equally thick layers for uniform final behavior of the embankment.

2. Application of material subject to continuous granulometric grading.

3. Use of the appropriate compaction equipment.

In transition embankments, unless otherwise specified in the Design, a minimum dry bulk density shall be ensured, equal to at least 92% of the maximum density, reached during the Modified Proctor compaction test at the upper layers of the embankment and down to 1.00m.

Materials shall be compacted under conditions approximating the optimum moisture content. When the moisture content of the laid material significantly diverges from the optimum one, spraying shall be conducted ensuring uniform moistening of the material, or (on a per case basis) the material shall be dried through raking for better airing or through mixing with dry batches of the material.

In no case is it allowed to perform compaction when the moisture content exceeds the optimum one. Therefore, under heavy rainfall, no compaction works shall be executed in a transition embankment.

Compaction near the slopes of technical works shall be carefully executed using light compactors (e.g. vibrating plates) to protect the subject works, especially exterior insulating layers.

4.5.3.3 Compaction control methods

The compaction of the earthworks basin and of all embankment layers shall continue to reach a percentage of density at least equal to the percentages of the laboratory values (ELOT EN 13286-2 or equivalent) depending on the height of the embankment. For this reason, during the execution of works compaction checks shall be performed and their results shall specify the required number of movements depending on the material. Alternatively, it is suggested to widely use instruments to measure in-situ density using the method of radioisotopes (ASTM D 6938 or equivalent). During compaction checks, Proctor Density (laboratory tests) shall not be corrected, because it will have been effected during Proctor test in the laboratory. In these cases, calibration is required for the material used each time, which can be performed during the construction of the trial section.

Construction works will be interrupted every time non-satisfactory results are obtained, due to rain, moist materials, frost or problems in equipment operation.

In case of significant works and following communication and AM's concurrence, apart from the construction of trial sections, compaction will be checked based on the Plate Load Test (per DIN 18134 or equivalent). The soil strength is determined based on the deformation modulus (E), as per the following formula:

Where : $E = 1.5P\ R/S$ [in MN/m^2] (1)
P = pressure exerted during the test [in MN/m^2]

R = radius of the loaded circular plate [in m]
S = measured settlement of the plate [in m].

The test is performed in two loading cycles (loading, uploading, re-loading). The E_v deformation modulus values to be obtained during the second loading (re-loading) are characterized as E_{v2}. The diameter of loading slabs is usually Φ 30cm. In soils of high bearing capacity, it is recommended to use plates with Φ 60cm diameter. Φ 60cm loading plates are also suitable for soft cohesive soils to reduce side-loss of soil materials during test, a fact that alters the test results.

The ratio of the second loading value to the first loading value E_{v2}:E_{v1} (re-loading: loading) must not be >2.20.

The degree of compaction must be such that the following results are reached, as a minimum (Table 3), based on the Plate Load Method (average: at least two tests).

Table 3 – Minimum strength of compacted soil

Type of Soil	E_{v2} value in (MN/m^2)
For cohesive soils	30
For foundation layers made of cohesive soils	45
For non-cohesive soils	60
For foundation layers made of non-cohesive soils	120

In view of the above, E_{v2} deformation modulus is related to CBR (see prEN-ISO 22476-13) as follows (Table 4):

Table 4 – CBR - ground deformation modulus correlation

	Type of soil	Minimum value E_2, (MN/m^2) for			
		CBR≥20	CBR≥10	CBR≥5	CBR≥3
(1)	Cohesive Soils Passing through sieve opening 0.063mm, per ISO 565: percentage over 34%	45	35	25	18
(2)	Granular soils Passing through sieve opening 0.063mm, per ISO 565: percentage up to 34%	60	47	33	24

4.5.3.4 Requirements for compaction of earth embankments

Unless there is special reference in the Design, in general, embankments must ensure a minimum dry apparent density equal to at least 90% of the maximum density achieved during Modified Proctor compaction test.

Unless there is special reference in the Design, as regards the materials used for road pavement subgrade layers, a minimum dry apparent density equal to at least 95% of the maximum density achieved during the modified Proctor compaction test shall be ensured.

For embankments related to extremely significant roadworks, compaction shall be applied with minimum dry apparent density equal to at least 95% of the maximum density achieved during the modified Proctor compaction test.

Unless otherwise specified in the Design, transition embankments shall ensure a minimum dry apparent density equal to at least 92% of the maximum density achieved during the modified Proctor compaction test at the top layers of the embankment down to 1m as a maximum.

4.5.4 Special requirements for the construction of embankments

4.5.4.1 Climatic restrictions as regards the construction

AM has the option to temporarily prohibit the execution of works if it deems that weather conditions are unfavourable and affect adversely the structure.

Earth embankments will not be constructed when the ambient temperature is below $2^{o}C$ or under rainfall, due to risk of deformation, fermentation and disorganization.

4.5.4.2 Vehicular traffic on the earth embankment under construction

Vehicular circulation is forbidden on the embankment layers under construction until completion of their compaction. If this cannot be avoided, traffic circulation shall be scheduled in such a manner so as not to disorganize the embankment mass and not to create wheel grooves.

4.5.4.3 Determination of the maximum value of permissible settlements

The Geotechnical Design for embankments reviews the foundation and construction conditions of the embankment (e.g. subsoil bearing

capacity control, direct settlements during construction and long-term settlements in cohesive layers, liquidation control in seismic stimulation etc.). The anticipated and permissible settlements, per check case and technical project case, as well as their evolution, as a function of time, shall be taken into consideration, especially in cases of high embankments and significant technical works and, based on the above, proper measures shall be implemented in view of improving the foundation conditions, the conditions for expediting settlements (etc. improvement, preloading, loading, drainage, soil replacement etc.).

4.5.5 Requirements for elevation accuracy of embankment layers

4.5.5.1 General – Earthworks level tolerances

The final surface of all layers for the construction of the embankment shall be configured in accordance with the longitudinal sloping and cants foreseen by the Design with elevation tolerances ±3cm.

Any surface abnormalities exceeding the aforementioned limits shall be reinstated by raking up, addition or removal of material and re-construction and compaction.

If the top surface at the level of earthworks remains exposed to weather conditions for a significant time period, especially during winter, it shall be checked before resuming the construction of the overlaying layers and the top layer of the existing embankment shall be either re-compacted, or re-constructed at a minimum thickness of 0.25m (or equally to the thickness of the top layer) and, subsequently, the construction of the overlaying layers shall be completed.

4.5.5.2 Subsidence of embankments and backfills - Configuration of areas

The dimensions, inclinations and elevations of embankments presented on the Design drawings refer to the completed construction of works, i.e. after completion of the anticipated subsidence of the embankment – backfill material for the configuration of areas, as well as the settlements of their foundation soil deriving from the superstructure load.

The Contractor is obliged to increase, either once or through gradual additions, the height of the crown as much as required to counterweight any type of subsidence, so that the final level of backfills be in accordance with the Design.

5.1 Controls

5.1.1 Scope and type of controls

These are on-site and laboratory controls.

The purpose of laboratory controls is to identify:

- The suitability of materials used for the construction of embankments
- The individual granulometric grading and properties of the appropriate materials, depending on the section and the level of the embankment layer, to be used.
- The maximum apparent density of the embankment materials after their compaction, with the optimum moisture content during compaction.

The results of the controls will be compared as to the requirements of this document.

5.1.2 Extent of controls

During construction and every 1000m^3 of laid material, laboratory controls shall be performed to confirm the quality and suitability of the backfilling material. If the volume of the material required for backfilling individual sections of the Project is less than 1000m^3, at least one series of laboratory controls shall be carried out. If required, the number of controls can change, with AM's concurrence.

If the embankment is based on natural soil, after having cleaned and compacted the foundation surface, at least one (1) compaction control shall be carried out every 100m^2 of surface. If required, the number of controls can change, with AM's concurrence.

Following the laying and compaction of each embankment layer and/or the transition embankment, the Contractor shall perform controls to identify the degree of compaction and the on site moisture, according to the appropriate methods, as specified in this article. These controls shall be performed per each layer and at least two (2) controls every 25m must certainly be performed for each compacted layer. If required, the number of controls can change, with AM's concurrence.

As regards the road pavement subgrade layer, the compaction control shall be performed per traffic lane, at a frequency of at least one control at a 50m-long section, in case of sand control method (E106 – 86/2 or equivalent), and at a 25m-long section, in case of using isotopes and radiation methods (ASTM D 6938-10 or equivalent).

In case of on site determination of the density using isotopes, devices must be calibrated for the specific materials on site the project, while at least one method every 10 successive measurements shall be executed based on the classic methods (sand method) to control calibration.

Sampling locations shall be uniformly distributed on the control surface, as per AM's judgement, while the compaction control shall include the entire thickness of the layer under examination.

If required, the soil strength parameters can be also specified through plate loading test. In this case, plate loading tests shall be executed at two adjacent locations.

5.2 Special controls of earthworks

5.2.1 Embankment control

Upon commencement of earthworks, the compaction reached by the Contractor based on the work method that he selected (equipment, compaction machinery, number of movements of road rollers, thickness of layers etc.) shall be verified on the appropriate applied ground materials.

If it is identified that the degree of compaction is smaller than the required one, the Contractor should change his work method in order to reach the compaction values foreseen by the Design and the current Specification.

Particular attention is required during compaction control if the soil type alters, if weather is wet, or if there are deviations from the specified work method.

5.2.2 Control of foundation layer

The distance between the various control locations depends on the local conditions. If irregular conditions are met, controls shall be performed every 50m as a maximum, if sand method is applied (E106-86/2 or equivalent), and every 25m if isotopes and radiation methods are used (ASTM D 6938-10 or equivalent).

If acceptance rules of clause 3 of this paragraph are not met, controls become more frequent (every 25m or 12m, respectively) to identify with precision the area with reduced density and to implement the necessary corrective measures.

5.2.3 Evaluation of control results

The dry density values of the in situ compacted material specified either based on the sand method (E106-86/2), or on isotopes and radiation methods (ASTM D 6938/10), expressed as compaction degree, i.e. as percentage (%) of the maximum laboratory density per the modified Proctor test, should meet the following acceptance criteria:

- Individual values

No individual value (X_i) shall be smaller than the percentage (X_π), reduced by three percentage units for cohesive soils and by five percentage units for non-cohesive soils.

Cohesive soils	: $X_i > X_\pi - 3$	i=1,2,3…5
Non-cohesive granular soils	: $X_i > X_\pi - 5$	i=1,2,3…5

- Average values

The average of five successive almost similar values (X_5) shall not be less than the percentage (X_π).

$$X_5 > X_\pi$$

If one of the above two acceptance criteria is not met, then the Contractor should introduce without any further delay the appropriate measures to reach the required compaction degree, with additional compaction, removal of very wet soils, moistening of very dry soils, reconstruction of the embankment, correction of the granulometric soil grading etc. throughout the section which is represented by the aforementioned tests.

5.3 Recording of control results

The control locations shall be noted on horizontal layout drawings of the earthwork.

The control and test results shall be recorded on special forms. These forms should record all data related to these controls (e.g. sampling location, number of layer, test results etc.).

The execution of controls must be recorded in the Project Log.

Control results shall be recorded in the Quality Project Log.

All controls (laboratory and on site) shall be recorded chronologically on a Control Record (in printed and electronic format). The printed format shall be signed by the Person responsible of the Laboratory and the Person responsible for Quality Control on the part of the Contractor.

6. Submittals

6.1 Material Submittal Sheets (MSS)

Prior to the commencement of any backfilling works, the Contractor should have submitted for approval to AM the Material Submittal Sheets (MSS) for embankment materials. No embankment work can commence prior to the approval by AM of the MSS for embankment materials.

The MSSs shall include all necessary controls to be executed in order to classify materials in the categories of Tables 1 and 2 of this article, for all embankment materials proposed to be incorporated in the works. Clear reference shall be also made to their origin, i.e. if they are materials deriving from Project excavation spoil, or borrow materials.

If crushed quarry material is used, the respective MSS must include the operation permit of this quarry or an equivalent legalizing document.

6.2 Backfilling Methodology

Prior to the commencement of any backfilling works, the Contractor should submit for approval to AM the Backfilling Methodology. No backfilling work can commence prior to AM's approval of this submittal.

The Backfilling Methodology shall indicatively include all data on the methods and equipment to be used, the approved embankment materials, the controls to be effected and, in general, the quality control plan, as well as the risk analysis along with the document including the measures to be implemented to minimize risks.

The Methodology must stress eventual cases of backfilling works in the Project, which require special attention, as well as cases where the described Methodology cannot be implemented (e.g. backfilling underneath struts) and relevant methods of addressing the above are proposed.

Moreover, clear reference must be made to the origin of the embankment materials to be approved, either Project excavation spoil, or borrow materials.

Finally, in case the construction of the Trial Embankment has preceded, the Backfilling Methodology should include the relevant results and conclusions.

02229 CONSTRUCTION OF TRACK BEARING LAYERS

1. SCOPE

This specification deals with the works for the construction of the track bearing layers and, in particular, the layers beneath the ballast or the trackbed concrete. This specification is based on the following documents:

- ETEP 02-07-01-00: Construction of embankments with suitable excavation or borrow materials
- UIC CODE 719 R Earthworks and track bed for railway lines (3rd edition, February 2008)

In addition, this specification describes the necessary quality control tests in order to verify the required physical and mechanical properties of the trackwork foundation layers.

2. NORMATIVE REFERENCES

Applicable area the stipulations in paragraph 4.2, article 02227 of this document.

The following documents are also applicable:

- ASTM D4253 – 16, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
- ASTM D4254 – 16, Standard Test Methods for Maximum Index Density and Unit Weight of Soils and Calculation of Relative Density
- ΕΛΟΤ EN 1097.01 E2, Aggregates mechanical and physical properties test – Part 1: Abrasion test (micro – Deval)
- ΕΛΟΤ EN 13250 E3, Geotextiles and geotextile-related products - Characteristics required for use in the construction of railways

3. TERMS AND DEFINITIONS

The following terms and definitions are used in this specification.

3.1 Trackwork

This is the main bearing infrastructure, which receives and distributes the loads exerted by the trains to the layers below; this infrastructure is renewed in certain fixed time intervals. The term "trackwork" comprises the rails, sleepers, rail fastening system and the trackbed, which can be either ballast or concrete (fixed track).

3.2 Blanket

Blanket is the layer immediately below the trackwork, which serves several functions (improvement of the bearing capacity, contribution in

the improved dynamic behaviour, acting as a filter between ballast and subgrade, surface water drainage, etc.).

3.3 Subgrade

This is the layer immediately below the blanket layer.

3.4 Foundation surface

This is the surface that serves as the subgrade foundation. Depending on the case, this can be the surface of the excavated natural soil, or the top surface of a properly compacted embankment.

3.5 Geotextile for railway projects

Depending on the classification of the earth material and in order to improve segregation of aggregates and filtering, the designer may propose the installation of geotextile per ELOT EN 13250, which is placed between the Blanket and Subgrade layers.

4 REQUIREMENTS FOR PROPER MATERIALS

4.1 Procurement and transportation of proper materials

When performing any type of excavation, the Contractor shall take measures to ensure that all appropriate excavation material can be used in the formation of the track bearing layers. This appropriate excavation material shall be deposited at temporary dumping sites, to be later transported to designated sites (see ELOT TS 1501-02-05-00-00).

In case these materials are unsuitable or insufficient, or it is not possible to coordinate the excavation/embankment works with the works of approved time schedule of the Project, the appropriate material shall be borrowed from inert quarries, as approved by ATTIKO METRO S.A. If the appropriate excavation materials cannot be utilized for reasons attributed to the Contractor, then the Contractor is obliged to provide at its own cost the required quantities of materials.

4.2 Materials

As regards the earth materials' suitability to be used in the formation of the track bearing layers, they are classified on the basis, a) of their geotechnical properties, and b) the local hydrogeological and hydrological conditions into the following categories (see also table 1):

- QS0 "Unsuitable" soils
- QS1 "Poor" soils or rock
- QS2 "Average" soils or rock
- QS3 "Good" soils or rock

The hydrogeological and hydrological conditions can be considered good if the uppermost layer of soil is not adversely affected by the

highest natural ground water. For the purpose of constructing the subgrade of this Project, the above condition is considered to have been met if:

a) The distance between the Highest Ground Water Level and the sleeper seating surface is at least 1.60 m.

b) There is no harmful natural transverse, longitudinal or vertical water flow in the subgrade.

c) Rainwater is correctly drained from the subgrade, and the longitudinal or transverse drainage system is in proper working order.

If any of one of these three criteria is not satisfied, the hydrogeological and hydrological conditions must be considered to be poor

Table 1 – Soil material Classes

No.	GEOTECHNICAL PROPERTIES	Class of soil material / rock
0.1	Organic soils (organic content ≥30% κ.β.).	QS0
0.2	Soft soils containing more than 15% fines (sieve: ISO 565, mesh 0,063 mm), with a high moisture content therefore unsuitable for compaction.	QS0
0.3	Thixotropic soils (e.g. quick-clay).	QS0
0.4	Soils containing soluble material (e.g. rock salt or gypsum).	QS0
0.5	Contaminated ground (e.g. industrial waste).	QS0
0.6	Mixed material / organic soils (organics content >5% and <30%).	QS0
0.7	High plasticity soils containing more than 15% fines (sieve: ISO 565, mesh 0,063 mm), swelling soils, collapsing soils	QS0
1.1	Soils containing more than 40% of fines (sieve: ISO 565, mesh 0,063 mm) (except for soils classified under 0.2 or 0.7)	QS1
1.2	Rocks which are very susceptible to weathering, e.g.: - Chalk with ρd < (1.7 t/m3) 106 pcf and high friability - Marl - Weathered shale).	QS1
1.3	Soils containing 15 to 40% of fines (sieve: ISO 565, mesh 0,063 mm) (except for soils classified under 0.2 or 0.7)	QS1*
1.4	Rocks which are moderately susceptible to weathering, e.g.: - Chalk with ρd < (1.7 t/m3) 106 pcf and low friability - unweathered shale.	QS1*
1.5	Soft Rocks, e.g. Microdeval wet(2) (MDE) > 40 and 1.6 Los Angeles(1) (LA) > 40.	QS1*
2.1	Soils containing from 5 to 15% of fines (sieve: ISO 565 mesh 0,063 mm) except for collapsing soils	QS2*
2.2	Uniform soil ($Cu^{(3)}$≤6) containing less than 5% of fines (sieve	QS2*

	ISO 565 mesh 0,063 mm).	
2.3	Moderately hard rock, e.g. if 25 < MDE ≤ 40 and 30 < LA < 40 .	QS2*
3.1	Well graded soils ($Cu^{(3)}$>6, 1<Cc<3) containing less than 5% of fines (sieve ISO 565 mesh 0,063 mm).	QS3
3.2	Hard rock, e.g.: if MDE ≤ 25 and LA ≤ 30 .	QS3

REMARKS

(1) ELOT EN 1097-02 E2 or equivalent.

(2) Microdeval (MDE) water content: ELOT EN 1097.01 E2 or equivalent.

(3)Cu: Uniformity Coefficient. Cu = d60/d10, where d60 and d10 the dimensions of the sieve mesh in mm, corresponding 60% and 10% passing particles percentages. Cc: Coefficient of curvature). Cc = the ratio $(D30)^2/(D10xD60)$, where D60, D30 and D10 stand for the particle sizes to which correspond the 60 %, 30 % and 10 % of the passing material shown in soil particle size curve.

(*) If the hydrogeological and hydrological conditions are classified as "good", these soils are classified into the immediately higher class (i.e., from QS1 to QS2, from QS2 to QS3).

In this project:

The blanket layer shall be formed using soil materials classified in class 3.1 of QS3. Exceptionally, if the hydrogeological and hydrological conditions are demonstrably "good", soil materials under classes 2.1 or 2.2 of QS2 can be used further to AM's approval. The thickness of the layer shall comply with the requirements of UIC 719R; in any case, this thickness shall be at least 30 cm, assuming CBR (min)= 10-17.

The subgrade layer shall be formed using soil materials classified in class 3.1 of QS3. Exceptionally, if the hydrogeological and hydrological conditions are demonstrably "good", soil materials under classes 2.1 or 2.2 of QS2 can be used further to AM's approval. The thickness of the subgrade layer shall comply with the requirements of UIC 719R; in any case, this thickness shall be at least 50 cm, assuming CBR (min)= 10-17.

If the subgrade placement surface is made of compacted embankment, the requirements set out in article 02227 of this document find application. As regards excavations of natural soil surfaces, the requirements set out in article 02226 of this document find application.

5 WORK EXECUTION METHOD

The construction of the trackwork bearing layers involves the following stages / processes in the order shown below:

1. Preparation of the subgrade "foundation" surface
2. Spreading the materials of the various layers

3. Compaction per layer.

The construction methodology shall be submitted by the Contractor to ATTIKO METRO S.A. for approval, in accordance with the provisions of paragraph 7.2 of this Article.

5.1 Preparation of the foundation surface

There shall a general excavation from the centerline level to standard excavation depth, according to the tramway corridor design, the typical cross-sections of the track alignment design and their application lengths.

When laying and compacting the materials of the various layers on natural soil, unsuitable ground materials or horticultural soil will be cleaned, grubbed and removed (bushes, roots, root-earth, horticultural soil with a high percentage of organics etc.) down to the entire required depth (see Article 02226 of this document). When the foundation surface is an embankment, its preparation shall take place using the materials and methodology described in article 02227 of this document.

In general, laying of materials on rain-soaked soil or soil softened due to traffic circulation is forbidden. In these cases, according to AM's judgment, the material shall be either replaced, or re-compacted after reducing moisture percentage to achieve maximum compaction

5.2 Laying of the blanket and subgrade layers

The configuration and acceptance of the foundation surface is followed by the configuration of the blanket and subgrade layers using suitable materials, in line with the provisions of the respective chapters herein.

The layers shall be continuous, parallel to the top surface, with a uniform thickness or as required in order to allow achievement of the required gradient and degree of compaction, throughout the entire thickness.

No other layer shall be configured unless it has been verified that the layer underneath complies with the compaction and stability requirements. If the layer underneath has smoothened due to excessive moisture (e.g. due to water infiltration), it shall not be permitted to place the subsequent layer before raking up, abrasion and re-compaction of the surface.

During the execution of works, the surface of the layers shall be level and shall have the necessary transverse inclination as per the Drainage Design, to ensure water discharge without any risk of corrosion, or excessive soaking of the layers.

In case the placement of the layers takes place around or on top of cast concrete, this work shall be carried out after removing the formwork and after structures have acquired the designed compressive strength. Unless otherwise specified by AM layers shall be placed on the basis of

the compressive strength calculations approved by AM. Special attention must be paid to select the proper machinery without causing damage to structures.

The layers shall be placed around structures as follows:

- The pertinent material shall be placed by hand or by using light mechanical means around and on top of structures up to a coverage thickness of 30cm. It is not permitted to spread materials directly on top of structures.
- In areas where the foreseen Methodology is difficult to be implemented, the Contractor must propose the appropriate methods in the relevant Construction Methodology.

5.3 Compaction

5.3.1 General Principles of Compaction

In order to achieve the optimum results during compaction, the following preconditions must be satisfied:

1. Compaction of the material in equally thick layers for homogenous final behavior.

2. Proper granulometry of the material (systematic removal of large grains from the material to be used before compaction of the layer).

3. Selection of the appropriate compaction equipment as to the weight, width, the option to perform vibrations and determination, based on this data, of the number of movements required for the foreseen compaction

In order to specify the degree of compaction, the Modified Proctor compaction test (ELOT EN 13286-2) shall BE applied.

The compaction of the surface where the embankment will be founded shall reach to minimum depth of 30cm. Plant materials, unsuitable materials and materials not compacted to the desired limits, should be either removed or improved. The surface of the embankment's foundation will be at the healthy soil's bearing layer

The type of machinery to be used in view of achieving the required compaction degree depends on the category of the soil to be compacted. The number of passes depends on the type of the machinery, its capacity and the thickness of the layer to be compacted.

Various methods can be used for compaction, depending on the material. For sand and gravel, compaction can be performed via vibration, sprinkling or rolling. For moderately cohesive soils, air compressors or compressors with metal teeth (grid rollers) can be used. Clay compaction is difficult, especially when natural moisture is

higher than optimum moisture (near Plasticity Index limit). Compressors with metal teeth give the best results, especially when the natural moisture level is slightly higher than the plasticity level. For natural sandy non-cohesive soils, compaction can be performed using a vibratory compactor or dynamic compaction.

Compaction shall commence parallel to the Project axis; in straight sections, inwards, while in curves (with cant), from the lowest to the highest level. At each run of the road roller, its rear wheels must fully overlap the trace of their previous movement.

At the last stage of compaction of the top layer, smooth wheel rollers (compactors) are required.

During compaction, the materials' moisture content shall be slightly lower than the optimum one. For this reason, measures shall be implemented, geared to the climatic conditions prevailing each time.

When the moisture content of the laid material is not the optimum one for compaction, sprinkling shall follow a way ensuring uniform moistening of the material (if the moisture level must be increased), or when moisture must be reduced, this shall be achieved either by air-drying or by mixing the material with dry soil material or by means of chemical additives, such as Quicklime or Hydrated lime etc., further to AM's relevant approval.

Especially in case of non-cohesive soils, if materials are laid and compacted during the dry season or when temperature is high, the material of each layer shall be racked up and uniformly sprinkled before compaction until the optimum moisture content is achieved; this moisture content must be maintained throughout compaction process.

In case of cohesive soils, if the moisture content is excessive and higher than the optimum one, then it shall be reduced to reach the optimum level by racking up and airing using special machinery.

In special cases and if so approved by AM, moisture content can be reduced by adding the proper materials (e.g. Lime or Hydrated Lime).

Compaction under conditions of excessive moisture is absolutely ruled out. Therefore, no compaction shall take place during constant rainfall.

Each layer shall be compacted at least to the specified minimum compaction degree and shall be constantly monitored during construction, at the Contractor's care and in the presence of AM's representatives. Whenever the obtained results are not satisfactory due to rain, increased moisture content of the materials, frost or machinery failure etc., compaction works shall be discontinued.

5.3.2 Compaction control methods

Compaction of all layers shall continue to achieve density values at least equal to the laboratory values (ELOT EN 13286-2) depending on the thickness of the layer. For this reason, compaction shall be controlled during the execution of works; the results of these controls shall specify the required number of passes depending on the material. Alternatively, it is suggested to widely use the radioisotopes method to measure in-situ density (ASTM D 6938 or equivalent). During compaction control, the Modified Proctor method shall be utilized (ELOT EN 13286-2).

Construction works shall be discontinued whenever non-satisfactory results are obtained, due to rain, high moisture content of the materials, frost or problems in equipment operation

Compaction shall be tested using the Plate Load Test method (per DIN 18134 or equivalent). The soil strength is determined based on the deformation modulus (Ev), as per the following formula:

$$E_v = 1{,}5P \cdot R/S \text{ [in MN/m}^2\text{]} \quad (1)$$

Where: P= pressure exerted during the test [in MN/m^2]

R= radius of the loaded circular plate [in m]

S= measured settlement of the plate [in m].

The test is executed in two loading cycles (loading, unloading, re-loading). The E_v deformation modulus values to be obtained during the second loading (re-loading) are designated as E_{v2}. The diameter of loading plates is usually Φ 30cm. In soils with anticipated high bearing capacity, it is recommended to use Φ 60cm plates. Φ 60cm loading plates are also suitable for soft cohesive soils to reduce side-loss of soil materials during test, a fact that alters the test results.

The ratio of the second loading value to the first loading value E_{v2}:E_{v1} (re-loading: loading) must not be >2.20

It is stressed that the dynamic plate loading method is on accepted in this Project by AM.

5.3.3 Requirements related to the compaction of Subgrade soil material

The subgrade soil material shall be compacted in dry apparent density equal to at least 95% of the maximum density, achieved using the Modified Proctor method (ELOT EN 13286-2).

The Ev2 deformation modulus during the second loading of the loaded plate static test (as per DIN 18134 or equivalent) in these cases shall be equal to 60 MN/m2, permitting thus the spreading of the blanket layer.

5.3.4 Requirements related to the compaction of the Blanket layer

The blanket layer shall be compacted in dry apparent density equal to at least 100% of the maximum density, achieved using the Modified Proctor method (ELOT EN 13286-2).

The Ev2 deformation modulus during the second loading of the loaded plate static test (as per DIN 18134 or equivalent) in these cases shall be equal to 120 MN/m2, permitting thus the spreading of the blanket layer, permitting thus the construction of the trackwork.

5.4 Special requirements for the construction of trackwork foundation layers

5.4.1 Climatic restrictions as regards the construction

AM has the option to temporarily prohibit the execution of works if it deems that weather conditions are unfavourable and adversely affect the construction works.

Construction works shall not take place when the ambient temperature is below 2^{o}C or under rainfall, due to risk of deformation, fermentation and disorganization

5.4.2 Vehicle circulation

Vehicular circulation is forbidden on the layers under construction until completion of their compaction. If this cannot be avoided, traffic circulation shall be scheduled in such a manner so as not to disorganize the layers' mass and not to create wheel tracks.

5.5 Requirements for elevation accuracy of the layers

5.5.1 General

The final surface of all layers shall be configured in accordance with the longitudinal sloping and cants foreseen in the Drainage Design with elevation tolerances $\pm$30mm.

Any surface unevenness exceeding the aforementioned limit shall be reworked by raking up, addition or removal of material and re-construction and compaction.

If the top surface of any layer remains exposed to weather conditions for a long time period, especially during winter, it shall be checked before resuming the construction of the overlaying layers and it shall be either re-compacted, or re-constructed at a minimum thickness of 0.25m (or equally to the thickness of the top layer) and, subsequently, the construction of the overlaying layers shall be completed.

5.5.2 Subsidence of layers

The dimensions, sloping and elevation of the layers refer to completed construction works, i.e. after completion of the anticipated subsidence of the materials and their foundation soil induced by the superstructure's load.

The Contractor is obliged to increase, either once or through gradual additions, the height of the crown as much as required to offset any type of subsidence, so that the final level of the layers is in accordance with the stipulations in this specification.

5.5.3 Flatness of the Blanket and Subgrade Layers

Flatness shall be controlled by a means of the three-meter ruler, perpendicular to the track axis.

Controls shall be conducted as selected and uniformly distributed points of the surface.

The maximum permitted flatness deviation (emax) at the crown of the layers shall be ±20 mm.

6 CONTROLS AND ACCEPTANCE

External laboratories performing quality controls shall be accredited.

6.1 Controls

6.1.1 Scope and Type of Controls

These are on-site and laboratory controls.

The purpose of laboratory controls is to verify:

- The suitability of materials used for the construction the layers
- The individual granulometric grading and properties of the appropriate materials, depending on the section and the level of the layer to be used.
- The maximum apparent density of the materials after their compaction at the optimum moisture content during compaction.

The results of the controls will be compared to the requirements of this document.

6.1.2 Extend of controls

During construction of the tramway foundation layers, laboratory controls shall be performed to confirm the quality and suitability of the laid material. At least two series of laboratory controls shall be carried out on the blanket and subgrade layers. If required, the number of controls can change, with AM's concurrence

As regards and subgrade's foundation layer, this being either natural soil excavation surface, or the top surface of the embankment, at least

one (1) compaction control shall be carried out every 100m^2 of surface. If required, the number of controls can change, with AM's concurrence

After spreading and compaction of each layer, the Contractor shall carry out controls to determine the compaction degree and the local moisture content using the proper methods as set out in this document.

As regards the blanket and subgrade layers, compaction control shall be conducted at 6 locations uniformly distributed on the project's surface, using the sand method (E106-86/2 or equivalent) or the isotope method (ASTM D 6938-10 or equivalent)

In case of on site determination of the density using isotopes, devices must be calibrated for the specific materials on site the project, while at least one method every 10 successive measurements shall be executed based on the classic methods (sand method) to control calibration

Sampling locations shall be uniformly distributed on the control surface, as per AM's judgement, while the compaction control shall include the entire thickness of the layer under examination

Moreover, at each compaction control location, the soil strength parameters shall also be verified by determining the deformation modulus (Ev), by means of plate loading static test (to be conducted as per DIN 18134 or other equivalent).

7 SUBMITTALS

7.1 Material Submission Sheets (MSS)

Prior to the commencement of any works, the Contractor should have submitted for approval to AM the Material Submittal Sheets (MSS) for materials of the various tramway foundation layers. No work can commence prior to the approval by AM of the MSS for involved materials.

The MSSs shall include all necessary controls to be executed in order to classify materials in the categories of Table 1 of this article, for all materials proposed to be incorporated in the works. Clear reference shall be also made to their origin, i.e. if they are materials deriving from Project excavation spoil, or borrow materials.

If crushed quarry material is used, the respective MSS must include the CE marking.

7.2 Construction methodology

Prior to the commencement of any works, the Contractor should submit for approval to AM the pertinent Construction Methodology. No work can commence prior to AM's approval of this submittal.

The Construction Methodology shall include, not limited to them, all data on the methods and equipment to be used, the approved materials, the controls to be carried out and, in general, the quality control plan.

The Methodology must highlight eventual cases of works in the Project, which require special attention, as well as cases where the described Methodology cannot be implemented, proposing relevant methods of addressing these cases.

Moreover, clear reference must be made to the origin of the materials to be approved, either Project excavation spoil, or borrow materials

02230 ROADWORKS

The applicable National (Greek) Technical Specifications (ETEP) for Roadworks are presented in the following table:

ETEP Code	ETEP Title
ELOT TS 1501-05-03-02-01	Road pavement subgrade layers and embankment bedding layers with lime stabilized soil
ELOT TS 1501-05-03-02-02	Road pavement subgrade layers with cement stabilized soil and cement bounded granular materials
ELOT TS 1501-05-03-05-01	Road pavement layers with cement bounded aggregates
ELOT TS 1501-05-03-07-00	Roller compacted concrete pavement
ELOT TS 1501-05-03-08-00	Road shoulders with horticultural soil and aggregates mixture
ELOT TS 1501-05-03-11-01	Asphalt pre-coating
ELOT TS 1501-05-03-12-04	Skid resistant asphalt slurry wearing course
ELOT TS 1501-05-03-14-00	Milling of asphalt concrete pavements
ELOT TS 1501-05-03-17-00	Road pavement layers with cement bound recycled materials resulting from asphalt concrete and underlying layers milling
ELOT TS 1501-05-03-18-00	Asphalt emulsion coating for the protection of stabilized pavement layers
ELOT TS 1501-05-04-01-00	Removal of horizontal pavement markings
ELOT TS 1501-05-04-03-00	Retroflecting road studs
ELOT TS 1501-05-04-04-00	Road delineators
ELOT TS 1501-05-04-05-00	Removal and/or repositioning of traffic signs and webs
ELOT TS 1501-05-05-05-00	Expropriation zone markers
ELOT TS 1501-05-05-06-00	Permanent road fences
ELOT TP 1501-05-02-01-00	Curbs, gutters and roadside concrete lined drainage ditches

Specification for ETEP)

ELOT TP 1501-05-02-02-00	Paving slabs and cobblestones for pedestrian areas
ELOT TP 1501-05-02-04-00	Road sound barriers
ELOT TP 1501-05-03-01-00	Construction of road sub-bases using non-cohesive aggregates
ELOT TP 1501-05-03-03-00	Road pavement layers with unbound aggregates
ELOT TP 1501-05-03-11-04	Hot mixed dense graded asphalt concrete layers
ELOT TP 1501-05-03-12-01	Skid resistant asphalt concrete wearing course
ELOT TP 1501-05-03-16-00	Full depth road pavement reclamation with cold in-situ recycling and addition of foamed asphalt (CIR)
ELOT TP 1501-05-04-07-00	Traffic signs mounting and support systems
ELOT TP 1501-05-07-01-00	Infrastructure for road lighting
ELOT TP 1501-05-07-02-00	Road lighting columns and fixtures

Moreover, for issues concerning the horizontal and vertical road and safety barriers signage, applicable shall be the respective Road Design Guidelines Manual (OMOE).

02900 SPECIFICATION FOR GREEN

1 PLANT MATERIAL

1.1 Planting of trees, shrubs, perennial plants

A. Greek Technical Specifications (GTS)

The following current GTS are applicable:

10-05-01-00: Planting of trees – shrubs

10-05-07-00: Planting of perennial, annual and bulbous plants

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specifications.

The following paragraph is added:

Planting soil

A layer of planting soil shall be added. The surface on to which this soil shall be laid must be cleaned and the surface soil must be removed to a depth of 5cm, while all useless material shall be removed (stones, litter, planting remains etc.). The surface shall be cultivated with the appropriate machinery in order to form the final surface. This surface shall receive a 35cm thick layer of planting soil, with the exception of the locations where shrubs or trees shall be planted with a bale higher than 35cm; these locations shall receive a layer of planting soil which shall cover the bale by 5cm. The planting soil must be fertile, collected from surfaces down to a depth of 50cm, brittle, of sandy-clay composition. It shall be organically active, with an organic content higher than 2% and pH value nearing the neutral point (6-7), sand content at least 55%, free of $CaCo_3$, or with a content less than 15%. The soil shall be sieved, free of clots, weeds, root remnants, gravel larger than 5cm and other foreign or toxic materials harmful to the development of the plants.

1.2 Planting materials supply and handling

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

10-09-01-00: Planting materials supply and handling

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specifications.

The following paragraph is added:

Species to be planted:

The following species of trees, shrubs and perennial plants shall be selected for planting out of those referred to in the above GTS.

1.2.1 Trees

Acacia floribunda	Ακακία πολυανθής	Δ4
Acacia saligna (cyanophylla)	Ακακία κυανόφυλη	Δ3
Acer negundo	Σφένδαμος	Δ5
Albitzia julibrissin	Ακακία Κωνσταντινουπόλεως	Δ9
Ceratonia siliqua	Χαρουπιά	Δ4
Cercis siliquastrum	Κουτσουπιά	Δ6
Citrus aurantium	Νεραντζιά	Δ3
Cypressus sempervirens	Κυπαρίσσι	Δ5
Cupressocyparis leylandii	Κυπαρίσσι leylandii	Δ4
Ficus australis	Φίκος	Δ5
Magnolia grandiflora	Μαγνόλια μεγανθής	Δ9
Melia azedarach	Ψευδομελιά	Δ5
Morus alba	Μουριά	Δ5
Paulownia tomentosa	Παυλόβνια	Δ5
Pinus pinea	Κουκουναριά	Δ5
Platanus orientalis	Πλάτανος	Δ7
Prunus pisardii	Προύνος	Δ3
Punica granatum	Ροδιά	Δ2
Quercus ilex	Αριά	Δ5
Schinus molle	Ψευδοπιπεριά	Δ4
Ulmus campestris	Φτελιά	Δ5
Washingtonia	Ουασιγκτόνια	Δ9

1.2.2 Shrubs and climbing shrubs

LATIN NAME	COMMON NAME	CAT.
Abelia x grandiflora	Αβέλια	Θ5
Arbutus unedo	Κουμαριά	Θ4
Berberis thunbergii	Βερβερίδα	Θ3
Bougainvillea glabra	Μπουκαμβίλια	Α4
Buxus sempervirens	Πυξός	Θ3
Callistemon spp.	Καλλιστήμονας	Θ6
Cassia floribunda	Κάσσια	Θ4
Ceanothus sp.	Κεάνωθος	Θ4
Choisia ternata	Χοισύα	Θ2
Cotinus coggurgia	Χρυσόξυλο	Θ3
Cotoneaster dammeri	Κυδωνίαστρο έρπων	Θ2
Cotoneaster Franchetii	Κυδωνίαστρο	Θ5
Cydonia japonica	Τσιντόνια	Θ3
Cytisus x praecox	Κύτισος	Θ4
Deutzia scadra	Δεύτζια	Θ3
Escallonia rubra	Εσκαλόνια	Θ5
Forsythia x intermedia	Φορσύθια	Θ3
Hibiscus sinensis	Ιβίσκος Σινικός	Θ5
Hibiscus syriacus	Ιβίσκος Συριακός	Θ3
Ilex aquifolium	Ίλεξ	Θ5
Jusminum grandiflorum	Γιασεμί Χιώτικο	Α4
Jusminum mesnyi	Γιασεμί κίτρινο	Α4
Jusminum nundiflorum	Γιασεμί γυμναθές	Α4
Lagerstroemia indica	Λαγκεστρέμια	Θ3
Lantana camara	Λαντάνα	Θ2
Lantana camara nana	Λαντάνα νάνα	Θ2
Lantana montevidensis	Λαντάνα έρπουσα	Θ2
Laurus nobilis	Δάφνη Απόλλωνα	Θ5
Myrtus communis	Μυρτιά	Θ4
Nandina domestica	Ναντίνα	Θ3
Nerium oleander	Πικροδάφνη	Θ3
Philadelphus coronarius	Φιλάδελφος	Θ1
Photinia x fraseri	Φωτίνια	Θ4
Pistacia lentiscus	Σχίνος	Θ3
Pittosporum heterophyllum	Αγγελική μικρόφυλη	Θ5
Pittosporum tobira Wheelers Dwarf	Αγγελική νάνα	Θ4
Plumbago capensis	Πλουμπάγκο	Α2
Polygonum baldschuanicum	Πολυγόνι	Α2
Prunus laurocerasus	Δαφνοκέρασος	Θ6
Quercus coccifera	Πουρνάρι	Θ3
Rhamnus alaternus	Ράμνος	Θ3
Rhynchospermum jasminoides	Ρυγχόσπερμο	Θ2
Rosa sp.	Τριανταφυλλιά	Θ3

Rosmarinus officinalis	Δενδρολίβανο	Θ5
Rossa sp.	Τριανταφυλλιά αναρ.	Α5
Spartum junceum	Σπάρτο	Θ2
Spiraea sp.	Σπειραία	Θ2
Syrigna voulgaris	Πασχαλιά	Θ3
Teycrium fruticans	Τεύκριο	Θ2
Viburnun tinus	Βιβούρνο	Θ4
Vitex agnus-castus	Λυγαριά	Θ3
Weigela sp.	Βειγκέλια	Θ4

1.2.3 Herbaceous, perennial, aromatic plants and plants for ground coverage

LATIN NAME	COMMON NAME	CATEGORY
Acanthus molis	Άκανθος	Π2
Agapanthys umpelatus	Αγάπανθος	Π2
Ajuca reptans	Αγιούκα	Π2
Artemisia arborescens	Αρτεμισία	Π2
Cerastium	Σεράστιο	Π2
Cistus spp.	Κιστός	Θ2
Iris pumila	Ίριδα	Π2
Lavandula angustifolia	Λεβάντα	
Phlomis fruticosa	Φλόμος	Θ2
Rosmarinus officinalis prostratus	Δενδρολίβανο	Θ2
Salvia officinalis	Σάλβια	Π2
Salvia jasminoides	Σάλβια	Π2
Santolina chamaecyparissus	Λεβαντίνη	Π2
Senecio cineraria	Σενέκιο	Π2
Verbena	Βερμπένα	Π2
Veronica speciosa	Βερονίκη	Θ2
Juniperus horizontalis	Άρκευθος οριζοντ.	Θ2
Coronilla emeroides	Κορονίλα	Θ2
Cotoneaster horizontalis	Κυδωνίαστρο οριζ.	Θ2
Hypericum sp.	Υπερικό	Θ2

The following species cal also be selected in addition to the aforementioned ones:

Trees:

-**Jacaranda mimosaefolia (Γιακαράντα),** 90lt earth bale, 4 to 4.5m tall, trunk perimeter 20-25cm.

- **Koirleuteria paniculata (Κοϊρλεουτέρια),** 90lt earth bale, 4 to 4.5m tall, trunk perimeter 18-20cm.
- **Olea europea (Ελιά),** 90lt earth bale, 2.5 to 2.75m tall, trunk perimeter 20-25cm.
- **Sophora japonica (Σοφόρα),** 90lt earth bale, 4 to 4.50m tall, trunk perimeter 18-20cm.
- **Robinia pseudoacacia (Ψευδακακία),** at sizes as the Sophora japonica.
- **Sterculia acerifolia (Στερκούλα),** 50lt earth bale, 3 to 3.50m tall, trunk perimeter 14-16cm.

Perennial and ground coverage plants:

Achillea sp. (Αχιλλέα)
Agapanthus africanus (Αγάπανθος)
Armeria spp. (Αρμέρια)
Asfodelus fistulosus (Ασφόδελος)
Asfodelus microcarpus (Ασφόδελος)
Bupleurum fruticosum (Βούπλευρο),
Coridothymus capitatus (Θυμάρι)
Ceanothus griseus (Κεάνωθος έρπων)
Ebenus cretica (Έβενος)
Helichrysum italicum (Ελίχρυσος)
Pachysandra terminalis (Παχυσάνδρα)
Pennisetum alopecuroides (Πενισέτο)
Sedum "Herbstrfude" (Σέδο),
Thymbra spicata (Θυμάρι)
Veronica spicata (Βερονίκη),
at sizes identical or close to those of categories Θ2 and Π2, as described in the above GTS.

All plants to be planted shall be presented in detail (location, density, spacing) in the planting design.

1.3 USE OF FERTILIZERS AND SOIL IMPROVEMENT AGENTS

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

1501-10-06-03-00: Application of fertilizers

1.4 Tree supporting

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

1501-10-05-09-00: Tree supporting

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specifications.

The following paragraph is added:

Propping methods

The method described in paragraph 6.2 "*Propping with struts"* of the above specification finds application if there is sufficient space and this method is justified due to the tree size.

Otherwise, we apply the stipulations in paragraph 6.1.2.1 "Propping with two piles", or in paragraph 6.1.1 "Propping with one pile" in this order.

2. INSTALLATION OF LAWN CARPET

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

1501-10-05-02-02: Installation of lawn carpet – not in the case of small size sports installations.

3. IRRIGATION

3.1 Irrigation of plants

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

1501-10-06-02-01: Irrigation of plants

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specifications.

The following paragraph is added:

Spray-line irrigation

In order to irrigate trees, shrubs and other plants (not lawn carpets), the spray line irrigation system is used with an appropriate programmer, as it is described in paragraph 5.3 of the above GTS.

3.2 Irrigation of lawn carpet – Ground coverage plants

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

- ELOT TP 1501-10-06-02-01: Irrigation of lawn carpet – ground coverage plants – lawn carpets at slopes

B. Additional requirements

Irrigation system

Lawn carpets are irrigated with water sprinkler system, as described in paragraph 5.4 of the above GTS. Ground coverage plants and bulb plants are irrigated with drip irrigation pipes and programmer, as described in paragraph 5.3 of the above GTS.

3.3 Installation of irrigation networks

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

- ELOT TP 1501-10-08-01-00: Installation of irrigation networks

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specifications.

The following paragraph is added:

Programmer

A suitable electrical programmer shall be used as described in paragraph 5.10.3 of the above GTS.
Moreover, the manholes shall be made of concrete, as described in paragraph 6.11.2 of the above GTS.

4. TRANSPLANTATION OF PLANTED TREES

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

- ELOT TP 1501-10-05-08-00: Transplantation of planted trees – shrubs

5. TREE – SHRUB CUTTING-UNROOTING

A. Greek Technical Specifications (GTS)

The following current GTS is applicable:

- ELOT TP 1501-10-07-01-00: Tree – shrub cutting-unrooting

03110 FORMWORK - SCAFFOLDING FOR CAST IN SITU CONCRETE

1 GENERAL

1.1 Description of Work

1.1.1 The work described in this Article includes the provision of labor, supply of installations, materials and equipment for the performance of all works relating to the design and construction of formwork (commonly known as moulds) and scaffolds utilized for casting of fresh concrete in the form and with the dimensions foreseen by the design relating to the permanent and temporary structures of the Project. The term "formwork" concerns formwork, steelwork and/or moulds made of other material. The formwork/scaffolding systems also include all the necessary auxiliary material (e.g. bonds, bolts, safe working floors, guardrails for protection against falling, safe accesses, etc.).

Formwork and scaffolds to be used should serve the following purposes:

a. To give concrete its shape

b. To produce the required configuration and appearance of the surfaces

c. To support the structure until it is in a position to bear the loads required to sustain after the removal of the scaffolds

d. To reinforce parts of the structures so as to address on a temporary basis additional loads developed during the construction works.

1.2 Reference standards

- ELOT TP 1501-01-04-00-00: Concrete formwork
- ELOT TP 1501-01-05-00-00: Formation of final surfaces in cast concrete without use of mortars
- ELOT TP 1501-01-03-00-00: Scaffolding
- ELOT EN 13670: Execution of concrete structures
- ELOT EN 13377: Prefabricated timber formwork beams. Requirements, classification and assessment
- ELOT EN 13986: Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking
- ELOT EN 12810: Facade scaffolds made of prefabricated components
- ELOT EN 12811: Temporary works equipment

- ELOT EN 12812 False Work – Performance Requirements and General Design
- EN 12813 Temporary Works Equipment, Load Bearing Towers of Pre-fabricated Components. Particular Methods of Structural Design
- ELOT EN 74: Couplers, spigot pins and baseplates for use in falsework and scaffolds
- ELOT EN 1065: Adjustable telescopic steel props - Product specifications, design and assessment by calculation and tests.
- DIN 18218 Pressure of Fresh Concrete on vertical formwork
- Greek Concrete Technology Code GCTC- 2016-FEK 1561/B/02-06-2016.

1.3 Submittals

For every system of formwork-scaffolding, the Contractor shall submit to AM for approval a document to include a detailed description and drawings of the system, materials, equipment, assembly/erection phases, the technical characteristics as provided by the manufacturer with reference to the allowable application limits, the product's approvals granted by an accredited certification agency, as well as the checks to be carried out at each stage. The submission and approval times are determined in the General Specification GS0200 "Design Requirements".

2 PRODUCTS

2.1 Materials

2.1.1 The scaffolds and formwork are usually made of metal or timber (or its products) or a combination of them. If, in a certain case, the Contractor intends to use any other material, this will be proposed to ATTIKO METRO for approval.

Materials in contact with concrete shall be chemically compatible with it, so as not to alter its appearance or tolerance. The wooden surfaces of the moulds should not absorb the concrete's mixing water; thus, they should be well sprinkled or spread with an approved material before concreting.

All elements, accessories and construction materials of the scaffolds shall fulfill the requirements of the relevant Standards and national regulative stipulations. The use of materials and accessories whose characteristics are unknown and not certified is forbidden. The construction materials of the various elements shall be easily identifiable.

2.1.2 For the various Project structures, scaffolds and formwork which are standardized and constitute industrial products shall be used (e.g.

precast formwork of standardized sections, wall steel formwork, standardized towers). Standard products/ materials available by the manufacturer shall be EXCLUSIVELY used. The use (partial or in full) of worksite materials (e.g. wooden access ladders, floor planks, wood posts for guardrails etc.) which have not been approved by the manufacturer is prohibited. Apart from the present article requirements, the directions of the manufacturer or the provider shall always be applied.

In case of small or secondary structures of the Project that cannot be covered by the limits of the aforementioned standardized configurations of scaffolding, common formwork can be used. These constitute wooden elements (planks, balks, joists, artificial timber panels etc) that are cut and assembled on site and are supported on the worksite ground with wooden or metal elements (posts, towers, frames etc).

The documentation required to be submitted in any case by the Contractor is described above in par. 1.3.

3 EXECUTION

3.1 Design of scaffolds and formwork

3.1.1 For all the structures of the Project, it is required that the scaffolding and formwork are designed by a Civil Engineer and that this design is submitted by the Contractor for approval.

Only in cases of ordinary simple structures (e.g. retaining walls for the reinstatement of the surrounding area with a height in the order of one meter, steps on ground), it is not required to submit a design and the formwork configuration may be done by applying empirical rules, with the Contractor bearing always the responsibility.

3.1.2 The design shall include at least the following:

a) Technical report which shall include:

- Analytical description of the formwork structure and information about the assembly, the bearing, the use, the concreting method (if required), the disassembly, as well as information about accesses, safety measures etc.
- Description of the structural model
- Reference to the applicable codes and the specifications of the construction materials
- Analytical determination of the expected loads during the formwork function in the various construction phases and justification of the loads on the basis of which the formwork members are dimensioned

- Analytical structural calculations and complete dimensioning of the formwork members on the basis of the design loads.

b) Drawings that shall include:

- Complete drawings of the formwork/scaffolding, details and construction data.
- Guidelines for erection and assembly, removal and disassembly, as well as for the use of any special pieces and materials. These guidelines shall include instructions for safe erection/dismantling.
- Special requirements for used materials and parts (acceptable number of uses).

3.1.3 The formwork and scaffolding shall be designed and constructed so as to safely withstand the loads which may be exerted during construction.

More specifically, formwork and scaffolding shall be calculated so as to be able to safely bear:
a) the vertical loads of concrete, workers, equipment and possible materials accumulation,
b) lateral pressures from fresh concrete,
c) impact and dynamic laying of concrete and of other materials and tools,
d) vibrations from concrete compacting,
e) load of the slab above (possibly),
f) accidental actions (e.g. earthquake or wind) that may be exerted during the period when concrete has not yet acquired sufficient strength (these are taken by the scaffolding).

The surfaces of formwork must have the required stiffness and be supported in such way as deformations from the aforementioned loads remain within the allowable tolerances of the structure (this requirement refers to the system of formwork-scaffolding).

3.1.4 The formwork and scaffolding shall conform to the method and progress rate of concreting (e.g. with regard to walls higher than 3.00m, the casting rate must be adjusted to the strength of the formwork and vice-versa), the vibration method and the curing, as well as the thermal processing of concrete, if so foreseen.

3.1.5 Formwork supporting elements, which pass through the concrete, must not affect it in any way. Any reinforcement supports incorporated must not influence durability or appearance (e.g. rust marks or water infiltration).

3.2 Construction of Scaffolds and Formwork

3.2.1 All supports on the ground, scaffolds and formwork must be constructed by specialized staff to introduce all safety measures

against falling and in accordance with the drawings and the specifications. Special attention must be given to the arrangement of the connections so that structural stability, proper transfer of loads and resistance to buckling, overturning and lateral instability is ensured at each phase of construction.

3.2.2 The joints between planks or between formwork and already hardened concrete where required, must be sufficiently watertight to prevent leakage of the concrete fine grain materials.

3.2.3 Faces of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits and other defects. All formwork shall be clean and free from standing water, dirt, shavings, chippings and other foreign matter.

3.2.4 Before each concreting operation is commenced, formwork shall be carefully examined and cleaned out while concrete contact faces of the formwork shall be treated with a suitable colorless, non-staining release agent, which shall not affect the concrete's final appearance. Particular care shall be taken to ensure that the release agent is not applied when the reinforcement has already been installed on the formwork, so that it does not come into contact with the reinforcement.

3.2.5 Where ties are built into the concrete for the purpose of supporting formwork, the whole or part of any such supports shall be capable of removal so that no part remaining embedded in the concrete shall be nearer than 50 mm from the surface. Holes left after removal of such supports shall be neatly filled with the appropriate non shrinkable repair mortar.

The use of wired connectors or connectors made of other materials breaking into pieces when removed with their fragments remaining in the concrete mass is prohibited.

Connectors shall follow a uniform and symmetrical layout.

3.2.6 Inserts and integrated materials

These may be:

a) temporary, intended for holding formwork at its place (connectors, bars, etc.), which, after concrete setting, shall either be kept or removed
b) materials integrated in the concrete, such as anchoring slabs, anchors, spacers, light weight aggregates for the configuration of slabs with voids (zoellner or sandwiches) and
c) hydraulic piping, electrical conduits or other indoor installations.

These items should not alter the bearing capacity of the concrete, they should be properly fixed for avoiding displacement during concreting, properly installed so as to avoid introducing any unforeseen actions on the structure and made of materials not harmful for the concrete and the reinforcement, while they should not prevent concreting laying and compaction and be sufficient resistant, so as not to alter their shape during concreting.

3.2.7 Formwork shall have either a level surface or a surface of the specified curvature, so that after removal of the formwork, delivered surfaces be completely level or ribbed, as specified.

3.2.8 Special concreting methods and special concrete types may add special requirements for the formwork. In such a case, Contractor shall submit these special requirements to ATTIKO METRO for approval.

3.2.9 In case where pipes, ducts or other installations of any kind are to be incorporated in the concrete, these must be provided and secured with suitable configuration of the formwork and scaffolds, so as not to sustain any deformation whatsoever during concrete laying and compaction.

3.2.10 Inspection of formwork and scaffolds, with regard to all above, shall take place before and during concreting.

3.2.11 In all cases, it is required to submit the certificate of application of the scaffold/formwork design, as foreseen by the Law, signed by one of the Contractor's Civil Engineers and the respective entry in the Safety Measures Log kept in the worksite.

3.2.12 Formwork and scaffolding must be inspected at all times and phases (assembly, use under loading conditions, disassembly) for ensuring protection of the employees against falling.

3.3 Removal of scaffolds and formwork

3.3.1 Determination of the time for removal of the scaffolds and formwork, as well as for discontinuation of protection measures regarding curing of the concrete depends on the type of structure, weather and other conditions affecting hardening, and on the materials, etc. used.

3.3.2 Removal of formwork must be carried out in accordance with the phases provided for in the design, without impacts and with purely static forces, when the concrete has been sufficiently hardened so that the subject structural element is in a position to safely undertake all loads imposed upon it during removal of formwork.

3.3.3 Removal of scaffolds must be done taking into consideration the hardening time required for both the structure, which they support and the structure supporting them. Special attention must be given to the structural elements, which, right upon removal of the scaffolds, undertake almost the total of loads assumed in the design. In certain cases and for reasons of general stability, some of the scaffolds may be required to remain.

3.3.4 The time required for removal of formwork for several structural members shall be as defined by the technical requirements of the Greek Concrete Technology Standard 2016.

3.3.5 In case the Contractor wishes the time for the removal of formwork of one specific member to be shorter than the time specified by the Greek Concrete Technology Standard, the progress of the concrete hardening will be controlled through laboratory tests of hardening checks with specimens, which shall remain next to the Project and be maintained (project specimens), in line with the Greek Concrete Technology Standard. In this case the formwork and scaffolds can be removed as soon as the concrete acquires the required strength. The Contractor shall submit to AM for approval a Technical report of the designer, which shall identify the structural member for which the early removal is proposed, the time in which the formwork will be removed, the calculation of the required strength, so that the member sustain safely the foreseen loads, the number and the type of the hardening checks specimens and the evaluation manner of the test results.

3.4 Tolerances

3.6.1 Tolerances related to the layout and dimensions of structures (structural elements thickness, spacing, vertical axis deviation, etc.) shall comply with the requirements of ELOT EN 13670. The relevant checks shall be carried out both during formwork delivery before formwork laying and after demoulding. In case several tolerance values apply, the strictest one shall be used.

03211 REINFORCING STEEL

A. Greek Technical Specifications (ETEPs)

The applicable Greek Technical Specification (ETEP) 01-02-01-00 Steel reinforcement for concrete.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/356/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented herebelow per chapter of the aforementioned ETEP.

1. Scope

The following paragraphs are added:

A) The materials and the works described concern both temporary and permanent structures of the Project.

4. Requirements

4.1 Materials

The following paragraph is added:

Highly ductile steel of grade B500C shall be utilized.
Item (d) does not apply for grade B500A meshes.

4.2 Acceptance Tests

The following paragraph is added:

Submittals

The Contractor shall submit to ATTIKO METRO S.A. for approval a Method Statement including all data related to the methods used, the personnel and equipment to be employed, a risk assessment and note of the adequate safety measures proposed. At the same time, the Contractor shall submit to ATTIKO METRO S.A. for approval the Material Submittal Sheets (MSS) which shall include the conformance certificates of the materials used, the test results and all data referred to in detail in the different parts of this Article. The submittal and approval periods are set in Article GS0200 of the General Specification - Design Requirements of ATTIKO METRO S.A..

5. Execution of works

5.5 Protection of starter bars

The following paragraph is added:

Protection of reinforcement starters in case of long-term construction works.

If relevant provisions are made for long-term construction works above the project (e.g. future addition of a building developed in height), starter bars of the appropriate height shall be installed over the roof slab, so as to ensure the required length in parallel to the reinforcing bars of the future extension. In addition, at each column or wall, the required length of its reinforcing bars anchoring should be secured at the last level.

In view of providing an effective protection of the reinforcement starter bars against corrosion and mechanical wear, both during the operation of this structure as well as during their revealing process for the addition of the future floor, the following measures shall be introduced, namely:

- The starter bars of the reinforcement shall be thoroughly cleaned and shall be freed from any foreign material, rust, concrete, etc., and shall be coated with a suitable material (e.g. anti-corrosion paint with a special resin or another material suitable for this use). The protective coating must not affect the steel bound with the concrete of the columns of the addition;
- The execution of concreting work shall follow using a protective concrete of a smaller strength, only on a perimeter stripe of a minimum thickness of approximately 20 cm (through the installation of intumescent polysterine items at the central part of the columns) and coating the top part of the starter bars with 10 cm thick concrete approximately. This protective concrete shall be removed during the phase of addition.

03220 STEEL WIRE MESH

This Article applies to steel wire mesh used as concrete reinforcement.

A. Greek Technical Specifications (ETEPs)

The applicable Greek Technical Specification (ETEP) 01-02-01-00 "Steel reinforcement for concrete" is in force with regard to its part concerning structural mesh..

Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/356/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply for ETEP 01-02-01-00 "Concrete Steel Reinforcement.

In paragraph 4.2 of ETEP 01-02-01-00, the following paragraph is added:

Submittals:

The Contractor shall submit to ATTIKO METRO S.A. for approval the Method Statement, which shall include all the data related to the methods employed, his personnel, the equipment, the risk analysis and the appropriate safety measures proposed. In addition, he shall also submit the Material Submission Sheets presenting the conformance certificates of the materials used, the test results, as well as all data referred to in detail in the different chapters of the present Article. Submission and approval times are set in Article GS0200 Design Requirements of the General Specifications.

03310 CONCRETE

1 GENERAL

1.1 Description of work

The work described in this Article includes the provision of work force, materials, installations and equipment and the performance of every necessary work for the production, transportation, placing and curing of concrete in the structures, as specified by the applicable specifications and construction drawings or as required by the local conditions and the instructions of ATTIKO METRO S.A.

1.2 Reference Standards

- ELOT EN 197-1, Cement – Part 1: Mix, specifications and compliance criteria for common concrete
- ELOT EN 934-2, Admixtures – Definitions, requirements, compliance, marking and labelling
- ELOT EN 12620, Aggregates for Concrete
- EN 1008, Concrete mix water – Specification for sampling, control and evaluation of the water suitability
- EN 12350-1:– Fresh Concrete Tests – Part 1 – Sampling
- EN 12350-2:– Fresh Concrete Tests – Part 2 – Settlement Test
- Greek Concrete Technology Code 2016– FEK 1561/B/02.06.2016
- ELOT EN 12390.08: Testing hardened concrete - Part 8: Depth of penetration of water under pressure
- ELOT TP 1501-01-01-01-00 "Concrete production and transportation"
- ELOT TP 1501-01-01-02-00 "Concrete casting"
- ELOT TP 1501-01-01-03-00 "Concrete curing"

1.3 Submittals

1.3.1 The Contractor shall submit to ATTIKO METRO S.A. for approval a Method Statement detailing the methods and equipment to be employed, the checks to be carried out at each stage and a risk assessment and note of the measures to be employed to minimize risks. At the same time, the Contractor shall submit to ATTIKO METRO S.A. for approval the Material Submittal Sheets (MSS) which shall include all the data related to the materials proposed, the conformance certificates of the materials used, the concrete mix design, the test results and all data referred to in detail in the

different parts of this Article. The submittal and approval periods are set in the General Specification - Design Requirements.

1.3.2 The laboratories which will design and perform the concrete laboratory tests shall fulfill the requirements set out in the GTS 2016.

2 PRODUCTS

2.1 Materials

2.1.1 All the materials used and all the works of placing, compacting and curing, as well as sampling, conformity checks and quality control of concrete shall be in accordance with the applicable standards and codes. The materials used shall be harmonized with the requirements of Regulation (EU) 305/2011 (CE Marking) as required by the applicable provisions.

2.1.2 For the basic constituents of concrete the following specific requirements are given:

a. Cement

This shall comply with the requirements of ELOT EN 197-1. The minimum required initial cement content shall be in accordance with the GCTC. The cement type shall be the appropriate one for the specific concrete mix, depending on the type of the structure, the area and the relevant corrosiveness of the soil and/or ground water.

b. Aggregates

These shall be crushed as per ELOT EN 12620 and the maximum grain size shall be 32mm..

2.2 Classes of Concrete

2.2.1 The classes of concrete to be used shall comply with provisions of the Design Specifications for Civil Works, the Concrete Technology Code and shall be indicated on the construction drawings.

2.2.2 Depending on the aggressivity grade of the soil and groundwater, the concrete shall satisfy the GCTS requirements, table ΠΒ2-1 and ΠΒ2-2 , so as to ensure the technical flawlessness and its durability through time.

2.2.3 The concrete to be used in the Project shall be of the "Worksite Concrete" type, as per paragraph B6 of the Concrete Technology Code and the relevant amendments (Decision no. DNSc/23597/FN 429/19.05.2017 – FEK 1839/B'/25.05.2017).

3 EXECUTION

3.1 Concrete Production, Transportation and Casting

3.1.1 In case of concrete structures with large thickness, special or additional requirements must be provided by the Contractor in the Method Statement and approved by ATTIKO METRO S.A., prior to execution of the works, to cope with the excessive hydration heat and associated volume changes in order to minimize cracking.

3.2 Cast in Situ Joints

3.2.1 For construction joints the requirements of GCTC, paragraphs D2.1 and D2.2.

3.2.2 Contraction or expansion joints shall be provided only where indicated on the drawings. When waterstops are present, particular attention shall be paid during placing of the concrete to ensure no movement of the waterstops and to achieve full compaction of concrete around the waterstops with no voids or honeycombs.

3.3 In Situ Quality Control

3.3.1 In situ quality control shall be as defined in GCTC

3.3.2 The Contractor's responsible engineer shall inspect and check all concreting works, equipment, materials, reinforcement, embedded elements, curing, protection of finished surface and, in general, all works relating to the subject.

3.3.3 A Quality Control inspection record shall be issued and filed on site in the framework of the Project Quality Plan and the corresponding Construction Inspection Sheet.

03311 REPAIR-REINSTATEMENT OF CONCRETE SURFACES

1 GENERAL

1.1 Description of work

The work described in this Article includes the provision of man power, materials, installations, equipment and the performance of every necessary work for the repair of concrete surfaces, at project's locations where interventions are required for the repair of construction deficiencies on the surface or the concrete sections structure either in underground or on over-ground Project structures. The repair and reinstatement of non-reinforced concrete is also included.

1.2 Reference Standards

- ELOT EN 1504: Products and systems for the protection and repair of concrete structures
- Greek Concrete Technology Code (CTC2016) - FEK1561/B/02.06.2016
- New (Greek) Reinforcing Steel Technology Standard (RSTS-2008, FEK 1416/B/17.07.08 and FEK 2113/B/13.10.08)

1.3 Submittals

The Contractor shall submit to ATTIKO METRO for approval a Method Statement detailing the methods and equipment to be employed, the checks to be carried out at each stage and a risk assessment and a document of the measures to be employed to minimize risks. At the same time, the Contractor shall submit to AM for approval the Material Submittal Sheets (MSS) which shall include all data related to the materials proposed, the conformance certificates of the materials used and all data referred to in detail in the different sections of this article. The submittal and approval periods are set in the General Specification entitled "Design Requirements".

2 MATERIALS

All the materials used for the works pertaining to the repair of construction deficiencies on the surface or concrete sections structure will have to be proper for the specific application, compatible one to the other when combined and not to have an adverse impact on concrete and on the reinforcement. For each material, in the framework of the associated MSS, its technical leaflet shall be submitted with a description, characteristics of the product, declaration of conformity, range of application, mechanical/

physical properties and instructions concerning application, and a Material Safety Data Sheet (MSDS).

With regard to the strength of the repairing materials, it is noted that in case that non shrinkable repairing mortar is used, its compressive and tensile strength shall be at least 20% higher than the concrete strength, while in case epoxy resins are used, the compressive and tensile strength shall be at least 50% higher than the concrete strength.

3 EXECUTION

The main categories of concrete deficiencies requiring repair and restoration are described below, along with the manner of addressing them.

3.1 Holes for formwork or embedding items support

These are throughout holes that remain in the concrete after the removal of the longitudinal bars (rods), which keep the formworks/metalwork fixed during concreting.

The holes shall be cleaned from any concrete debris and dust via pressurized air or water (approximately 3 bars) and then they will be filled in on either side or on one side, depending on whether the section of the structure is inner or lies at the perimeter, using the appropriate, approved, non-shrinkable repairing mortar that will be injected into the hole. Similarly, the wide sections of their ends shall be sealed. The use and application method of each material shall be determined according to the manufacturers' instructions.

3.2 Blowholes on the surface

These are quite densely holes of great size (cavities more than 6mm), occupying a distinct area on a concrete surface that will not be coated or lined.

The surface of the concrete that will be repaired shall be sound and clean, free of any concrete debris, contamination and dust, which will be removed via pressurized water or air (approximately 3 bars). The cavities shall be sealed by the use of proper, approved, non-shrinkable repair mortar for repairs and finishes. The use and application method of each material shall be determined according to the manufacturers' instructions.

3.3 Honey-combed formations

These are concrete surfaces presenting locally honey-combed formations; the said surfaces are also rough. The extent of the

defect shall be investigated, in order to ascertain the depth of the honey-combed formation and to proceed with the repair of the entire damage and not only of the damage on the surface of the concrete which is probably the only visible one. An extensive reference to the extent and the repair of the damage is described in the following section "3.4 Local segregations (coarse-grained surfaces)".

3.4 Local segregations (coarse-grained surfaces)

These are areas of a concrete segment where gravels are locally accumulated and separated from the concrete cement mortar. The damage described in this paragraph can be divided in two categories.

i) CATEGORY "A"

This category addresses the following damage: the depth of local segregations (honey-combed formations referred to in the previous paragraph) in the concrete part of the structure is smaller than the thickness of the reinforcement cover.

The surface enclosing the coarse-grained surface (or the honey-combed formations) will be diligently removed or dismantled. The intervention shall go to such a depth to ensure that sound concrete is revealed without the reinforcement being visible. The surface of the concrete to be repaired will have to be sound and clean, free of any debris concrete, contamination and dust, cleaned via pressurized water or air (approximately 3 bars).

The surface shall be repaired by the use of proper, approved, non-shrinkable repair mortar. The use and application method of each material shall be determined according to the manufacturers' instructions.

ii) CATEGORY "B"

This category includes the following damage: the depth of local segregations (honey-combed formations referred to in the previous paragraph) in the concrete part of the structure is greater than the thickness of the reinforcement cover.

Similarly as above, the surface enclosing the coarse-grained surface (or the honey-combed formations) will be diligently removed or dismantled. The intervention shall go to such a depth to ensure that sound concrete is revealed taking all precautions so as not to harm the reinforcement. The surface of the concrete that will be repaired will have to be sound and clean, free of any debris concrete, contamination and dust, cleaned via pressurized water or air (approximately 3 bars). The exposed reinforcement shall be cleaned and free from any concrete debris, dust etc.; it shall also be

protected against corrosion, as required, through application of special corrosion resistant coating or materials included in the repairing mortar.
In case damaged reinforcement items are ascertained, then these shall be supplemented or replaced in line with the instructions of the responsible Designer.

The surface shall be repaired by the use of proper, approved, non-shrinkable repair mortar. The use and application method of each material shall be determined according to the manufacturer's instructions.

In case that the extent of the surface and the depth of the section under repair can affect the durability and/or the resistance of the structure, then the corrective actions and the reinstatement method shall be submitted to AM for approval.

3.5 Dihedral or trihedral angles' broken edges

These are local wears or small cuttings in angles, caused by "hits" (due to various reasons) during or after the removal of the formwork/ metalwork of the concreted section.

The depth of the removal of concrete of the damaged area depends on the size of the angle's cutting.
The surface of the concrete that will be repaired will have to be sound and clean, free of any debris concrete, contamination and dust, cleaned via pressurized water or air (approximately 3 bars). The surface shall be repaired by the use of proper, approved, non-shrinkable repair mortar. The appropriate guide shall be utilized to ensure the verticality of the edges. The use and application method of each material shall be determined according to the manufacturer's instructions.

If a section of the reinforcement has been revealed due to the broken edge, then this section shall be protected against any corrosion through the application of a special corrosion resistant coating or materials included in the repairing mortar.

3.6 Cuts of concrete pieces

These are local cuts and wears, due to "hits" (mainly due to objects' impact) during or after the dismantling of the concreted section formwork/metalwork.

The procedure for the preparation of the surface to be repaired and reinstated is the same as described above.
If a section of the reinforcement has been revealed due to the broken edge, then this section shall be protected against any

corrosion with the application of a special corrosion resistant coating or materials included in the repairing mortar.

In case the extent of the surface and the depth of the section under repair can affect the durability and/or the resistance of the structure, then the corrective actions and the reinstatement method shall be determined by the Designer and submitted to AM for approval.

3.7 Cavities

These are undesirable voids that remain in a concrete segment after the concreting process for various reasons. The damage described in this paragraph can be divided in two categories.

- CATEGORY "A"

This category addresses the following damage: the depth of the cavity in the concreted section of the structure is smaller than the thickness of the reinforcement cover.

The area with the cavity shall be subject to a local dismantling process. The intervention shall go to such a depth to ensure that sound concrete is revealed without the reinforcement being visible. The surface of the concrete that will be repaired will have to be sound and clean, free of any debris concrete, contamination and dust, cleaned via pressurized water or air (approximately 3 bars).

The surface shall be repaired by the use of proper, approved, non-shrinkable repair mortar, while the surface to be reinstated shall remain water-saturated,. The use and application method of each material shall be determined according to the manufacturers' instructions.

- CATEGORY "B"

This category includes the following damage: the depth of the cavity in the concreted section of the structure is greater than the thickness of the reinforcement coating.

The procedure for the preparation of the surface to be repaired and reinstated is the same as described above.

The exposed reinforcement shall be cleaned and free from any concrete debris, dust etc.; it shall also be protected against corrosion, as required, through application of special corrosion resistant coating or materials included in the repairing mortar.
In case damaged reinforcement items are ascertained, then these shall be supplemented or replaced in line with the instructions of the responsible Designer.

The surface shall be repaired by the use of proper, approved, non-shrinkable repair mortar. The use and application method of each material shall be determined according to the manufacturer's instructions.

In case the extent of the surface and the depth of the section under repair affect the durability and/or the strength of the structure, then the corrective actions and the reinstatement method shall be determined by the Designer and be submitted to AM for approval.

3.8 Concrete surfaces protrusions

These are surfaces of concreted sections presenting locally minor concrete protrusions, for various reasons (e.g. due to poor contact among formworks etc.). It is pointed out that this paragraph does not concern concrete surfaces protrusions of structures deviating from their theoretical position (gauge) beyond the foreseen tolerances, in which case another procedure will apply.

The area with the protrusion shall be subject to a local dismantling process. After the dismantling, the surface of the concrete that will be repaired will have to be sound and clean, free of any concrete debris, contamination and dust, cleaned via pressurized water or air (approximately 3 bars).

The surface shall be repaired by the use of proper, approved, non-shrinkable repair mortar. The use and application method of each material shall be determined according to the manufacturer's instructions.

3.9 Hairline cracking

These are fine surface cracks or cracks of small depth, which appear on hardened concrete and are due to a number of reasons (e.g. shrinkage cracking). Wider cracks and/or cracks of greater depth will have to be addressed on a per case basis further to the designer's assessment and a proposal submitted to AM. The damage described in this paragraph can be divided in two categories.

<u>i) Cracks without leakage</u>

These are hairline cracks presenting no moisture.

The crack and its surrounding area shall be thoroughly cleaned by means of pressurized water/air and any cement deposits, earth, oils, greases, etc. shall be removed.

There shall be a temporary surface sealing along the crack through an appropriate material (epoxy paste, polyester filler etc.) and, subsequently the holes shall be drilled directly on the crack and

special noses (packers) shall be installed for grout pouring. The number, diameter, location and the depth of the holes depend on the crack characteristics (length, width, depth).

Once the temporary seal of the crack has hardened, the crack shall be filled with the appropriate, thin, two-component epoxy resin through injection under pressure at consecutive layers via the packers, starting from the lowest nose (on vertical cracks) or from the one end (on horizontal cracks) until the crack is fully sealed, when the material can no longer penetrate into the concrete and the surface of the crack crystallizes upon setting of the material.

The use and application method of each material shall be determined according to the manufacturers' instructions.

ii) Cracks with leakage

These are hairline leaking cracks on concrete for construction purposes where there is no waterproofing system complying with the Specifications. The case of leakages in construction works having a waterproofing is addressed in the Article 03340 "Waterproofing", while after the relevant intervention, cracks that have been dried shall be sealed according to the previous paragraph.

The concrete surface that will be repaired will have to be sound and clean, free of any concrete debris, contamination and dust, via pressurized water or air. As regards leaking cracks without any pressure (weeping), a temporary surface sealing along the crack through an appropriate material (e.g. special fast setting hydraulic cement) shall precede; this material will have to stop the leakage immediately and it will be set within a few minutes. It is stressed that, as regards leaking cracks with major water pressure, firstly, polyurethane foam shall be injected from the noses (packers) described below in order to seal the said cracks temporarily.

The holes shall be drilled on either side of the crack with a 45^0 inclination, they shall be properly spaced from the crack and from one to another and they shall be drilled at the appropriate depth, ensuring that the holes pierce the interface of the crack (for throughout cracks, the spacing shall be d/2, where d=the width of the element).
Noses (packers) shall be installed in the holes for the grout injection. The permanent sealing of the crack shall be made through the application of an appropriate approved material (e.g. acrylic, polyurethane or epoxy resin suitable for leaking cracks), through an injection under pressure via the packers. The material must be fluid enough to penetrate and to fill the concrete voids and pores ensuring full filling of the crack. The grouting shall be executed gradually starting from the lowest nose (in vertical cracks) or from the one end (in horizontal cracks) until the injected material instead of water flows

out from the subsequent nose. The pump gets disconnected from the nose, which is sealed and the grouting continues from the subsequent nose following a diagonal course on either side of the crack, until the injected material flows out from the subsequent nose; this procedure continues until all cracks are sealed. Upon completion of the works, the noses shall be removed and the concrete surface shall be repaired by sealing the remaining holes through the application of an appropriate cement material.

The use and application method of each material shall be determined according to the manufacturers' instructions.

4 IN SITU QUALITY CONTROL

Concerning the quality control of the repairs of the concrete for construction purposes the following procedure shall be followed.

- The Contractor shall submit the Construction Methodology to AM for approval as designated in par.1.3 in the present article; the subject Methodology shall include all cases of deficiencies and the associated methods and materials for their repair. At the same time, the Contractor shall submit for approval the respective MSSs of the materials.

- The construction deficiencies are immediately detected by the construction engineers and/or the quality control engineers and are recorded in a Special Concrete Deficiencies Record and Repair Sheet. This Record will include the following as an example: identification of the structural element deficiencies' locations, characteristic dimensions of the deficiency, type of deficiency, method of repair, materials intended for use, required maintenance etc. Having being signed by the Contractor's responsible engineers, it shall be delivered to AM engineers for review and countersigned before the commencement of works. As far as the cracks are concerned, these shall be followed up for any eventual expansion or leakage until they are repaired.

- In case a specific deficiency is deemed to be a serious concrete damage that may cause adverse impact on the safety, durability and operation of the structure, then the designer shall be relatively informed, he/she shall assess the situation and the damage's impact and shall propose the respective actions.

- During repairs, a document entitled "Announcement of Concrete Repair-Reinstatement" shall be kept and updated on a daily basis. This document shall record the position and dimensions of the damage, the date, materials to be used for

repair along with their relevant approved MSS, leakage – if any, the number of holes and the grouting pressure (on cracks), the revealing of reinforcements or not and their condition, the consumption of repairing materials etc.

- Upon repair, concrete surfaces shall be sound, smooth, homogeneous, without any color alterations on visible elevations (on fair-faced concrete), free of wears and discontinuities. In order to avoid any eventual "injuries", the necessary protection measures shall be introduced on lately repaired surfaces, as required. Moreover, wherever maintenance of the repaired surface is required, then the required measures shall be introduced, in line with the manufacturer's instructions.

04101 INDUSTRIAL FLOOR WITH HARDENER AND/OR EPOXY MATERIALS

1 GENERAL

1.1 Description of Work

This specification covers the creation of industrial floors of high abrasion resistance in the mechanical areas of the Project. It concerns the final layer applied above the concrete used for filling floors, as described in Article 04200 "Filling concrete as floor substrate". The final layer of industrial floors shall consist either of hardeners or exopy products or of a combination of both

1.2 References

ELOT EN 13892	Methods of test for screed material
ELOT EN 13813	Screed material and floor screeds. Screed material. Properties and requirements
ELOT EN 1504-2	Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Part 2: Surface protection systems for concrete

1.3 Submittals

For each material, a MSS shall be submitted to AM for approval. It shall include as a minimum:

- Technical characteristics based on the manufacturer's catalogue.
- CE Conformity Certificates.
- Color Chart
- Material Safety data sheet.

2 MATERIALS

2.1 Substrate

Filling concrete to be used as substrate for industrial floors shall be manufactured as per Article 04200.

2.2 First coat

A hardener for industrial floors shall be applied on the wet concrete as a coating (when the concrete is dewatered). The application method is described in article 3.1 herein.

2.3 Second coat (if necessary)

If increased resistance to chemical weathering is required due to acids, oil, alkali, mineral oils, etc., an epoxy coating shall be applied upon application of the hardener for industrial fllors and/or without its application, directly on the hardened filling concrete substrate.

Materials shall be delivered in pre-weighted packaging for easier installation.

2.4 Characteristics

The final surface shall have the following characteristics:

1. Cement-based materials (hardeners for industrial floors)

- Minimum compressive strength: 50 Mpa (ELOT EN 13892-2).
- Minimum flexural strength: 7 Mpa (ELOT EN 13892-2).
- Minimum abrasion resistance: 200μm.

2. Epoxy flooring

- Bonding strength: 2 Mpa (ELOT EN 13892-8).
- Abrasion resistance: 50μm.

3 EXECUTION

1. Cement-based materials (hardeners for industrial floors)

First, the filling concrete shall be laid, as described in para. 3.1, article 04200 "Filling concrete as floor substrate" of this Specification.

As soon as concreting works are completed and once the surface is fully cured (surface fully dewatered), so as to enable stepping on it, it shall be coated with a quartz-based hardener for industrial floors or other material, as per the manufacturer's instructions.

The maintenance of the concrete, the cutting of the joints and their filling with the appropriate material shall follow as normal and as foreseen in para. 3.1, article 04200 of this Specification.

2. Epoxy flooring

Ensure that the substrate on which the epoxy flooring (hardened filling concrete with or without industrial flooring) can be laid has been adequately prepared, that is free from plastering droppings, deposits from cementations mixes and any other debris (e.g. dust) and that the area has been secured against the instruction of dust, insects, animals, moisture and water.

Any cavities and scrolls have been filled flush with the surface with appropriate filler. The finished floor shall have a deviation tolerance of ±2mm per linear meter of the surface. The coated surface shall have a uniform appearance in texture.

All doors and openings shall be closed during application and curing phases.

There must be no trace of humidity during application and curing phases.

Walls, columns and other trades must be protected against roller mark and spit. Mark borders and limits with masking tapes to avoid material overflow.

The primer shall be applied as per the manufacturer's instructions, to increase adhesion of the main coating and to ensure that the substrate of the main coating is completely sealed and pores-free. Otherwise, a second layer shall apply.

The final epoxy resins coating shall be ensured either through the application of paint or through the creation of a self-levelling floor and protection of the final flooring, as per the manufacturer's instructions.

Upon application of the final coat and the foreseen curing time, on the basis of the manufacturer's instructions, all surfaces shall be cleaned with vacuum to remove any trace of dust and other debris.

All tapes shall be removed before materials' curing.

4 PROTECTION

Ensure that working areas is free from any other trades.

Areas shall be sealed against any dust or debris.

Circulation of personnel shall be restricted during materials application and throughout the entire curing time defined by the manufacturer.

Installers shall read material safety data sheet before application.

5 ON SITE QUALITY CONTROL

It shall be verified and recorded that:

- materials are in line with the approved MSS.
- The requirements of this specification are respected.

04200 FILLING CONCRETE AS FLOOR SUBSTRATE

1 GENERAL

1.1 Description of the Works

This specification concerns the supply and construction of filling concrete to form the substrate for the various kinds of final floorings to be used in the Project (ceramic tiles, sidewalk slabs, industrial floor, etc.).

1.2 Standards

CTC-2016	Greek Concrete Technology Code – FEK 1561/b/02-06-2016
ELOT 1421	Steel for the reinforcement of concrete. Weldable reinforcing steel
ELOT EN 10080	Steel for the reinforcement of concrete. Weldable reinforcing steel. General
ELOT EN 13304	Bitumen and bituminous binders. Framework for specification of oxidised bitumen

1.3 Submittals

The Contractor shall prepare and submit for approval to ATTIKO METRO S.A. the MSSs for the Concrete Mix Designs and the structural mesh.

2 MATERIALS

2.1 Filling concrete – structural mesh Filling concrete of C20/25 class minimum shall be laid, lightly reinforced with T131 structural mesh as substrate to floors.

3 EXECUTION

3.1 Configuration

- Perimeter joints shall be configured by installing adhesive tape for separating purposes on all vertical perimeter walls and the free columns of the area. The foreseen geometry shall be ensured through the use of formworks, mitred corners and guides where required.

- Adhesion must be ensured between old and new concrete through the use of the appropriate adhesion material.
- T131 structural mesh must be installed, supported on spacers and/or trestle, in full compliance with the requirements for coverage.
- The concrete must be laid and leveled using guides, planks or laser screed machinery.
- Further leveling of the concrete surface with a floating disc when the concrete is dewatered.
- Covering of the flooring for 7 days with a plastic sheet or wet burlap for curing of the concrete. Cutting of joints within 48 hours from laying of the concrete on a 4mx4m or 5mx5m grid before deformations are developed due to drying contraction. Joints shall be 5 mm wide and approximately 25 mm deep.
- Joints shall be filled with industrial asphalt product, especially designed for the aforementioned purpose or polyurethane compound and any excess shall be removed whilst still hot. It is noted that no joints shall be formed at the filling concrete at the locations of the construction joints of the bearing structure of the Stations and Shafts of the Project, however flooring shall continue and a joint shall be cut in the same position, as described above.

3.2 Protection and Maintenance

If any works are planned after the construction of the flooring, the Contractor shall take all necessary precautions to protect the floor from any damage (mechanical or chemical and staining). The floor shall be delivered clean.

3.3 On Site Quality Control

3.3.1 The Contractor's Engineer shall check the quality of materials and works in accordance with the design study drawings and the relevant articles of this specification.

3.3.2 It shall be verified and recorded that:

- The finished flooring surface is absolutely level if the design does not envisage any falls.
- If it is established that at any random flooring area of 10m x 10m there are any deviations exceeding 5mm in the flooring surface, the surface shall be removed and reformed at the Contractor's own cost.
- The requirements of this specification have been adhered to.

05521 GALVANIZED STEEL HANDRAILS & BALUSTRADES

1 GENERAL

1.1 Description of Work

The purpose of this specification is to describe the technical requirements for the supply and installation of handrails and balustrades made of galvanized steel.

1.2 Reference Standards

EN ISO 14122-3	Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails
ELOT EN 1991	Actions of Structures
EN 10025:	Hot rolled products of non alloy structural steel.
ELOT EN ISO 10219:	Cold formed welded structural hollow sections of non-alloy and fine grain steels
ELOT EN ISO 10220:	Seamless and welded steel pipes - Dimensions and mass per length unit.
ELOT EN ISO 636:	Welding consumables. Wire electrode and filler metals for gas-shielded arc welding of unalloyed & fine grain steels – Classification.
ELOT EN ISO 2560:	Welding consumables – Lined electrodes for manual arc welding of unalloyed and fine grain steel - Classification.
EN ISO 4063:	Welding and allied processes - Nomenclature of processes and reference numbers.
ELOT EN ISO 15609-1:	Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding.
ELOT EN ISO 15614-1:	Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys.
ELOT EN ISO 9606 -1:	Qualification testing of welders — Fusion welding — Part 1: Steels.
ELOT EN ISO 1461:	Hot dip galvanized coatings on fabricated iron and steel articles.
ELOT EN ISO 4014	Hexagon bolts – categories A & B.

Greek Building Code, FEK 59/D/03.02.89, as currently in force.

1.3 Submittals

Material submittals (MSS) shall be prepared and submitted to the ATTIKO METRO S.A. for approval.

Unless otherwise specified, each material submittal shall include as a minimum:

- Manufacturer's product data.
- Assembly, erection and installation manual.
- Welding procedure.
- 300 mm long sample for each type of handrails and balustrades.
- Design Calculation Notes.
- Galvanizing repair product and methods of application.

2 MATERIALS

2.1 General

Handrails and balustrades shall be fabricated and installed so as to withstand the required loads as specified in paragraph 3 of Article 3 of the Design Specification for CW of ATTIKO METRO S.A.
The height to the handrails shall be 90cm.

The balustrades shall be fabricated and installed with a minimum height of 1.10m.

2.2 Galvanized Steel Tubes

The galvanized steel tube to be used for handrails and balustrades shall be, unless otherwise specified, minimum diameter 50mm with a circular shape and of length as shown on construction drawings with a minimum steel grade S235JR in compliance with the requirements of ELOT EN 10025.

The thickness of the pipe shall be in accordance with the Design Calculation Notes.

2.3 Anchor Plates

Anchor plates shall be made from steel with a minimum thickness of 5 mm and steel grade at least S235JR, conforming with the requirements of EN 10025.

When handrails are fixed on the walls, they shall be fixed with the necessary corrosion resistant anchoring plates and anchors to sustain loads as defined in the submitted calculation notes.

2.4 Welding

Welding shall be performed by arc welding in compliance with the requirements of ELOT EN ISO 636.

Electrodes to be used shall be in compliance with ELOT EN ISO 2560.

Welding shall be implemented according to the submitted procedures. All welding shall be performed by Certified Welders.

2.5 Galvanizing

Unless otherwise specified, the steel elements to be used for the fabrication of handrails and balustrades shall be galvanized by the hot-dip process in accordance with ELOT EN ISO 1461.

Galvanizing to be used in repair work where original galvanization has been removed, shall be made using cold galvanizing compounds manufactured for the purpose and shall be approved by AM.

2.6 Fixing

2.6.1 General

Unless otherwise specified, fixing items to be used shall be galvanized or of compatible, non-corrodible material.

2.6.2 Anchors-Fasteners & Accessories

Anchors, fasteners and accessories shall be provided as required for a complete and finish installation.

Bolts, nuts and washers shall conform to ELOT EN ISO 4014.

All materials shall be galvanized or of corrosion-resistant material.

2.6.3 Expansion Bolts

Unless otherwise specified, where anchors are not embedded into the concrete, galvanized expansion type anchors shall be used with matching galvanized steel bolts or studs with nuts of sizes as per the shop drawings.

3 EXECUTION

3.1 Inspection

The areas and conditions under which handrails and balustrades are to be installed shall be examined and the work shall not proceed until satisfactory conditions have been ensured.

As a minimum the following shall be verified:

Surfaces are clean and all foreign materials have been removed.

Concrete is sound and broken edges have been repaired where necessary.

Work area is free from other trade works.

3.2 Handrail & Balustrade Installation

The installation of handrails and balustrades shall be performed as per the construction drawings and the manufacturer's instructions.

Brackets on walls for the installation of handrails shall be as shown on the Architectural DFD Drawings. Particular finish details shall be as shown on detail drawings.

Vertical posts can either be welded or fixed on anchoring plates or set on drilled holes in concrete.

3.3 Fastening to in-Place Construction

Fastening to in-place construction shall be performed using appropriate anchorage and fasteners adapted to the type of support in compliance with the manufacturer's instructions and requirements.

3.4 Cutting, Fitting and Placement

Cutting, drilling and fitting required for on-site installation of the work shall be performed with the due diligence. The work shall be plumb, aligned, level and free of rack, measured from established lines and levels.

Unless otherwise specified, temporary recesses or anchors in the formwork shall be provided for items which are to be built into concrete or masonry.

3.5 Exposed Connections

Exposed connections shall be fitted together to form tight hairline joints.

Sharp edges are prohibited.

3.6 Welding

Welding shall be performed in the shop.

Welded joints shall be ground and dressed smooth to match adjacent surfaces and so that the shape and profile of the item welded is maintained and so that the weld seam is invisible in the finished work.

In any case, field welding are limited to the case shown on drawings. Galvanization touch-up work shall be in accordance with the approved repair material submittals.

3.7 Adjusting

Prior to installing handrail into the final position, it shall be adjusted to ensure proper matching of joints and correct alignment throughout its length.

Posts and supports shall be spaced as shown on construction drawings and plumbed in each direction.

4 PROTECTION AND MAINTENANCE

Handrails shall be maintained in clean condition throughout the construction period, so that they shall be without evidence of deterioration or damage other than the effect of normal weathering.

Selected method of cleaning in compliance with the manufacturer's instructions and requirements shall promote the achievement of uniform appearance.

Protect finishes of handrails and balustrades from damages during construction period with temporary protective coating approved by the handrail manufacturer. Remove protective covering at the time of completion of the relevant works.

Restore damaged finishes during installation and construction period, so that no evidence remains of corrective works. Return items which cannot be properly restored. Make required alteration and refit at the final location.

Store handrail and balustrade systems inside well ventilated areas, away from uncured concrete and masonry and protected against weather, moisture, soiling, abrasion, extreme temperature and humidity.

5 FIELD QUALITY CONTROL

Visual inspection shall be made to verify that:

- The handrails used comply with the material submittal.
- The handrail work is performed in compliance with the construction drawings, manufacturer's requirements and recommendations and the requirements of this specification.

Tests and quality control must also be executed by the Supervision Team regarding the load bearing capacity of welded galvanized profiles (balustrades, handrails).

05550 STRUCTURAL STEEL STRUCTURES

1 GENERAL

1.1 Description

1.1.1 The purpose of this article is to describe the technical requirements for the supply and construction of the steel structures foreseen by the pertinent design.

1.1.2 All metal structures shall be designed and constructed so as to bear with the required safety the loads defined in the specifications for the design and the relevant applicable regulations.

1.1.3 The metal structures exposed to the environment shall be also checked against wind and snow loading, in accordance with the applicable regulations.

1.2 Reference standards

The following standards apply with regard to the design and construction of the various steel structures:

- ELOT EN 1090-1: Execution of steel structures and aluminium structures. Part 1: Requirements for conformity assessment of structural components
- ELOT EN 1090-2: Execution of steel structures and aluminium structures. Part 2: Technical requirements for steel structures
- ELOT EN 10025: Hot rolled non-alloyed structural steel products
- ELOT EN ISO 15609-1: Specification and approval of procedures for metal parts welding – Welding procedure specification – Part 1: Arc welding
- ELOT EN ISO 15614-01: Specification and review of suitability of procedures for metal parts welding – Welding procedure test – Part 1: Arc welding and gas for steel and arc welding for nickel and nickel alloys
- ELOT EN ISO 9606: Qualification testing of welders -- Fusion welding - Part 1: Steels
- ELOT EN ISO 4014: Hexagon bolts– product categories A & B
- ELOT EN ISO 4016: Hexagon bolts – product category C
- ELOT EN ISO 4017: Hexagon screws – product categories A & B

- ELOT EN ISO 4018: Hexagon screws – product category C
- ELOT EN ISO 4032: Hexagon nuts, type 1 – product category A & B
- ELOT EN ISO 4034: Hexagon nuts – product category C
- ELOT EN ISO 7089: Flat washers – Normal line – Product category A
- ELOT EN ISO 7090: Flat chamfered washers – Normal line – Product category A
- ELOT EN ISO 7091: Flat washers – Normal line – Product category C
- ELOT EN 10216.01/A1: Seamless steel tubes for facilities under pressure - Technical delivery conditions – Part 1: Non-alloyed steel pipes with pre-determined properties in room temperature
- ELOT EN 10219-01 E2: Welded cupped cross sections of structures, cold rolled, made of non-alloyed and fine-grain steels – Part1 : Technical delivery conditions
- ELOT EN 10219-02 E2: Welded cupped cross sections of structures, cold rolled, made of non-alloyed and fine-grain steels – Part 2 : Tolerances, dimensions and properties of cross sections
- EC-3: Steel structures, with its annexes and the National Application Text
- ELOT EN ISO 1460: Metal coatings – Hot dip coatings in ferrous materials – Weighted mass determination per surface unit
- ELOT EN ISO 1461: Hot deep galvanized coatings of ready-made steel/iron products – Specifications and testing methods.
- ELOT EN ISO 12944: Paints and varnishes - corrosion protection of steel structures by paint coating (Part 1 – Part 8)

1.3 Submittals

1.3.1 The Contractor shall submit to ATTIKO METRO S.A. for approval a Method Statement including details of the methods to be employed, the personnel and equipment proposed, the stages of erection, the methods of temporary support, the checks to be carried out at each stage, a risk assessment and the measures proposed to deal with them. The submission and approval times are determined in the General Specification Design Requirements.

At the same time the Material Submittal Sheets (MSS) which shall include all the data related to the materials proposed, the conformance certificates of the materials used, the test results and

all data referred to in detail in the different parts of this article shall also be submitted for approval.

1.3.2 The Contractor shall submit samples of the following:
- color samples (on a tube part 0.50 m long and on a node)
- galvanization samples (on a tube part 0.50 m long and on a node)

1.3.3 The Contractor shall submit structural design and shop drawings to ATTIKO METRO according to the Design Specification of this Project.

2 PRODUCTS

2.1 Steel Members

The materials must be in conformance with the qualities specified in the design, in an excellent state without defects, deformations and size tolerance outside the limits allowable by the relevant regulations for similar projects.

Their tolerance and the critical dimensions margins, which affect the assembly of the connected members for each category of the required accuracy of the connection, must be in conformance with the aforementioned standards. The dimension tolerances and the permissible limits must be shown on the shop drawings to be prepared by the Contractor.

Especially for those cross sections which shall be used in those members of the structure which shall be subject to serious fatigue, such as main bearing elements, columns, etc., a detailed inspection shall be carried out during the construction and acceptance, in order to pinpoint any eventual faults that may spring from rolling or other factors. These inspections are very important because such faults may reduce or even eliminate the strength of the structure locally.

Special emphasis is placed on the need to ensure the required quality of the connections of the steel parts of a metal structure. All bolts, nails, welds, etc., not satisfying these quality requirements shall be considered non-compliant material, shall not be used and shall be immediately removed from the site.

The electrodes for the welding activities must fully comply with the welding methodology.

Similar attention shall be paid to the materials used in the construction of the bearing surfaces and connections and the incorporated items of the steel structure into the reinforced concrete.

2.2 Nodes

The node shall be configured in accordance with the stipulation of the structural design and the specifications.

2.3 Anchoring Systems and Accessories

In general, as regards the main supports of metal parts on reinforced concrete elements of the bearing structure, provision should be made in the design and the DFD drawings for all required supporting means (anchors, plates, etc.), to incorporate them into the concrete during the concreting works. At secondary support points, the use of chemical anchors or other type of anchors is permitted, which are placed after the concreting works, according to the relevant article of this Volume. Such installation of anchors shall be performed so as no damage is caused to the concrete and the existing reinforcement. With regard to the permissible loads and anchor spacing, the manufacturers' instructions apply.

2.4 Other accessories

Contractor shall supply and install all accessories required to produce a complete structure according to the approved DFD construction drawings.

2.5 Corrosion protection

All steel members shall be adequately protected against corrosion. The most appropriate methodology is hot dip galvanization, wherever this is feasible, according to ELOT EN ISO 1461.

2.6 Paint

Following the application of the corrosion protection layer, members and nodes shall be coated with the foreseen fire resistant paint. Wherever required, the galvanized steel parts shall be appropriately prepared to accept the paint coat.

The exact color and gloss grade shall be agreed with ATTIKO METRO S.A. on the basis of samples, as these are described above.

2.7 Fire Protection

All steel members and their connections shall be designed and manufactured so as to provide sufficient protection against fire, as per Eurocode 3, Part 1-2 "Design of Structural Members against Fire" and the fire protection requirements of the Project's Specifications.

3 EXECUTION

3.1 Installation

3.1.1 The steel structure shall be installed in the position and elevations as shown on the approved DFD construction drawings and according to the directions of ATTIKO METRO S.A.

3.1.2 The exact method to be followed will be the Contractor's responsibility but the entire construction procedure shall be clearly described in the Method Statement submitted to ATTIKO METRO S.A.

3.2 Temporary supports

All temporary fixing elements shall be placed, plumbed and aligned in accordance with the requirements of the design and, once installed, shall be checked by the Contractor's responsible engineer as to their geometry and structural integrity.

3.3 Welding

Steel elements to be welded shall be cut to their exact dimensions and their surfaces shall be properly prepared for welding as detailed on the approved fabrication drawings and shall be free from rust, grease or other foreign materials.

Welding of steel elements shall be performed according to the aforementioned Standards.

Welding materials and equipment shall be suitable for the selected Welding Methodology.

All welders to be involved in the project shall hold the relevant welder certifications, which shall be submitted to AM.

3.4 Bolts, nuts, washers

Bolts, nuts and washers shall conform to the aforementioned Standards. Bolts shall be checked using an accredited dynamometer against the foreseen values proposed by the design.

The quality class of bolts and nuts shall be selected according to the approved construction drawings.

4 PROTECTION

All parts of the structure shall be properly stored on site and handled with care to avoid damaging of their structural integrity, corrosion

protection and color layers and, in general, of their proper operation and appearance.

Damaged, defective or misplaced materials shall be repaired or replaced at ATTIKO METRO's discretion, in accordance with the applicable standards and the manufacturer's and AM's instructions.

5 ON SITE QUALITY CONTROLS

The Contractor's responsible Engineer shall check the material quality and the works related to the assembling and installation of the steel structure according to the design drawings and this Article. Records of bolt torques and the final "as constructed" dimensions of the steel structure shall be recorded on forms approved by ATTIKO METRO in the framework of the QCP.

05610 FIXING ANCHORS

1 GENERAL

1.1 Description of work

This Specification covers the supply and installation of anchors to be used for fixing of various elements, devices and machinery on concrete structure.

1.2 Reference Standards

- ETAG 001: Metal anchors for use in concrete.
- ELOT EN ISO 2081: Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel
- ELOT EN ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.

1.3 Anchor Determination Assumptions

All areas of the Tramway system are classified as "Wet Areas" as regards the presence of water-moisture. These areas include members and structures exposed to the elements. This classification is independent from the waterproofing protection required for various concrete structures.

The Contractor has to take into account the above classification during the preparation of the designs and during the selection of the E/M and railway systems, as well as during their installation.

A) The loads (per anchor) to be mounted either on horizontal or vertical/inverted surfaces are divided in three (3) classes. In detail:
   - **Class R1** - Static Loads less than or equal to 1 kN
   - **Class R2** - Static Loads greater than 1 kN and dynamic loads less than or equal to 1 kN
   - **Class R3** – Dynamic loads greater than 1 kN

   Note: Dynamic loads are created due to operation vibrations or repeated loading.

B) Load is defined as the self-weight of the equipment, fixture, material, etc, plus any related service loads (i.e. mobile, dynamic loads, etc. if any). For linear systems such as piping, cable tray,

air ducts, false ceilings, etc. it shall be assumed as the total load (self weight, live, dynamic, etc.) per support.

C) For floor-mounted equipment, class R1 may be used regardless of the equipment weight, unless otherwise specified by the manufacturer, or the equipment is subject to vibration or repeated loading.

D) For concrete structural elements, metal or chemical type anchors can be used. In brickwall structural elements, exclusive use shall be made of chemical type anchors.

1.4 Submittals

The Contractor shall submit to ATTIKO METRO S.A. for approval the Material Submittal Sheets (MSS) which shall include all the data related to the methods employed, the equipment, the conformance certificates of the materials used, the test results and all data referred to in detail in other parts of this Article.

2 ANCHOR TYPES

2.1 All anchors shall be sized based on the calculation notes and shall be as shown in the construction drawings.

2.2 The anchors shall be stainless steel only, encapsulated in the appropriate welding material to prevent eventual corrosion of the steel reinforcement in the presence of moisture

2.3 The corrosion protection of anchors shall in no way be less than that of the component or item anchored (e.g. stainless steel materials shall be anchored with stainless steel anchors), but the opposite is still applicable.

2.4 The anchor types defined are presented below:

LOAD CLASS	STRUCTURAL ELEMENT		
	Concrete surface		
R1	Nailed expansion anchor or chemical type anchor		
R2	Tightened expansion anchor or chemical type anchor		
R3	Undercut type		

	anchor or chemical type anchor		

2.5 The following shall be taken into consideration for the proper selection of anchor types:

- Design load
- Characteristic strength of the structure
- Distance from edges of the structural element
- Axial (N) and shear (T) loading characteristics.
- Anchor group interface

3 EXECUTION

3.1 Anchors shall be applied in line with the construction drawings and the types defined above.

3.2 Manufacturer's instructions shall be followed and strictly adhered to.

4 PROTECTION AND MAINTENANCE

The chemical anchors shall be properly stored and it shall be verified that they have not expired. Empty packaging of adhesive materials shall be treated in line with the applicable legislation depending on their indicated toxicity profile.

5 IN SITU QUALITY CONTROL

The Contractor's Engineer in charge shall check the quality of both materials and work in accordance with the design drawings and the individual Articles of this Specification.

The following must be verified and recorded, namely:

- That all anchors have been approved for their specific use on the basis of the relevant Material Submission Sheets.
- That the requirements of this Specification have been met.

07110 WATERPROOFING OF TERRACES, ROOFS AND BASEMENT WALLS USING ASPHALT MEMBRANES

A. Greek Technical Specification

Applicable shall be the Greek Technical Specification (ETEP) 03-06-01-01: "Waterproofing of terraces and roofs. using reinforced concrete".

B. Supplementary Requirements

In implementation of paragraph 13 of the Ministerial Decision under Ref. No. DIPAD/oik/356/04.10.2012, applicable are the following supplementary requirements of ATTIKO METRO S.A., presented in the individual Chapters of the corresponding ETEP as above.

1. Scope

1.1 Add waterproofing of walls in the basements of buildings.

2. Reference Standards

ELOT 13707	Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics
ELOT EN 13859	Flexible sheets for waterproofing. Definitions and characteristics of underlays
ELOT EN 13969	Flexible sheets for waterproofing. Bitumen damp proof sheets including bitumen basement tanking sheets. Definitions and characteristics
ELOT EN 13970	Flexible sheets for waterproofing. Bitumen water vapour control layers. Definitions and characteristics
ELOT EN 14967	Flexible sheets for waterproofing. Bitumen damp proof courses. Definitions and characteristics

3 Definitions and terms

In this Specification acceptable are only CE certified membranes, based on ELOT EN 13707, namely: Elastomer (SBS) sealing asphalt membranes with polyester reinforcement and with the following technical characteristics:

- Tensile stress: lengthwise 850 N/50mm, widthwise 650 N/50mm, per ELOT EN 12311-1
- Elongation: lengthwise 45%, widthwise 50%, per ELOT EN 12311-1

- Resistance to tearing (nail shank): lengthwise 550 N, transversely 350 N, per ELOT EN 12310-1.
- Puncture, resistance to static loading per ELOT EN 12730 up to a load of 20 Kg, resistance to dynamic loading per ELOT EN 12961 (Method A)
- Flexibility at low temperatures -20^{o}C, per ELOT EN 1109
- Resistance at high temperature 110^{o}C, per ELOT EN 1110
- Dimensional stability (L/T %), -0.4/+0.3 per ELOT EN 1107.

4. Main settings for the installation of asphalt membranes at the terraces – roofs

The following paragraph is added:

Waterproofing of basement walls:

For the waterproofing of concrete surfaces to be backfilled, a cement sealant shall be applied according to the manufacturer's instructions.

The sub-base shall be smooth and fixed. The surface will not have any voids or protruding items, holes or cracks. Weathered parts shall be removed with wire brush or other mechanical means. Asphalt, oil or paint shall be properly removed.

Mixing and application shall be in accordance with the manufacturer's instructions and an approved method.

Waterproofing materials will not be applied when ambient temperature is less than 5 ^{o}C.

Sealant shall be preserved (if required) and protected against direct sunlight, the wind and frost using polyethylene sheet.

07210 THERMAL INSULATION OF EXTERNAL WALLS

A. Greek Technical Specification

Applicable is the Greek Technical Specification (ETEP) 03-06-02-02: "Thermal Insulation of External Walls"..

B. Supplementary Requirements

In implementation of paragraph 13 of the Ministerial Decision under Ref. No. DIPAD/oik/356/04.10.2012, applicable are the following supplementary requirements of ATTIKO METRO S.A., presented in the individual Chapters of the corresponding ETEP as above.

2. Reference Standards

ELOT EN 13162 Building heat insulation materials – MW industrial Products – Specification
ELOT EN 13163 Building heat insulation materials – EPS industrial Products – Specification
ELOT EN 13164 Building heat insulation materials – XPS industrial Products – Specification
ELOT EN 13165 Building heat insulation materials – PUR industrial Products – Specification
ELOT EN 13166 Building heat insulation materials – PF industrial Products – Specification
ELOT EN 13167 Building heat insulation materials – CG industrial Products – Specification
ELOT EN 13168 Building heat insulation materials – WW industrial Products – Specification
ELOT EN 13169 Building heat insulation materials – EPB industrial Products – Specification
ELOT EN 13170 Building heat insulation materials – ICB industrial Products – Specification
ELOT EN 13171 Building heat insulation materials – WF industrial Products – Specification
ELOT EN 13172 Thermal insulating products - Evaluation of conformity
ELOT EN ISO 9229 Thermal Insulation – Vocabulary
ELOT EN 13813 Screed material and floor screeds. Screed material. Properties and requirements
ELOT EN 13707 Flexible sheets for waterproofing -. Reinforced bitumen sheets for roof waterproofing - Definitions and characteristics
ELOT EN 13859-1 Flexible sheets for waterproofing – definitions and characteristics of underlays – Part 1: Underlays for discontinuous roofing
ELOT EN 13956 Flexible sheets for waterproofing. Plastic and rubber sheets for roof waterproofing. Definitions and characteristics

ELOT EN 13967 Flexible sheets for waterproofing. Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet. Definitions and characteristics

ELOT EN 13970+A1 Flexible sheets for waterproofing - Bitumen water vapour control layers - Definitions and characteristics
ELOT EN 13984 Flexible sheets for waterproofing. Plastic and rubber vapour control layers. Definitions and characteristics
ELOT EN 14695 Flexible sheets for waterproofing. Reinforced bitumen sheets for waterproofing of concrete bridge decks and other trafficked areas of concrete. Definitions and characteristics
ELOT EN 14909 Flexible sheets for waterproofing. Plastic and rubber damp proof courses. Definitions and characteristics
ELOT EN 14967 Flexible sheets for waterproofing - Bitumen damp proof courses - Definitions and characteristics
ELOT EN 15814+A2 Polymer modified bituminous thick coatings for waterproofing. Definitions and requirements
ELOT EN 13187 Thermal performance of buildings - Qualitative detection of thermal irregularities in building envelopes - Infrared method

2.1 Submittals

The Contractor shall prepare and submit Material Submittal Sheets (MSS) for approval by ATTIKO METRO S.A.. Each MSS will comprise at least the following:

- Technical characteristics of products/systems by the Manufacturer
- Application Methodology
- Certificates of Compliance
- Fire Rating Certificates
- Typical Detail Drawings for Thermal Insulation.

4.1 Criteria for selecting light thermal insulating materials

The following are added:

The thermal insulating material shall be selected during the DFD phase, having also taken into account the applicable Regulation on the Energy Performance of Buildings (KENAK) and the Fire Protection Regulation, .

5. Work Execution Methodology

The indicative Methodology shall be decided based on paragraphs 5.1, 5.2, 5.3 & 5.5 at the DFD phase and shall also cover the requirements of KENAK.

07220 THERMAL INSULATION OF TERRACES

A. Greek Technical Specification

Applicable is ELOT TP 1501-03-06-02-01: "Thermal Insulation of Terraces"..

B. Supplementary Requirements

In implementation of paragraph 13 of the Ministerial Decision under Ref. No. DIPAD/oik/356/04.10.2012, applicable are the following supplementary requirements of ATTIKO METRO S.A., presented in the individual Chapters of the corresponding Greek Technical Specification (ETEP) as above.

2. **Reference Standards**

ELOT EN 13162 Building heat insulation materials – MW industrial Products – Specification
ELOT EN 13163 Building heat insulation materials – EPS industrial Products – Specification
ELOT EN 13164 Building heat insulation materials – XPS industrial Products – Specification
ELOT EN 13165 Building heat insulation materials – PUR industrial Products – Specification
ELOT EN 13166 Building heat insulation materials – PF industrial Products – Specification
ELOT EN 13167 Building heat insulation materials – CG industrial Products – Specification
ELOT EN 13168 Building heat insulation materials – WW industrial Products – Specification
ELOT EN 13169 Building heat insulation materials – EPB industrial Products – Specification
ELOT EN 13170 Building heat insulation materials – ICB industrial Products – Specification
ELOT EN 13171 Building heat insulation materials – WF industrial Products – Specification
ELOT EN 13172 Thermal insulating products - Evaluation of conformity
ELOT EN ISO 9229 Thermal Insulation – Vocabulary
ELOT EN 13813 Screed material and floor screeds. Screed material. Properties and requirements
ELOT EN 13707 Flexible sheets for waterproofing -. Reinforced bitumen sheets for roof waterproofing - Definitions and characteristics
ELOT EN 13859-1 Flexible sheets for waterproofing – definitions and characteristics of underlays – Part 1: Underlays for discontinuous roofing
ELOT EN 13956 Flexible sheets for waterproofing. Plastic and rubber sheets for roof waterproofing. Definitions and characteristics

ELOT EN 13967 Flexible sheets for waterproofing. Plastic and rubber damp proof sheets including plastic and rubber basement tanking sheet. Definitions and characteristics
ELOT EN 13970+A1 Flexible sheets for waterproofing - Bitumen water vapour control layers - Definitions and characteristics
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ELOT EN 15814+A2 Polymer modified bituminous thick coatings for waterproofing. Definitions and requirements
ELOT EN 13187 Thermal performance of buildings - Qualitative detection of thermal irregularities in building envelopes - Infrared method.

2.1 Submittals

The Contractor shall prepare and submit Material Submittal Sheets (MSS) for approval by ATTIKO METRO S.A.. Each MSS will comprise at least the following:

- Technical characteristics of products/systems by the Manufacturer
- Application Methodology
- Certificates of Compliance
- Fire Rating Certificates
- Typical Detail Drawings for Thermal Insulation.

3.1.1 Light thermal insulating materials

The following are added:

The thermal insulating material shall be selected during the DFD phase, having also taken into account the applicable Regulation on the Energy Performance of Buildings (KENAK) and the Fire Protection Regulation.

3.1.2 Classification of light thermal insulating materials according to their chemical texture

Paragraph (a) concerning extruded polystyrene (XPS) and paragraph (c) concerning rockwool are applicable.

As regards the heat insulating plates, the following must be submitted:

a) XPS plates according to ELOT EN 13164, bearing the appropriate technical characteristics, in accordance with the heat insulation design.

b) Rockwool plates or quilts, as per ELOT EN 13162. In cases where black lining is required, the plates shall be covered with non-woven black coloured texture. The density and thickness of rockwool shall be in accordance with the thermal insulation drawings and design.

5. Construction method (basic elements that must be taken into account in the DFD)

Thermal insulation details, taking also into consideration the requirements of the applicable KENAK, shall be submitted to AM for approval during the DFD phase.

07900 SEALANTS

1 GENERAL

1.1 Description of Works

This document describes the technical requirements and controls for furnishing and installation of sealants in facilities where indicated on construction drawings and as specified herein including seals for air, water and/or fire.

1.2 References

ELOT EN ISO 6927:	Buildings and Civil Engineering works - Sealants – Vocabulary
ELOT EN ISO 11600:	Building structures – Joint materials – Classification and requirements for sealants
ETAG 026:	Fire stopping and fire sealing products
ELOT EN 14188:	Joint Fillers and Sealants
ELOT EN 15651:	Sealants for non-structural use in joints in buildings and pedestrian walkways

1.3 Submittals

Material Submittals (MSS) shall be prepared and submitted to AM for approval. These MSSs shall include the following:

- Manufacturer's product data.
- Manufacturer's Certificates of compliance for the related products.
- Construction Methodology.
- Compatibility with the applied marbles, granites and tiles used in the Project.
- Samples consisting of strips of actual products showing full range of colours available for each product exposed to view.

2 MATERIALS

2.1 General

Sealants to be used shall be designed for adhesion to the surfaces to which they shall be applied, as specified by the above-referenced standards and shall be:

- Stainless steel metal covers
- Shaped filling-sealing materials (e.g. cords)
- Unshaped sealing materials (e.g. mastic).

2.2 Type of Sealants

- Type of sealant to be used on granite / marble and tile should be in accordance with ELOT EN 14188, System M type, type ns, class B, C.
- Backer rods are closed cell polyethylene foam in circular cord lengths.

They enable the correct width to depth ratio of the sealing slot to be obtained and provide a firm backing to ensure that sealant is forced against during implementation.
Also, they function as a bond breaker at the back of the seal preventing additional stress on the sealant.
The compatibility by the sealant is 100%.
The cord size of backer rods shall be 10 mm – 50 mm. The diameter of the cord shall be approximately 20-25% larger than the width of the joint, positioned so that the required minimum sealant depth is obtained, measured at the center of the joint.

2.3 Color of Sealant

Unless otherwise specified, for concealed and exposed joints the color of sealant to be used shall be manufacture's standard color which has the best overall performance qualities for the application shown.

Unless otherwise specified, sealants colours for exposed joints shall approximately match the colours of the adjacent surfaces.

3 EXECUTION

Sealants shall be used as shown on construction drawings in accordance with manufacturer's requirements and recommendations and approved standards and details.

3.1 Inspection

- Before application, surfaces shall be cleaned by methods and cleaning materials approved by manufacturer's of joint sealants.
- Any damage unidentified during construction should be repaired or replaced as appropriate.
- Joints shall be prepared and the sealant mixed (as required) and applied in accordance with the manufacturer's instructions.

- Where a particularly neat finish is required, mask the face edges of the joint before priming and remove immediately after tooling is completed.

3.2 Installation

Sealant materials shall be installed in compliance with the manufacturer's requirements and recommendations and in accordance with approved standards.

4 PROTECTION

4.1 Health and Safety

Manufacturer's health and safety requirements shall be applied during transportation, handling, storage and execution.

Good hygiene and safety practices should be followed in compliance with the manufacturer's requirements and recommendations, such as use of eye protection, wash hands thoroughly after use, keep away from source of ignition, no breath of vapor, use of well - ventilated areas.

4.2 Sealant Protection

Exposed sealant surfaces shall be protected from damage during the construction period.

Joint sealants shall be protected during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes.

If despite such protection, damage or deterioration shall occur, damaged or deteriorated joint sealants shall be cut and removed immediately so that repaired areas are indistinguishable from original work.

08110 ALUMINUM WINDOWS AND DOORS, GLASS PANES

A. Greek Technical Specification

The applicable Greek Technical Specification (ETEP) 03-08-03-00 "Aluminum Windows and Doors".

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/356/04.10.2012, applicable shall be the following supplementary requirements of ATTIKO METRO S.A., which are presented here-below per chapter of the aforementioned PETEP.

3.1 Aluminum System

The first paragraph of clause 4.1 is amended as follows:

Aluminum system means all items necessary for the complete construction of a specific type of aluminum door or window. These items are **heavy-duty** aluminum profiles, properly designed, as well as other materials and special fixtures, such as glasses, rubber gaskets, brush seals, wheels, hinges etc.

4.7.1 Anodizing (anodic oxidation)

Classes of average minimum thickess 5μm and 10μm do not apply.

4.8 Manufacturing of Doors and Windows Frames

e) Thermal break system for the fixed parts of windows/doors.

5.5.3.1 Fixing

b) Glass Panes

The following additions are made:

The interior glass panels of the building must meet the requirements of the Materials and Workmanship Specification 10610 of AM. With regard to glass panels in buildings, the Greek Technical Specification ETEP 03-08-07-02 applies in general. Sub-paragraph 4.1.1. of paragraph 4.1 applies to double glass panes.

The materials of the glass must comply with the following standards:

ELOT EN 572, simple and reinforced glass.
ELOT EN 1279-1, Insulating glass units.

5.5.3.3 Mastic Joint Sealant

The following addition is made:

Sealants shall be used as shown on the shop drawings and in line with the instructions and recommendations of the manufacturer.

4. Incorporated materials – acceptance criteria

4.3 Special connecting items

Unless otherwise specified by the window manufacturer, fasteners to be used shall be stainless steel. Concealed fasteners shall be used to the extent applicable and practicable.

Where exposed fasteners are required, flat-head stainless steel screws shall be used, unless otherwise specified. All exposed fasteners shall be stainless steel.

All screws for fixing shall be stainless steel to prevent electrolytic action.

5.5 General construction requirements

5.5.1 Construction and installation of false frames

False frames shall always be used for the required anchoring in the concrete or masonry walls, in accordance with the requirements of the aforementioned ETEP.

5.6 Tightness between aluminum structure and building

The following additions are made:

Aluminum elements shall be separated from sources of corrosion or electrolytic action at the points of contact with other materials, following the manufacturer's recommendations.

Aluminum will be separated from steel through a special paint layer suitable for this purpose or through the installation of an appropriate pad.

6.1 On-site Quality Control

The following addition is made:

Damaged aluminum windows, which cannot be fully repaired on site of the project, shall be returned to the factory for the necessary modifications and finishes to be made.

08120 DOOR AND WINDOW HARDWARE

1 GENERAL

1.1 Description of Work

The purpose of this technical specification is to describe the technical requirements for the supply and installation of hardware to be used for the doors of the Depot Expansion.

1.2 Definitions

1.2.1 Door Hardware Set (HS)

Door Hardware Set is a combination of Hardware Components.

1.2.2 Door Hardware Components (HC)

Door Hardware Components are items constituting a Door Hardware Set (HS) and are specified separately in this Technical Specification.

1.3 References

ELOT EN 1935	Building hardware. Single-axis hinges. Requirements and test methods
ELOT EN 1158	Building hardware. Door coordinator devices. Requirements and test methods
ELOT EN 12209	Building hardware. Mechanically operated locks and locking plates. Requirements and test methods
ELOT EN 1303	Building hardware - cylinders for locks Requirements and test methods
ELOT EN 1125	Building hardware. Panic exit devices operated by a horizontal bar, for use on escape routes. Requirements and test methods.
ELOT EN 179	Building hardware. Emergency exit devices operated by a lever handle or push pad, for use on escape routes. Requirements and test methods.
ELOT EN 1906	Building hardware. Lever handles and knob furniture. Requirements and test methods.
ELOT EN 12320	Building hardware. Padlocks and

	padlock fittings. Requirements and test methods.
ELOT EN 15269-20	Extended application of test results for fire resistance and/ or smoke control for door, shutter and openable window assemblies, including their elements of building hardware - Part 20: Smoke control for hinged and pivoted steel, timber and metal framed glazed doorsets.
ELOT EN 13501	Fire classification of construction products and building elements.
ELOT EN 1154	Building hardware. Controlled door closing devices. Requirements and test methods.

1.4 Submittals

Each Hardware Component shall be submitted for approval by ATTIKO METRO S.A.

Each Material Submittal Sheet shall include as a minimum:

- Manufacturer's product data.
- Certificate of compliance with the relevant standards.
- Installation and adjusting instructions.
- Sample.

2 MATERIALS

2.1 General

Hardware shall be of suitable design and shall have sufficient strength and stiffness to perform the function for which it will be used (Heavy Duty Hardware Category for Public Spaces).

Hardware shall be attached securely on the doors with corrosion resistant dowels or bolts and shall be of proper design and quality for use on heavy-duty doors and frames.

The finish class of the door hardware shall be subject to AM's approval.

Door hardware not specifically mentioned, but necessary for proper installation and function of the Project's Doors, shall be supplied

corresponding in quality, size, function and finish to the specified one.

With the exception of door closers, all types of door hardware shall be of the same manufacturer.

All bolts' caps shall be of Philips type.

The Contractor shall construct the master locking system and shall see that the following requirements are met. Namely:

- he shall deliver and install permanent cylinders with cores.
- he shall adjust each lockset so as to ensure its satisfactory operation.
- he shall test the keys for proper operation.
- he shall add a label to permanent keys indicating the location and schedule heading number.
- he shall deliver permanent keys and control keys to ATTIKO METRO S.A.

2.2 Door Hardware Components (HC)

The following HC are hereby defined:

- HC1-Door Hinges
- HC2-Mortise Lock removable cylinder core and strike plate
- HC3- External back plate with hole for handle above keyway
- HC4- Lever handle set
- HC5-Extension Flush Bolt
- HC6-Key Storage System

2.2.1 Door Hinges (HC1)

Door Hinges shall be of heavy duty industrial type, of galvanized steel material and shall be welded on doors frames by the door manufacturer. Each door shall be equipped with one spring hinge and one fixed hinge. Hinges shall be screwed on doors and frames by corrosion resistant face screws.

Doors over 2.30m height and up to 3.00m shall be equipped with three hinges and one (1) additional hinge for every additional 750 mm of door height.

2.2.2 Mortise Lock (HC2) Removable cylinder core and strike plate

Mortise locks shall receive suitable and compatible cylinder core with six (6) pins and master key.

All mortise locks shall be equipped with:

1. Heavy duty low-friction tongues.
2. 25mm (min) throw deadbolt.
3. Stainless steel or chrome plated armor front and matching strike plate with extended lip to protect trim from marring by latch bolt.
4. Anti-vandal slip clutch.
5. Lock sets to be capable of receiving cylinder cores of any manufacturer.

The case and the internal parts of the Mortise Lock shall be of galvanized steel material.

The final cylinder shall be installed only at the end of the works and all keys shall be handed over to ATTIKO METRO.

2.2.3 External back plate with hole for handle above keyway (HC3)

It shall comply with the requirements of paragraph 2.2.12, together with the lever handle set.

2.2.4 Lever Handle Set (HC4)

All lever handles shall be made of stainless steel material, shock-proof that will comply with the provisions of the specified standards.

The above handles shall be provided with profile keyhole satin dull back-plate.
Doors at escape routes in non public areas shall be equipped with handles appropriately labeled.

2.2. 5 Extension Flush Bolt (HC5)

It shall be used on the inactive leaf of the double leaf doors and only on non panic doors, securing the leaf both at the top and bottom. The handle shall be of stainless steel material. The flush bolt (pin) shall be of galvanized steel material.

The bottom flush bolt shall be supported on a stainless steel floor recessed strike. A second similar strike shall be provided to be installed at the open position of the leaf holder.

3 EXECUTION

Door hardware components shall be installed and fixed on the doors securely with dowels, screws etc., corrosion-resistant elements, in accordance with the manufacturer's instructions and recommendations. For hardware to be installed onto surfaces which later shall be painted, each component of hardware should be

properly installed and then removed and stored during the final door finish application.

After completion of the finishes, hardware components shall be reinstalled securely and adjusted for smoothly and normal operation.

4 PROTECTION AND MAINTENANCE

The storage and transfer of door hardware shall be made in compliance with manufacturer's instructions and recommendations.

Hardware shall be stored in packing with identification related to approved door hardware schedule.

Door hardware components and parts shall be lubricated, based on the manufacturer's instructions of maintenance.

5 FIELD QUALITY CONTROL

The Quality Control shall be made to check that:

- All materials that are used comply with the Material Submittals Sheets and the requirements of the Technical Specifications.
- Hardware components shall be installed in line with the Architectural Door Hardware Schedule Drawings.
- Hardware components and operational characteristics comply with the specifications and are in satisfactory working order, clean and polished and are fastened at all points where required.
- All keys are properly tagged.

09331 ADHESIVE FOR NATURAL STONES AND CERAMIC TILES

1 GENERAL

1.1 Description of Work

This technical specification covers the supply and use of Mortar/adhesive for installation of natural stones and ceramic tiles on floors and walls.

1.2 References

ELOT EN 12004	Tile adhesive – Requirements, compliance evaluation, classification and characterization
ELOT EN 13888	Grout for tiles. Requirements, evaluation of conformity, classification and designation
ELOT EN 1501-03-07-02-00	Ceramic tiles covering of indoor and outdoor surfaces
ELOT EN 1501-03-07-03-00	Natural stone paving
ELOT EN 1501-03-07-04-00	Cladding with marble, granite and natural stones

1.3 Submittals

Material Submittal Sheets (MSS) shall be prepared and submitted to ATTIKO METRO approval.

Unless otherwise specified, each material submittal shall include as a minimum:

- EU Certificates of Conformity
- Technical Characteristics of the Product
- Manufacturer's Application Instructions

2 MATERIALS

2.1 General

Materials shall comply with the aforementioned Standards.

09332 CHEMICAL PROTECTION OF NATURAL STONE

A. Greek Technical Specification

The applicable Greek Technical Specification (ETEP) 05-02-03-00 "Antigraffiti coatings" is in force.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/35D/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented here-below per chapter of the aforementioned ETEP.

4.1 General Requirements

The texture of the final surface must be the same with the texture of the surface before and after application of the anti-graffiti coating.

4.2 Coating materials, type I (single use)

Not applicable paragraph. Paragraph 4.4 applies "Coating materials, type II (multi-purpose).

4.4 Coating materials, type II (multi-purpose):

- The product to be used must be compatible with the joint filler.

5.1 General Requirements

A mock-up for tiles shall be prepared to demonstrate the efficiency of the system.

Commercially available permanent marker and air spray system shall be used. Using the manufacturer's recommended cleaning agent, the two items shall be easily permanently removed without spoiling natural stone

09335 CERAMIC TILES

A. Greek Technical Specification (ETEP)

The applicable Greek Technical Specification (ETEP) 03-07-02-00 "Ceramic tiles covering of indoor and outdoor surfaces" is in force.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/35D/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented here-below per chapter of the aforementioned ETEP.

4. Requirements

The Ceramic Tiles shall be approved by Material Submittal Sheets, which shall include, as a minimum:

- Manufacturer's Product Data.
- Declaration of performance per Regulation EU (CE) 305/2011 due to harmonized standard ELOT EN 14411 in effect
- Samples of each product.
- Sample of lifting accessories, which might be submitted by a separate submittal.

Anti-graffiti treatment shall be ensured for all wall tiles prior to the project's delivery.

09660 PAVING SLABS AND COBBLESTONES FOR PEDESTRIAN AREAS

All aforementioned works are in conformity with the requirements of the following Greek Technical Specification.

A. Greek Technical Specification (GTS)

The following ETEP is applicable:

- 05-02-02-00: Paving slabs and cobblestones for pedestrian areas

B. Additional requirements

In application of paragraph 13 of Ministerial Decision no. DIPAD/oik/356/04.10.2012, the following additional requirements of ATTIKO METRO S.A. are applicable, as quoted below in each individual chapter of the above Greek Technical Specification.

1. The Designs including paving slabs and cobblestones for pedestrian areas are required to make reference to the category of materials, according to the aforementioned Standard.

09910 PAINTING OF CONCRETE SURFACES

A. Greek Technical Specification

The applicable Greek Technical Specification (ETEP) 03-10-01-00 "Concrete painting" is in force.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/35D/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented herebelow per chapters of the aforementioned Provisional Greek Technical Specification.

2. Definitions

2.1 Anti-oil Paint

Anti-oil paint is a paint resisting to petroleum product. Each paint manufacturer shall certify that the proposed paint is not sensitive to petroleum product.

2.2 Anti-Acid Paint

Anti-acid paint is a paint which is not affected at 20^0C by the following products:

- Sulphuric acid: 50 ‰
- Caustic natrium: 50 ‰
- Carbonic natrium
- Benzine (petrol)
- Mineral oils
- Ammonium carbonate

By definition, anti-acid paint is also an anti-oil paint.

2.3 Anti Dust Paint

Anti-dust paints are paints totally resistant to water, having a high thermal softening point and being smog resistant. Incorporated to these paints is a special resin having being tested showing a natural resistance to dirt and dust.

2.4 Special screed Floor Epoxy Paint (Parking areas)

Anti-slip epoxy paint, resistant to friction, applied to industrial floor with a base made of screed.

4. Materials – Acceptance Criteria

4.1.a Anti-Dust Paint (Antistatic Paint)

Solvent-based acrylic antistatic paint, which can be used without a primer or other appropriate system, in compliance with the internal approved specifications of the manufacturer (MDFT-95 microns, as a minimum).

4.1.b Oil Resistant Paint

Two-part epoxy or two part urethane paint systems, in compliance with manufacturer's approved internal specifications and ELOT 1145 Part 5 – Table 6, system 6-30.1 shall be applied.

Unless paint manufacturer recommends otherwise, the MDFT shall be of 150 microns (min) for primer coat and MDFT of 75 microns (min) for each of the two finish coats, for a total MDFT of 300 microns (min).

4.1.c Anti-Acid Paint

Two-part epoxy or two part urethane acid resistant paint systems in compliance with manufacturer's approved internal specifications and ELOT 1145 Part 5 – Table 6, system 6-30.1 shall be applied.

The MDFT shall be of 150 microns (min) for primer coat and MDFT of 75 microns (min) for each of the two finish coats, for a total MDFT of 300 microns (min).

4.1.d Epoxy Paint for Parking Areas

Colored self-leveled floor with an epoxy resins base, 3-4mm thick, smooth, highly resistant to friction, with good chemical tolerance, waterproof and anti-slip to be applied on the special screed floor for parking areas.

5.1 Work-crew

The following paragraph is added to paragraph b):

Where works at height must be executed, safe scaffolding shall be made available, in line with the legislation in force. These shall necessarily have complete working platforms, access ladder and a hatch. If elevating working decks are used, these shall be certified accordingly.

5.3 Alignment – Review – Acceptance

5.3.c Submittals

Material submittal sheet (MSS) shall be prepared and submitted to AM for approval.

Unless otherwise specified, each material submittal shall include, as a minimum:

- Technical information for each material proposed for use including preparation requirements and application method.
- Manufacturer's Quality Management Certificate as per EN ISO 9001:2000
- Manufacturer's data color samples proposed for use.
- Material safety data sheet, as per 91/155/EC & 2001/58/EC.
- At the start of the work, mock-up shall be made showing color and textures at a place to be agreed upon.

5.7 Application

5.7.7 Application of Exopy Paint in Parking Facilities

5.7.7.1 Preparatory work

The preparation method of the floor consists in the "Closed circuit sphere-blast" in view of achieving the maximum possible adhesion, the best removal of the anti-evaporating membrane and finally in view of accelerating the removal of the moisture from the floor.

5.7.7.2 Cleaning and sealing the floor joints

The floor shall be cleaned thoroughly. Oils, grease and other organic and inorganic pollutants shall be cleaned with the use of mechanical or chemical means (or a combination of the above). Cracks, holes, floor expansion joints as well as at the perimeter of the covers of gratings, manholes and wherever there is a discontinuation of the resinous floor, a joint is opened with the use of a handwheel; putty work with resin mortar is executed for the proper anchorage of the floor.

5.7.7.3 Priming

Having checked that the floor is clean and dry (its moisture must not exceed 4%), epoxy-prime shall be applied with a rubber and with a consumption of 250-350gr/m^2.

5.7.7.4 Epoxy floor colored paint construction

After the polymerisation of the prime and before the lapse of 24 hours, the epoxy floor shall be placed with an airless pistol and a consumption of 0.25-0.30gr/m^2.

The second and final layer of the epoxy floor with the use of a roller follows on the subsequent day and with the same consumption.

The overall consumption of the resin shall be 500-600gr/m^2 and the thickness of the deriving floor shall be approximately 0.6mm.

Accessibility time:	24 hours (at 22^0C)
Time for light use:	72 hours (at 22^0C)
Full Polymerization time:	7 days (at 22^0C)

5.7.7.5 Construction of floor striping

Further to the floor coating and prior to their full polymerisation, the stripings of the underground parking are floors are carried out with a two-component epoxy material.

09911 PAINTING OF PLASTERED SURFACES

A. Greek Technical Specification

The applicable Greek Technical Specification (ETEP) 03-10-02-00 "Render and plaster painting" is in force.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/35D/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented here-below per chapters of the aforementioned Greek Technical Specification.

3. Definitions

2.1 Anti-oil Paint

Anti-oil paint is a paint resisting to petroleum product. Each paint manufacturer shall certify that the proposed paint is not sensitive to petroleum product.

2.2 Anti-Acid Paint

Anti-acid paint is a paint which is not affected at 20^0C by the following products:

- Sulphuric acid: 50 ‰
- Caustic natrium: 50 ‰
- Carbonic natrium
- Benzine (petrol)
- Mineral oils
- Ammonium carbonate

2.3 Anti Dust Paint

Paints totally resistant to water; they contain a special resin that improves their natural resistance to dirt and dust.

4. Materials – Acceptance Criteria

4.1.a Anti-Dust Paint (Antistatic Paint)

Solvent-based acrylic antistatic paint, which can be used without a primer or other appropriate system, in compliance with the internal approved specifications of the manufacturer (MDFT-95 microns, as a minimum).

4.1.b Oil Resistant Paint

Two-part epoxy or two part urethane paint systems, in compliance with manufacturer's specifications and ELOT EN 12944 shall be applied.

Unless paint manufacturer recommends otherwise, the MDFT shall be of 150 microns for primer coat and MDFT of 75 microns for each of the two finish coats (min).

4.1.c Anti-Acid Paint

Two-part epoxy or two part urethane acid resistant paint systems in compliance with manufacturer's specifications shall be applied.

The MDFT shall be of 150 microns for primer coat and MDFT of 75 microns for each of the two finish coats (min).

5.1 Work-crew

The following paragraph is added to paragraph b):

Where works at height must be executed, safe scaffolding shall be made available, in line with the legislation in force. These shall necessarily have complete working platforms, access ladder and a hatch. If elevating working decks are used, these shall be certified accordingly.

5.3 Alignment – Review – Acceptance

5.3.c Submittals

Material submittal sheet (MSS) shall be prepared and submitted to AM for approval.

Unless otherwise specified, each material submittal shall include, as a minimum:

- Product technical data for each material proposed for use, including surface preparation requirements and application method.
- For non specialized coatings (i.e. anti-oil, anti-acid, anti-dust paints, epoxy points etc.), the relevant Ecolabel Certification must be submitted, in line with EU Regulation 66/2010.
- Manufacturer's Quality Management Certificate as per EN ISO 9001.
- Manufacturer's data color samples proposed for use.
- Material safety data sheet, as per 91/155/EC & 2001/58/EC.
- At the start of the work, mock-up shall be made showing color and textures at a place to be agreed upon.

09930 ANTI-DUST PROTECTION AND PAINTING OF STEEL SURFACES

A. Greek Technical Specification

The applicable Greek Technical Specification (ETEP) 03-10-03-00 "Corrosion protection and painting of steel" is in force.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/35D/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented herebelow per chapters of the aforementioned Greek Technical Specification.

2. Standardized Reference

ELOT EN 13381-8 - Test methods for determining the contribution to the fire resistance of structural members – Part 8: Applied reactive protection to steel members.

ELOT EN 13501 - Fire classification of construction products and building elements.

ETAG 018 – Fire protective products.

4. Materials – Acceptance Criteria

4.1.1 Primer

4.1.1.a Steel

Primer shall contain corrosion resistant components, such as iron oxide, zinc chromate or phosphate, chromate, zinc dust or combination of item. Selection of the primer type shall be given in material submittals sheet and shall be recommended by the manufacturer for the specific use.

4.1.1.b Galvanized Steel

Primer containing a combination of organic resin, chromate pigments and phosphoric acid catalysts shall be used. Selection of the primer type shall be given in material submittals sheet and as recommended by the manufacturer for the specific use.

4.1.2 Fire-resistant paint for steel items

The Contractor shall propose a certified system of fire-resistant paint as per ETAG 018. The system's performance, in terms of fire-resistance, shall comply with the Project's fire-protection design.

7.2.1 Works at height – Scaffolding - Elevating Working Decks

Where works at height must be executed, safe scaffolding shall be made available, in line with the legislation in force. These shall necessarily have complete working platforms, an access ladder and a hatch. If elevating working decks are used, these shall be certified accordingly.

15420 SANITARY WARE, COMMON

A. Greek Technical Specification (ETEP)

The applicable Greek Technical Specification (ETEP) 04-04-03-01: "Sanitary ware, common" is in force.

B. Supplementary Requirements

In implementation of para. 13 of Ministerial Decision under ref. no. DIPAD/oik/35D/04.10.2012, the following supplementary requirements of ATTIKO METRO S.A. apply, presented herebelow per chapters of the aforementioned ETEP.

2. Scope

Applied for wall-mounted vitreous china water closets, wall-mounted vitreous china wash basin, vitreous china wash basin in the form of a bucket and a stainless steel chrome-plated sink.

4. Requirements

4.1 Accepted materials
In general, paragraph 4.1 of ETEP shall not apply. Instead, the following are applicable:

4.1.1 Water Closet

Water closets shall comply with the requirements of ELOT EN 997 and ELOT EN 14055 and TOTEE 2412/86. They shall be of the wall mounted, rear flush type.

The seats and covers shall be compatible with the closets, of urea, in white color, according to the manufacturer's specifications and with a non corrosive material posts (chrome plated bronze or stainless steel) screws, washers.

4.1.2 Wash Basins

Wash basins shall comply with the requirements of ELOT EN 14688 and TOTEE 2412/86. They shall be of overflow type with dimensions: 58 x 46 cm. They shall be wall hung, with no pedestal, (min ∅ 40 mm) chrome plated "P"-trap shall be made of vitreous china white in color, equipped with a hot-cold water mixing faucet, a rocker drainage system, dismountable tap siphon including all accessory works and auxiliary supplies.
The wash basins shall be vandal proof and water shall be supplied via an outlet spray.

All accessories shall be chrome plated.

Fixing shall be by bolting the units on the wall with fixing devices according to manufacturer's recommendations and installed as shown in the construction drawings.

4.1.3 Bucket Sink

Bucket sink to be used in cleaner's room shall be made of overflow type, with dimensions approx. 34 x 44 cm, of vitreous china, in white color, of wall hung type, with chrome plated "P"-trap.

Bucket sink shall be provided with only cold water hose bib.

4.1.4 Kitchen Sink

Stainless steel kitchen sink, quality 1.4301 (AISI 304) per ELOT EN 13310, with overflow, with bowl dimensions 34 x 34 cm, total dimension 86 x 50 cm and with matching size chrome plated "P"-trap, as to be shown on the standard detail drawing.

The kitchen sink shall be equipped with cold and hot water mixing faucet, chromium plated, and all accessory works and auxiliary supplies.

Kitchen sink shall be suitable for counter standing with single compartment bowl.

All aforementioned paragraphs shall be coordinated with the aforementioned requirements.

5. Construction method – Finished work requirements

5.2 General requirements for the installation of sanitary ware, common. The following are added:

Sanitary Appliances shall be provided with the following Design Requirements:

- They shall be of water-conservation type.
- They shall be constructed of dense, durable, non -absorbent materials and shall have smooth impervious surfaces free from concealed pooling surfaces.
- All porcelain enamel surfaces on appliances shall be acid resistant.
- Exposed fittings including escutcheon plates shall be chromium plated bronze, there must not be any plastic part except decorative trim on faucet and washer handles.

- Flexible elastic pipes connecting the isolation valves with the water mixers shall be of approved manufacturer consisting of stainless steel lined flexible elastic pipe of material suitable for 110^{o} C and 10 bar working conditions.
- The water closets and the urinals shall have exposed flush valves from a reliable manufacturer according to ELOT EN 12541, ¾" supply, fully chrome plated. Their operation pressure shall be 10bars and the test pressure 16bars. The water flow shall be from 1.0 to 1.3l/s.
- All pipes and valves protruding from walls shall be equipped with decorative escutcheon plates.

5.3 Sanitary appliances - Method of installation

5.3.1 General

The following are added:
One isolation valve shall be provided for each hot water and cold water connection to each appliance.

Wherever a fixture is provided with concealed slip-joint connection, water hammer arrestor or valve, a stainless steel 1.4401 (AISI 316) access panel at least 300 mm in its smaller dimension shall be provided.

5.3.7 Other WC accessories

Toilet accessories shall include the items as specified here below with fixing materials and equipment for ease of maintenance and replacement.

The following toilet accessories shall be used, according to paragraphs 5.3.3 and 5.3.4 of ELOT TP 1501-04-04-03-03:

- Toilet roll holder in stainless steel.
- Paper towel dispenser with disposal bin in stainless steel.
- Soap holders and/or soap dispensers in stainless steel.
- Coat hooks, hook towel holders and other hooks in stainless steel.
- Mirror 60 x 40 cm framed in stainless steel with shelf.
- Toilet brush made of stainless steel plate.
- Washroom waste bin made of stainless steel plate.

5.3.8 Submittals

The Sanitary appliances and their accessories shall be approved by the Material Submittal Sheets (MSS), which shall include:

- Manufacturer's product data and illustrations/data of the specified fixtures and products, including water saving option.
- CE compliance certificates.
- Maintenance instructions, including spare parts list for the hydraulic fixtures.
- Connection diagrams and outline drawings.
- Manufacturer's standard color charts.
- Installation and operation instructions.
- Samples.
- Manufacturer's current ISO 9001 Certificate.

10620 POLYCARBONATE SHEETS

1 GENERAL

1.1 Description of the works

This specification describes the installation of polycarbonate sheets on the roof of sheds, as indicated on the construction drawings.

Installation of polycarbonate sheets is understood to be complete with all its components.

Polycarbonate sheets, fixation materials and all accessories necessary to complete the installation must be produced / supplied as a single system by the same manufacturer

1.2 Reference Standards

ELOT EN 14963 Roof coverings - Continuous rooflights of plastics with or without upstands - Classification, requirements and test methods

ELOT EN 1013 Light transmitting single skin profiled plastics sheets for internal and external roofs, walls and ceilings – Part 1: Requirements and test methods

ELOT EN 11963 Plastics - Polycarbonate sheets - Types, dimensions and characteristics

ELOT EN ISO 527 1 – 5 Plastics - Determination of tensile properties

ELOT EN ISO 62 Plastics - Determination of water absorption

ELOT EN ISO 75 1 – 3 Plastics - Determination of temperature of deflection under load

ELOT EN ISO 306 Plastics - Thermoplastic materials - Determination of Vicat softening temperature (VST)

EN 13501 Fire classification of construction products and building elements

DIN 5036 Radiometric and photometric properties of materials.

ASTM D1044 Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion

1.3 Submittals

The Materials Submittal Sheet (MSS) shall be submitted to ATTIKO METRO S.A. for approval and shall contain:

- Manufacturer's product data.
- Drawings for approval by ATTIKO METRO SA, showing the construction and installation of all items, including drawings for reflected ceilings, cross sections, details and interfaces with other works.
- Certificate for the manufacturer's compliance with the reference standards.
- Manufacturer Quality management system certificate to ISO 9001: 2015.
- Installation, Cleaning and Maintenance Manual

1.4 Specimens

Before work commences, specimens of ceilings approximately 1.50x1.50 in a position to be indicated by ATTIKO METRO SA shall be prepared and approved by ATTIKO METRO S.A., complete (with all joints and components), with at least 2 mounting points in each direction

These specimens shall remain until the end of all works, serving as a reference guide for all related works to be compared with them.

2 MATERIALS

2.1 General

The shed shall be covered with transparent polycarbonate honeycomb sheets at least 20 mm thick, mounted on aluminum frames.
Polycarbonate sheets must comply with the above standards as a minimum.
The system consists of the following components according to the manufacturer's instructions and recommendations:

- Polycarbonate cover sheets
- Joining of the sheets by means of specific profiles (or as specified by the manufacturer)
- Fixation according to the manufacturer's instructions depending on the type of bearing frame

2.2 Infrastructure

All infrastructure items shall comply with the manufacturer's specifications.

The spacing between the mounting points and the tolerances must be in accordance with the manufacturer's technical specifications.

The sheets are jointed to each other by means of the appropriate profiles (or as specified by the manufacturer), to ensure a firm and sturdy connection, as well as a watertight construction.

Polycarbonate sheets thermal shrinking/expansion shall be received according to the manufacturer's instructions

This is the proposed installation method:

- The maximum distance between the mounting points, for transparent, 20 mm thick cellular sheets, must be in accordance with the manufacturer's specifications and the above standards.
- Polycarbonate sheets shall be transparent as per DIN 5036 and the pertinent specimen, curved, with excellent UV-resistant , protective film on both sides, an fire-resistant rate B-s1, d0, per EN 13501, and resistant to abrasion as per ASTM D1044.

3 EXECUTION

3.1 General

The sheets shall be accepted, transported and cut in accordance with the manufacturer's instructions and recommendations.

Roof covering shall be carried out as shown on the approved Architectural drawings.

Installation shall be carried out according to the design tolerances

3.2 Product delivery and storage

As per the manufacturer's instructions.

3.3 Placement

According to the approved construction methodology.

4 INSPECTION AT THE WORKSITE

Inspection that:

- The roof is in compliance with the approved specimens.
- All delivered materials are properly labelled by the manufacturer, or are delivered sealed in packages properly labelled.

- All materials as stored as described in the specification and/or recommended by the manufacturer.
- All sheets and frames are free of damage.
- All components comply with the specifications.
- All installed items comply with the specified tolerances, as to the horizontal and vertical planes.
- All works are carried out on the basis of the construction drawings, the manufacturer's specifications and the application standards.
- Products are properly handled during construction.

5 PROTECTION AND MAINTENANCE

Periodic cleaning as per the manufacturer's instructions.