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1. GENERAL PROVISIONS

1.1. Objectives and summary of works

1.1.1. Objectives

The objective of the assignment is improvement of water supply and wastewater systems of Shengavit, Kentron, Arabkir, Davtashen, Kanaker-Zeytun, Malatia-Sebastia, Nork Marash, Nor Nork, Erebuni, Ajapnyak and Davtashen (village) districts within Yerevan administrative area.

1.1.2. Summary of Works

Within the framework of the project it is planned to implement works for improvement of water supply and wastewater systems within Yerevan city administrative area, in Shengavit, Kentron, Arabkir, Davtashen, Kanaker-Zeytun, Malatia-Sebastia, Nork Marash, Nor Nork, Erebuni, Ajapnyak and Davtashen (village) districts (see the attached maps). In the water supply system repair of water lines of the distribution network or construction of new ones, construction of regulation nodes, construction of water metering chambers for about 10000 private houses is planned in the districts built up with private houses; while in the wastewater system replacement of emergency segments of the sewerage network is planned.

1.2. Location of Construction Site

The construction sites are located within the administrative area of Yerevan city.

1.3. General Information about Construction Site and Existing structures

1.3.1. Construction Site

1.3.2. Structures

The below structures are planned during the project implementation:

- ✓ Construction and repair of water supply distribution network pipes DN40-DN315 - about 84.5km
- ✓ Construction of rectangular and circular water supply chambers – about 233 units
- ✓ Construction of water metering chambers for private houses – about 10000 units
- ✓ Replacement of emergency segments of sewerage network with DN150-DN800 pipes - about 7.5 km
- ✓ Construction of wastewater chambers – about 190 unit

1.4. Access to the construction site and warehouses

Before the implementation of construction works the Contractor must be sure in the accessibility of the roads to and inside the construction site. The Contractor must explore the condition of roads, taking into account their limited loading and weight of mechanisms operating at the construction site.

While implementing construction works in functioning parts of streets, the Contractor must provide security of transport and pedestrians. If needed, the Contractor must construct a bypassing road. The cost of the mentioned works is to be included in the Contract amount.

Open pits, trenches and wells are to be fenced, provided with traffic signs and illuminated during night time.

Each separate part of the construction site where the construction works are implemented should be accessible both for workers and for mechanisms and machines.

The building materials and subjects ought to be accepted and stored by the established order in the sites or warehouses envisaged for them.

1.5. Drawings and calculations

1.5.1. Drawings of tender documents

The attached drawings are an integral part of tender documentation. They will be completed later on by additional sets of drawings of the actual works of each area. These additional sets of drawings will be provided to the Contractor together with the corresponding service order.

During implementation of the works, if project changes are required, they will be implemented by the Engineer and become an integral part of the project. The Contractor is guided by figures of the project. In case of absence of any figures the Contractor receives it from the Engineer and the Engineer's decision is considered a final one.

1.5.2. Additional drawings

If needed, the Contractor can present a proposal in a form of drawing(s).

1.5.3. Detailed information on location of Contractor's facilities

The Contractor shall provide information on location of his facilities, including:

- the place of the Contractor's headquarters office and the laboratory places for testing of building materials, including the connecting ways.
- the location of working sites, places for spare parts (according to the fuel, lubricant, building materials) and the roads leading to them, the fence and the access.
- proposals for the implementation of the temporary works.

1.5.4. Working drawings and calculations

The Contractor shall present for the Engineer's approval the following information:

- working drawings of the pipelines to be laid (in the form of a plan view and a longitudinal profile, taking into account existing structures and networks)
- drawings of the shuttering of concrete works
- reinforcement provided for use
- concrete, if it is made in the factory conditions, or cement and inert materials, if the concrete is made in the construction site.
- prefabricated reinforced concrete constructions

- fasteners, water proofing and other materials
- all drawings of temporary works, including calculations
- alternative design solutions in form of drawings, if accepted by the Engineer.

1.5.5. Procedure of working drawings and calculations

All drawings and calculations designed by the Contractor should be presented by the following way:

- all drawings must be clean and completed
- it is advised to select the following scale in the drawings: 1:1000, 1:500, 1:100, 1:50, 1:20, 1:10 and 1:1, depending on the aspect of the drawing and the details indicated on it. The drawings must be of standard sizes.

Fifteen days before the beginning of the works the Contractor shall present two copies of these drawings for the Engineer's approval. After taking the Engineer's comments and proposals into account, the corrected drawings must be again presented in two copies for the final approval.

The beginning of the work of any section is allowed after the Engineer's approval of drawings and calculations.

The delay in receiving the Engineer's approval of the drawings and calculations does not make the Contractor free from the obligations and duties he has.

All kind of project changes proposed by the Contractor will be implemented without any additional payment.

In case of disagreement with the Engineer's alternatives and suggestions, the Contractor informs the Engineer in written form within a 7 days period and presents 2 copies of suggested drawings and/or the calculations to the Engineer. In case of new disagreement with the Engineer, item 1.5.8 of this Technical Specifications shall apply.

1.5.6. "As-built" drawings

All hidden works shall be registered in the order established by law.

Fifteen days before the completion of the constructions the Contractor must present 2 copies of factual as-built drawings with the location of the constructions, their depths, forms, diameters and material, grades and sizes indicated on them, as they are actually constructed.

1.5.7 Cost of drawings

The costs of all drawings and calculations presented to the Engineer are to be included into the bill of quantities of tender proposals.

1.5.8 Right to the design changes

The Engineer reserves the right of any changes in the design.

Architectural, design, technological and other changes of significant importance are to be agreed by the Engineer with the author of the design, as well as with the Client in the case the Contract price increases because of the changes.

During the implementation of the earthworks, after the opening of embankment or trench, the correspondence between the design and the sort of soils and their carrying capacity is recorded by engineer-geologist. In the case if soils with unsatisfactory carrying capacity are recorded as a

result of examination of the soil in the foundation of structures, a new design solution is to be developed.

1.6. Engineering survey and survey control

1.6.1. General provisions

During the implementation of the construction works the Contractor must ensure the design elevation marks, inclinations, angles and other design requirements. The layout of structures axis, angles and their fixing shall be implemented after the rooting out and clearing the site, but before the starting the other works.

1.6.2. Data on survey control

The Engineer provides the Contractor with all data necessary for the survey control of axis points.

The survey control of both axis and main points of the structures and water pipe-lines shall be controlled and accepted by the Engineer.

The marks and sizes are indicated on the drawings in meters and millimeters.

The benchmarks are presented to the Contractor with the notification about the beginning of the construction. But before the starting of the construction works the Contractor shall control the precision of the benchmarks according to the main benchmarks.

1.6.3. Temporary Bench Marks (TBM)

The Contractor must set up the TBMs for buildings and along all water pipe-lines. The distance of these TBMs from the axis line shall be coordinated with the Engineer.

The Contractor shall bring into a level all TBMs and refer them to the main and existing system of benchmarks.

1.6.4. Leveling control

The difference of the results of the repeated leveling must not exceed $5L$ mm, where: L is the distance of leveling points in kilometers.

1.6.5. Implementation and quality of the works

The Contractor must present to the Engineer the following:

- longitudinal section of the pipelines before the beginning of the works and after the completion of the works,
- cross-section of the water pipe-line at intervals not exceeding 25 meters (before the beginning of the works and after work completion). The cross-section shall include the whole width of the front of construction works,
- the Contractor shall hire qualified and experienced topographers for the implementation of geodetic works,
- during the implementation of geodetic works the Contractor shall use geodetic tools being in good repair and in proper condition,
- all field journals, calculations and maps used during the geodetic works must be presented to the Engineer after geodetic works.

Before the beginning of the geodetic works it is necessary to present the using tools and equipment for the Engineer's approval,

1.7. Ensuring the established level of quality

The quality of each implemented work must be on high level. All materials used must meet the required quality and comply with the specification.

1.8. Water and power supply on the construction site

The Contractor must personally arrange the implementation of power and water supply to the construction site.

If the concrete is to be prepared with water taken from a watercourse a chemical analysis of the water should be implemented to identify its fitness for usage to make concrete.

The provision of the heating of the temporary buildings should be implemented in accordance with the fire-prevention rules and requirements.

1.9. The mutual coordination with the water supply

The Contractor must arrange the schedule of organization of the works and implement the construction works in such a way that it is possible to provide a continuous water supply to the residential areas.

The schedule of organization of the works should be submitted for the Engineer's approval.

1.10. Photo works

The Contractor shall take photos of all the procedure of the construction works.

The expenses on photo works (including the compiling of album) are to be included in the unit costs of of tender proposal.

The photo album is handed to the client.

1.11. Materials

1.11.1. Documents to be presented

The Contractor shall present all materials' and items' certificates used during the work to the Engineer.

Before importing the planned devices and equipment, the Contractor shall agree the parameters of the devices and equipment with the Client and only after that initiate the procurement process.

The presented certificate of the materials and items must contain all necessary data about their origin, quality and established standard requirements.

1.11.2. Selection of the provider of the materials

Before signing the contract on the purchase of the materials with the supplier, the Contractor shall coordinate it with the Engineer.

If the quality of provider's works does not meet the Contract's requirements, the Engineer is entitled to reject the approval taken earlier. The Contractor must find a new provider, taking all necessary and unforeseen expenses on his account.

1.11.3. Samples

In addition to the samples of materials indicated in the specifications the Engineer is entitled to demand the selection of additional samples of materials used, which after getting the approval will be kept by the Engineer.

The Engineer is entitled to reject the purchase or use of any material if it does not correspond to the sample presented earlier.

1.11.4. Testing

The Engineer is entitled to request a testing of any material or item used.

The Contractor is obliged to provide the Engineer's access to his and sub-contractor's site in order to supervise the performance of the above-mentioned activity.

The Contractor is obliged to provide any necessary labor help, equipment and area for the implementation of the testing of the material, even if the testing is outside the construction site.

All costs related to the testing will be borne by the Contractor.

1.11.5. Testing certificates

In case the Engineer does not test the materials and items directly in the manufacturing place of this material, the Contractor must receive certificates from the provider and present them to the Engineer.

At the Engineer's request, any material or item with these certificates can be re-tested by an independent testing company.

If the Engineer finds out some item or material not corresponding to the certificate, or records their unfitness for the further use because of the wrong storage conditions, the materials must be removed from the construction site and replaced without any compensation for their cost and transport expenses.

1.12. Schedule of the construction

The construction starts from the day of putting the client's order in force.

The duration of the construction and terms of starting up are stipulated by the contract.

1.13. Program of works

Within 10 days of the delivery of the Letter of Acceptance, the Contractor shall present the detailed program of works and "Construction works organization design" for the Engineer's approval.

The program shall contain in graphical form illustrations according to the types of works, including the schedule of purchase of materials and items.

The program shall reflect the stages with the certain terms for each type of work.

After the Engineer's approval the program becomes an undivided part of the contract.

The program can be reviewed in 15 days and the Contractor is obliged to inform the Engineer about any changes proposed.

1.14. Accounts and meetings

1.14.1. Accounts

The Contractor regularly once a month can present the account of factually performed works to the Engineer, if not otherwise specified by the Contract.

The account form and the number of copies is identified by the Client.

In case of necessity the Contractor should include other data (if they do not contradict the present legislation) at the Client's order.

1.14.2. Meetings on the construction site

The Contractor shall participate to all meetings called by the Engineer.

1.15. Guidance to the working out of the order

1.15.1. Changes

In accordance with the contract general regulations, the Engineer, with the agreement of the Client or the design author, is entitled to make any necessary changes he finds appropriate, mentioned below:

- to increase or decrease the scope of any work stipulated by contract
- not to implement one or more of these works (on condition that they will not be done further by the Client, other Contractor or operating organization)
- to change the sizes of structures or the depth and grade of their location
- to implement the additional works for the completion of construction works
- to change the order or terms of implementation of the construction works.

The Contractor is not entitled to make any of above-mentioned changes without the Engineer's instructions.

1.15.2. Instruction to changes

Instruction to changes must be drawn up by the Engineer in the form of a Change Order.

The instruction shall have a consecutive number of change order. The number of contract, the description of changes, the reason of changes and the costs of changes of contract.

1.15.3. The estimation of changes

All changes will be estimated by the unit prices of similar works mentioned in the contract, if they are acceptable by the Engineer's opinion.

If there is not any kind of price of a similar work, some other prices for the similar work are assumed as a basis or a new price of the given work is decided after the cooperative calculation made by the Client, the Engineer and the Contractor.

In case of disagreement with the Contractor's part and before taking the final decision by the Client, the Engineer during the period of average estimation of works determines a tentative price, based and acceptable by him.

1.16. Temporary facilities of the Contractor

1.16.1. General provisions

The Contractor is responsible for the areas used for storehouses, offices, accommodation for workers, garages, laboratories, workshops, facilities for manufacturing of concrete and for other purposes.

Within one month the Contractor shall present to the Engineer a detailed plan in which all temporary structures with the roads leading to them, the lines of temporary electricity and water supply as well as heating are shown.

The district for workers, before its setting, must have necessary regulations during the construction period, and further be kept in proper condition.

The workers' homes must be furnished in a proper way.

The Contractor is responsible for these temporary facilities as well as for the construction of roads leading to them, the construction of these facilities and their further de-mounting.

The accommodation for workers must be open for the inspectors and meet the sanitary hygiene requirements, any remark should be immediately taken into consideration and corrected by the Contractor.

1.16.2. Providing safety requirements

The Contractor must ensure conforming to the safety rules' requirements established by the law.

The Contractor must follow the requirements of SNiP III-4-80 on "Construction safety engineering" and have the copies of the corresponding rules and standards.

The Contractor shall regularly instruct the construction staff on the safety engineering requirements and run a log.

The costs required for provision of safety rules must be included in the unit costs of works.

The Contractor shall provide safe implementation of all types of construction works, as well as access-roads for approaching of fire-fighting vehicles and ambulance car to the construction site.

1.16.3. Guarantee of sanitary hygiene requirements

The Contractor must ensure the satisfactory sanitary condition in the district for workers and on the construction site. The Contractor constructs and exploits the drainage of the surface waters and protects the drinking water from the pollution.

The Contractor must ensure the sanitary hygiene requirements according to the norms currently in force in Armenia .

1.16.4. Places of first (emergency) aid and labor protection

The Contractor is obliged to arrange the out-patient treatment of the staff, and in case of emergency (accident) take the sufferers to the hospital organize further aid to them.

Independent on the scope of the measures taken for elimination of emergency consequences and for medical treatment, the Contractor is responsible for their qualitative and operative implementation.

1.16.5. Places of rest

The Contractor must give or create the opportunity to arrange the leisure and entertainment measures.

The Contractor must also control safe conditions of the accommodation for workers and the implementation of the leisure measures.

1.16.6. Fire-prevention measures

The Contractor should provide the accommodation for workers, the stores for the fuel and building materials with fire-fighting equipment, set the signaling system and control its uninterrupted work.

1.16.7. Lighting

The Contractor on his account sets and arranges the system of lighting (inside and outside lighting) the site, the accommodation for workers, his office and warehouses.

The Contractor presents his plan to the Engineer's approval before the beginning of the work.

1.16.8. Fence

The contractor is obliged to fence the construction site.

The temporary fence must be agreed with the local (regional) authorities.

1.16.9. Clearing of the construction site

After the termination of the construction works and before the final handing the structures to the client, the Contractor must remove all mechanisms and equipment, clear the site from the unnecessary soil, stones, materials, waste and so on.

1.16.10 Geodesic equipment for the Client

The Contractor shall obtain geodesic equipment for use by the Engineer, keep it in a good state all along the works period and replace it with new one, if needed.

This equipment is ownership of the Contractor and must be returned after expiration of the Contract.

1.17. Excavation and removal and protection of the structures

1.17.1. Excavation and removal

After receiving the Engineer's approval, it is carried out the excavation and removal of structures that hinder the construction that are subject to realization.

All materials extracted during the excavation and removal of structures are stored in the certain storage coordinated by the Engineer.

The construction waste is to be removed to the landfill mentioned by the local governing body.

1.17.2. Backfilling of the small holes and leveling of the site

After completion of construction works, leveling of the site is carried out.

After the leveling of the site, flattened surfaces shall correspond to the former level and the pits shall be filled with the soil, providing the thickness of the upper vegetative layer.

1.17.3. Permission for the excavation and removal

The Engineer gives the written permission on the excavation and removal of the construction structures for which the Contractor is responsible.

The excavation and removal of the buildings and structures is forbidden without the written permission of the Engineer and the implementation of necessary measures.

1.17.4. Maintenance conditions of the roads

The Contractor is responsible for maintaining the technical condition of the roads where construction works are carried out. The Contractor implements on his account all additional works to keep the roads in proper quality and form including the additional measures on safety ensuring.

1.17.5. Protection of structures on the site

The Contractor is obliged to protect the existing structures, especially the trees and agricultural works from damage.

In case of damage of structures the Contractor restores them at his own expense.

1.17.6. Reduction of harmful effects

The Contractor shall take all necessary measures for the reduction (release) of harmful effect on the environment. These measures will be checked and monitored by the Engineer.

At a minimum, in order to release the harmful effect in form of dust caused by traffic, roads must be watered a few times a day, but the Engineer is entitled to ask the Contractor to take any additional necessary measure

The corresponding expenses of all these measures are deemed to be included in unit prices.

1.18. Removal of surface and ground waters

1.18.1. General provisions

The Contractor must provide the protection of ditches and foundation pits from penetration of surface and ground waters, and drinking water - from pollution.

The Contractor must ensure the uninterrupted work of drainage or pumps during the process of removal of penetrated ground waters.

1.18.2. Repair of damage

The Contractor is responsible for damage appeared as a result of his activity and is obliged to eliminate this damage.

1.18.3. Existing facilities and services

The Contractor must insure the integrity of all operated surface and underground facilities and services.

1.18.4. Ensuring of works in dry conditions

The Contractor shall ensure the implementation of the works in dry conditions and shall take all measures in order to not delay the works.

The Contractor is responsible for any delay due to insufficient dewatering.

1.19. Undersoil structures, cables and pipelines

1.19.1. Drawings

The alignment of the existing underground and over ground structures (canals, pipelines, cables, etc.) are mentioned in the drawings for information only.

Before starting the construction works, the Contractor shall apply to the organizations operating underground communications, for specification of the routes of the communications and gaining their agreement to conduct construction works in their zone.

1.19.2. Description and instructions

The Client or the Engineer provides to the Contractor the information on undersoil electrical cable and pipe-line and the instructions concerning their protection.

The Contractor must follow these instructions in order to protect the existing service lines, taking also into account updated specifications to be obtained from the corresponding operators.

1.19.3. Precautions

Mechanical excavators must not be used near the undersoil electrical cables and pipe-lines.

The works shall be conducted so that in case of possible accident there must be an access to it with the purpose of repair.

1.19.4. Intercommunication with the existing structures

During the implementation of the works the Contractor must ensure the protection of the existing buildings and structures from damage independently of their belonging to someone's property, if they are not intended for excavation and removal by the Engineer's instruction.

The Contractor must implement enough measures for their protection according to the Engineer's approval, and after the completion of the works he must demolish the temporary protective facilities.

The Contractor is responsible for the damage and is obliged to repair this damage at his own expense.

1.20. Construction and maintenance of temporary access roads

In case of absence of roads near the construction site, the Contractor must construct access roads at its own expense.

The Contractor must construct and explore the temporary access roads necessary for the implementation of contract works .

The temporary access and/or by-passing roads must be constructed when taking into account the traffic of lorries and other hard vehicles and equipment.

15 days before starting the construction the Contractor shall present to the Engineer the drawing of the temporary access and/or by-passing roads and the programme of their implementation.

The Contractor is not entitled to start the works before the Engineer's approval.

The Contractor must construct these temporary access and/or by-passing roads according to the approved drawings, and ensure their maintenance till the completion of the construction.

After the completion of the construction, the Contractor must remove these temporary roads upon request from the Engineer.

All roads existing on the area of construction site are considered as access roads. The Contractor fulfills their technical service and repair works.

The public and rural roads and bridges can also be used as access roads.

The Contractor fulfills the maintenance and repair works of these roads so that to meet the requirements of local authorities.

After the construction completion, the Contractor shall rehabilitate the roads to their previous form.

1.21. Laboratory and laboratory equipment

The Contractor must provide a suitably equipped laboratory, where it will be possible to implement the testing of materials mentioned in the technical specifications.

10 day before starting the construction the Contractor must present to the Engineer's approval the schedule of laboratory testing of the materials.

This schedule must contain all the necessary tests of all materials, as well as the list of laboratory equipment and materials necessary for analyses.

The laboratory maintenance, electricity and water supply is at the expense of the Contractor.

The Contractor nominates the head of laboratory responsible for testing. At Engineer's or his representative's request the Contractor makes tests in their presence.

The Contractor is allowed to rent such a laboratory.

1.22. Exploration drilling and trial pits

In order to determine the technical peculiarities of the foundations of soilstructures the Contractor can make the exploration drilling or opening of prospective pits.

1.23. The client's and Engineer's requests concerning the control of construction works

The Contractor will meet the client's and Engineer's requirements mentioned in TS, item 3 and in bill of quantities.

1.24. Temporary use of private land

Temporary use of private land is implemented according to the laws and regulations currently in force.

The implementation of construction works within the area is forbidden until a written agreement of the land owner has been received by the Engineer.

It is necessary during the process of work to provide the protection of the land and the buildings situated on this land, and after the works to restore the former condition of the land.

2. STANDARDS AND NORMS

2.1. Standards and norms

The design solutions are mentioned corresponding to the construction standards and norms of the Republic of Armenia and the former USSR, therefore all construction works must be implemented according to the requirements of these standards and norms.

The Contractor may propose standards and norms of other countries instead of the mentioned ones, if they are not inferior to the planned ones.

The Contractor presents the detailed description of their requirements for the Engineer's approval. This presentation should be at least 28 days before the approval day.

If in the opinion of the Engineer, the suggestion does not meet the provided requirements, the Contractor must operate with the standards mentioned in the design.

The Contractor must gain the certificates of all necessary materials and items and at the Engineer's request present these certificates for checking the correspondence of the quality of materials and items.

If the requirement concerning the quality of materials and works is not mentioned clearly or completely in the contract documents, the latter must be of high quality.

The Contractor must have in the construction site at least one copy of the approved standards of all construction works and the latter must be accessible for the Engineer's use.

2.1.1. Basic list of standards and norms

General position and rules of works implementation

SNiP 3.02.01-87	Earth structures, bases and foundations
SNiP 2.04.02-84*	Water supply: external networks and structures
SNiP 3.05.04.-85*	External networks and structures. Water supply and wastewater removal
SNiP III - 42-80	Main pipelines
SNiP 2.04.02-85	Sewerage: external networks and structures
SNiP 2.03.01-84*	Concrete and ferroconcrete constructions
SNiP 2.06.08-87	Concrete and ferroconcrete constructions of hydrotechnical constructions
SNiP 2.03.11-85	Protection of construction structures from corrosion
SNiP 3.04.03-85	Protection of construction structures and facilities from corrosion
SNiP 3.01.01-85*	Construction production organization
SNiP 3.01.03-84	Land surveying works in construction
SNiP III – 4 -80*	Construction safety engineering

By materials and works

Concretes, mixtures – GOSTs 5802-86, 7473-2010, 10180-90, 18105-86, 22690-88, 24211-2008, 25192-82, 25246-82, 25820-2000, 25881-83, 26633-91, 27006-86, 28013-98

Cement - GOSTs 125-79, 965-89, 969-91, 10178-85, 22236-85, 22266-94, 25328-82, 30515-97, 31108-2003

Crushed rock, gravel, sand GOSTs 8267-93, 8735-88, 8736-93, 22263-76, 23735-79

Water for mixture, concrete	GOSTs 23732-79, 27384-2002
Reinforcement and mesh	GOSTs 380-2005, 2246-70, 5781-82, 6727-80, 7348-81, 10884-94, 10922-90, 23279-85
Electrodes, welding methods, testing of welding seam	GOSTs 5264-80, 9467-75, 14098-91, 19521-74, 25997-83, 26389-84
Pipes and shaped parts	GOSTs 3265-75, 8437-75, 8731-87, 8733-74, 9544-2005, 10704-91, 10705-80, 10706-76, 10707-80, 12815-80, 18599-2001, 22130-86, 22446-77, 22689.0-89, 22689.1-89, 22689.2-89, 23289-94, 25812-83, 26349-84
Layer steel, corrugated steel, shaped steel	GOSTs 103-2006, 2590-2006, 8239-89, 8240-97, 8509-93, 8510-93, 8568-77, 14637-89, 19903-74, 23118-99, 24839-81, 26020-83, 27772-88
Concrete and reinforced concrete construction	GOSTs 8020-90, 8717.0-84, 8717.1-84, 9561-91, 13015-2003, 18979-90, 18980-90, 21506-87, 23478-79, 23616-79, 26815-86, 27215-87, 28042-89 AST 153-2005
Protectuion against corrosion in construction	GOSTs 9812-74, 25621-83, 28574-90
Materials for cover construction	GOSTs 2697-83, 2889-80, 6617-76, 7415-86, 9548-74, 10296-79, 10923-93, 10999-76, 30547-97, 30693-2000
Surfaces cleaning level	GOSTs 9.402-80
Adherence quality	GOSTs 15140-78
Scaffolds and tipping bridges	GOSTs 27321-87, 27372-87, 28012-89

2.1.1. Other standards

Any other similar standard to the above ones and from ISO, EN or BS can be applied.

The Contractor shall also refer to other standards stated in the subsequent sections of these Technical Specifications.

2.2. Tolerance

The Contractor implements the construction works of the programs, technical specifications, as well as SNiP 3.03.01-87 and corresponding measures within the required tolerances. The Client is entitled for the given construction to request the corresponding degree of accuracy in order to implement the works.

3. DETAILED SPECIFICATIONS

3.1. General provisions

3.1.1. Guarantee

The cost for the implementation of all guarantees necessary under the contract is to be foreseen in the Contractor's price.

While preparing the bid, the Contractor shall include in the unit costs the costs related to the organization of the construction works.

3.1.2. Insurance

3.1.2.1. The insurance of structures

The Contractor is obliged for insurance of the works intended by the Contract.

3.1.2.2. The insurance of third parties

In order to implement the Contract obligations, the Contractor is obliged to provide an insurance to protect third parties against damages caused by works.

3.1.2.3. The insurance of workers from accident

The Contractor is obliged to insure the workers taking part in construction works, during the whole construction period.

3.1.3. Temporary equipment of the Contractor

The Contractor must build, store and further remount or remove his temporary facilities, in order to properly organize the course of the works.

All expenses connected to the above mentioned (item 1.16) are deemed to be included in the cost estimation.

3.1.4. Temporary access roads

All expenses connected to the construction, storage of the temporary access or by-passing roads and in future to the restoration of the site as well as the rent of land (paragraph 1.20) are deemed to be included in the cost estimation.

3.1.5. Accounts and photo works

The Contractor presents all kind of accounts, reports, correspondences, documents not requiring a separate payment, to the Engineer or a Client, according to the agreement, with the exception of the photos which become the client's property.

Expenses borne by the Contractor (1.10) and connected to the photo works, are deemed to be included in the cost estimation.

3.1.6. Removal of the surface and ground waters

The expenses connected to the works mentioned in paragraph 1.18 are deemed to be included in the cost estimation.

3.1.7. Laboratories and laboratory equipment

The Contractor's expenses for the implementation of the works mentioned in paragraph 1.21 are deemed to be included in the bill of quantities.

3.1.8. Exploration drilling and prospecting pits

NA

3.1.9. Measurements and payment

The payments will be made according to the bill of quantities and actual works executed.

3.2. Clearing and uprooting

3.2.1. General provisions

The clearing of the site, the uprooting, the removal of bushes and other unnecessary plants from the construction site and the tap zone are included in this section of the specifications.

3.2.2. Clearing of the construction site

After taking the Engineer's approval the Contractor removes all the obstructing trees and bushes from the work implementation area. Other trees on the site must be protected from damage.

At the Engineer's request all necessary materials and equipment must be stored and handed to the Client's representative. All other materials must be burnt or removed outside the site to the zone coordinated with the Engineer and local bodies.

3.2.3. Notification of the beginning of the works

Before the beginning of uprooting and the clearing of the site the Contractor must apply to the Engineer in the written form and begin the works after receiving the written approval from the latter. Before the beginning of the construction works the Contractor must finish the process of the uprooting and the clearing of the site.

3.2.4. Valuation and payment

The payment for uprooting and the clearing of the site is implemented for one square meter.

3.2.5. Clearing (stripping)

3.2.5.1. The general description

This part of the specification includes the clearing of soil layer and stock-piling on the area of construction, in the separated places designated for these purposes.

3.2.5.2. Clearing

The clearing consists of the removal of all organic, materials unnecessary for the construction (soil layer, roots) from the foundations of embankments and roads and pits.

The materials useful for agricultural purposes are collected in the separate place for the further use.

The materials not suitable for further use are stored in the separate disposal area.

The Engineer determines the degree and quality of clearing.

3.2.5.3. Valuation and payment

The measurement for payment is to be carried out by square meters.

3.3. Earthworks

Before beginning the works, the Contractor shall study in detail and clarify the existence of underground and over-ground structures (networks or other structures), their location in plan and take measures for safety works and for providing the continuous operation of the existing structures.

3.3.1. General provisions

The earthworks consist of the development of excavations and trenches, backfill, the removal of soil.

These works include the transportation and the piling, dewatering, pumping out, final leveling of excavations, trenches, embankments and excavations according to the depths, widths, and levels defined on the drawings.

While making the estimation of earthwork the Contractor shall take into account that the trench volumes in the design are calculated with slopes.

The Contractor shall also take into account the geotechnical and hydrogeotechnical conditions.

During evaluation of earthwork the Contractor shall take into account that excavation of soils in the zones of underground networks, reservoirs, spring intakes and other structures must be done manually.

During excavation in streets with asphalt-concrete cover the cut asphalt-concrete fragments must be loaded on trucks and transported to landfill.

3.3.2. Classification of the materials

3.3.2.1. The simple development of soil

The simple development of soils is carried out in vegetable layer, sand, clay, mud, peat, major-block and other similar non-rock grounds, which are developed by spade, mattock, excavator, scraper and other common land digging mechanisms.

The dismantled rocks are also considered to be not mountainous rocks, which are composed with the clods not exceeding 2/3 size of the excavator scoop or if their weight is not exceeding 25kg in the case of hand development.

3.3.2.2. Development of rock and semi-rock soils

The rock and semi-rock soils are those ones, for the development of which it is required to carry out preliminary hoeing through granulating hammers or explosion.

The excavation of rocks and concrete and reinforced concrete constructions is implemented up to the level when it is possible to load them on dump-truck.

Explosive works can be allowed only in the case of existence of the design agreed with the corresponding over-controlled body.

3.3.3. Separate types of construction works

3.3.3.1. Preparatory works

Before the earthworks the preparatory works must be implemented according to the requirements of the TS. Before each development the examination (prospecting, survey) is implemented.

The preliminary valuation (measurement) is implemented by means of registration of the examination results in order to more accurately determine the scope of works.

The clearing and uprooting is implemented in all excavated zones according to the paragraph 3.2. The stripping works and storage of vegetative layer is implemented according to the paragraph 3.2.

3.3.3.2. General requirements

Earthworks are implemented under the Engineer's control.

If during the work there is a necessity at the Engineer's request to change the slope grade of the excavation or embankment, the Contractor must meet these requirements.

In case of increase or decrease of the scope of earthworks the condition of "change" is in force.

All soils dangerous for landslide the scope of which is not included in the project are to be completely removed at the Engineer's request to avoid the further destruction.

The excavation planned for the non-construction structures are implemented by the sizes designed by the Engineer.

Necessary measures must be undertaken in order to maintain the layer under the survey undamaged.

All additional excavations made by the Contractor must be backfilled and compacted by the Contractor.

All necessary materials must be placed not far from the excavations.

The materials used in the embankments must have optimal moisture.

During the implementation of earthworks there are possibly some parts of land where crossing the existing and operating structures will be necessary. The Contractor must take into consideration these circumstances and choose the corresponding construction technology and equipment in order to work in such conditions.

The Contractor must fulfill the corresponding measures to protect the structures from the surface waters.

During the excavation when it is a gravel useful for further works, it is necessary at the Engineer's request to store this gravel for the further use.

After excavation of pits or trenches, the materials useless for other purposes are moved to a disposal area approved by the Engineer.

All disposal areas are leveled and profiled according to the Engineer's instruction.

3.3.3.3. Excavation of pits or trenches

In case of mechanized excavation of trenches or pits, they are excavated up to the marks indicated on the drawing with 10 – 15cm shortage, after that developed by hand up to the design mark.

After opening the trenches or pits, the Contractor's engineer-geologist examines the foundation soils in order to determine their conformity with the design. Only after receiving his approval, it is allowed to carry out the works of the next stage.

If the soil of the foundation does not correspond to the design one and is not suitable for the foundations, an additional design solution is developed.

The scope of additional works will be taken into account by the Engineer.

The Contractor will take into account that the excavation of trenches will be carried out in the conditions of wet soils.

Measures are to be taken for ground water removal and keeping the trench dry, as well as for avoiding collapses.

The inclination of the slope of trenches or pits must correspond to the design one.

The slopes must be cleaned from the unstable rocks or be reinforced.

3.3.3.4. Preparation of the bases

In order to place the structures after the development of the pit, it is necessary to receive the engineer-geologist's conclusion and Engineer's approval.

The weak bases are reinforced according to the design.

The base of structures must have contours and grade indicated in the project.

If during the excavation without the Engineer's instruction, the mark of the pit is lower than one mentioned on the design, the Contractor implements on his account the concrete works of the foundation until the mark indicated on the project. In such a case it is prohibited to make the ordinary back covering to get to the mark mentioned on the project.

3.3.3.5. Leveling works

The leveling works include the development of the surfaces and the profiling. The difference between the leveled surface heights and the design heights shall not exceed ± 150 mm, if not otherwise planned under the design.

During the recultivation of the site the thickness of the soil layer must be not less than 100mm.

3.3.4. Excavation of the soil for the structures

3.3.4.1. General provisions

The grade of slope of the excavation for the foundations of structures and the mark of the base and the kind of the soil must correspond to the project and satisfy the Engineer's requirements.

3.3.4.2. Additional earthworks

If during construction the level of the excavation developed for the construction or the level of the base of trench of the pipe-line, is lower than one in the design, it is necessary to create a new solution and bring it to the level mentioned on the project on the Engineer's instructions.

3.3.4.3. Inspection

After the termination of earthworks the Contractor informs the Engineer in order to get the Engineer's approval about the depth of the excavation and the base must be cleared from granular materials.

3.3.4.4. Unsuitable materials

During the implementation of earthworks unsuitable materials must be removed.

3.3.4.5. Resistance of slope during the development of soil

The sizes of excavations and trenches made for the structures must give the possibility for the free implementation of the foundations. During this period the Contractor is responsible for the resistance of slope and must foresee its reinforcement.

3.3.4.6. Resistance of slope of rocks

The grade of slope more than 60° is not stable and can bring to its destruction. The Contractor must foresee the activity providing the resistance of the slopes which must be approved by the Engineer. The cost of such works must be included in preliminary calculation.

3.3.4.7. Change of inclination of slopes

During the works there must be the necessity to change the inclination of slopes or sizes of excavations. According to the contract, the Contractor is not entitled to additional payments for the change of excavation works.

3.3.4.8. Dump of soil

The Contractor must transfer the dumped soil and place it in the special places for the dumps. This soil can be used for the filling and other purposes at the Engineer's instruction.

3.3.5. Development of the soil in trenches and pits

3.3.5.1. Change of the sizes

The trenches and pits must be dug according to the sizes and inclinations of slopes, indicated on the drawings, if there is no necessity to change the slopes of the excavations and sizes in terms of correspondence of the soil with the design features. The Engineer informs the Contractor about the changes of sizes in written form.

The payment for additionally carried out earthworks is carried out in accordance with the amounts mentioned in the cost estimation.

3.3.5.2. Water removal (water pumping) from the trenches or pits

During excavation of trenches or pits it is necessary to take measures for removal of surface and ground water. The measures to be taken are to be agreed in advance with the Engineer. Not depending on the type of excavation (dry or humid) of the trench, changes in the estimates of the payment are not made.

3.3.6. Backfilling

3.3.6.1. General provisions

Backfill is carried out manually and mechanically, from excavated material or from soft soils brought on site.

In case of polyethylene pipes, after the protective sand layer, and on the steel pipes the first 50cm layer of backfill is implemented of soft soil.

3.3.6.2. Compaction of backfill

The backfill must be homogeneous in the density. The backfill is compacted in the horizontal layers of equal thickness. The stones in the soil with the size more than 2/3 of the height of the fill layer is not permitted.

In the dependence on the compacted material and types of equipment for the packing, the thickness of the layer must be approved by the Engineer, if these parameters are not set by the project. During the process of packing of the first layers of the fill, the degree of the packing, optimal humidity of the soil must be confirmed.

The surfaces of connected soils (loam, clay) before the fill of the next layer must be loosened on the depth of 5 cm.

The density of each layer must be checked by the Engineer.

Over-humid soil is dried by scooping and ventilation. The sections of the fill not approved by the Engineer because of insufficient density or bad condition of soil must be overdone without additional payment.

3.3.6.3. Tests of the compacted backfilling

The parameters and fitness of the compacted filling must be checked at the Engineer's instruction according to the procedures described in the norms. The density of the filling must be not less than the natural density of the soil.

3.3.7. Control, measuring, payment

3.3.7.1. Control of the earthworks

The control of the excavations for the structures is implemented according to the corresponding sizes in the plan, the marks of the base, the contour interval of the slopes.

During the implementation of works the Engineer classifies the soils by the categories (if the different prices are set up by the contract).

The parameters of the reserve excavations and the fill of the dumps are also under the control.

The fillings are controlled by sizes and density. Three samples are selected from each layer of the fill: in the loam and clays - by the method of pressing into the calibrated cylinder with the diameter of 50mm, 75mm, in the granular soils - by the pit with the sizes of more than 3 sizes of the biggest piece of the rock. The density is determined by the weight of the rock in the circle or selected volume of the pit which is determined by the volume of the filling of the pit by the sand from calibrated capacity.

Not less than 9 tests (from each 10 ones) must show the capacity equal or higher than one in the design. The proportion of one from 10 to the less side can be not more than 5% from one in the design.

The capacity of each layer of the filling is determined by as the average one from 2 nearest indicators of 3 tests.

3.3.7.2. Measuring of the scope of earthworks

The excavation of the soils is measured in m³ in the frame of indicated in the drawings. Additional excavation made by the Contractor's fault is restored by the Contractor without taking into account the scope of works. Additional development necessary because of inclination of bases or slopes is taken into consideration by the Engineer in the sizes indicated by him.

The scope of works is taken into consideration according to the categories of soils with their natural capacity.

The volumes of fillings are measured by the amounts of the compacted soil within the project outlines.

All volumes are set up by the measuring reel or geodetic survey. The excavation and embankments implemented by the Contractor for his own purposes are not taken into consideration.

3.3.7.3. Payment

The payment is implemented by measurement approved by the Engineer according to the actually implemented scope of earthworks. The repeated works implemented by the Contractor in order to liquidate the defect in the work are not paid. The cost for the accompanying works according to the design is taken into account in the price list of the main works. The cost of works on the confirmation of bases are accounted separately and paid in the contract terms.

3.3.8. Geotechnical surveys

3.3.8.1. General provisions

If the Contactor deems it necessary, he has to carry out geotechnical investigations at his own expenses, except otherwise stated in the Contract.

3.3.8.2. Inspection

The Engineering-geotechnical surveys are completely implemented by the competent staff under the guidance of a qualified engineer.

3.3.8.3. Laboratory testing

The program of the laboratory testing is defined by the Contractor.

3.3.8.4. Valuation and payment

The cost of geotechnical investigations is deemed included in the global price of the Contractor.

3.4. Explosive works

3.4.1. Description

In the following section the conditions, demands and statements are described for development of rock and semi-rock soils by explosion method in the trenches and pits.

3.4.2. General requirements

The permission for the implementation of explosive works and permissible parameters of the explosion are given by the State Mining and Technical Inspection and by bodies of internal affairs. Explosive works can be implemented only after the written permission of the Engineer.

The Contractor must meet all the current norms of the Republic of Armenia (maintenance of the explosion materials, replacement, storage and usage).

After receiving the approve of the Engineer the Contractor can chose any method of explosion works meeting the safety rules' demands.

For the explosion works the Contractor gets from the store and transfers to the object the necessary volume of the explosion material only for the given day.

The explosion materials intended for usage must be kept in the safe place, at the safe distance from the explosion place and be under the guard control.

To keep explosives In the place where the explosion materials are kept is not allowed.

Not used explosives must be transferred to the store on the same day.

The Contractor must do all the instruction of the Engineer and is responsible for all consequences of the explosions.

3.4.3. Materials, Tools And Equipment

All the materials, tools and equipment that are used must be approved by the Engineer.

The Engineer can determine the certain type of the explosive for the given place.

The safety device of the explosive must protect the explosive from the influence of humidity of the wet media within 30 minutes in the wet soils.

The fuse must have sufficient safety length.

All the explosives must be new and dry. Before the beginning of the work all the explosives must be observed and damaged ones must be rejected.

3.4.4. The Staff

Explosion works must be implemented and controlled by the skilled specialists.

3.4.5. Explosion Works

The explosion works are implemented at the certain hours, that's to say in the afternoon or in the evening, at the end of the working day.

The employees nearby must know about the hours of the explosions in advance.

All the fillers for the explosions are prepared by the supervisor of the explosion works.

Before the implementation of the explosion works red flags must be installed at a distance calculated for all directions and the people must be evacuated.

The explosion holes with the demanded depth must be dug in the places mentioned previously.

The explosion must be as light as possible (not strong).

The method of explosion that can cause damage must not be used.

In the case when the explosion works must be carried out by means of the explosion powder, fuse with the demanded sufficient length must be installed in the explosion holes dug previously and only afterwards the explosion powder is filled into the holes. The explosion powder must be carefully strengthened by a copper stick with round head, afterwards the explosion hole must be carefully filled and strengthened with soft soil.

The given design does not foresee soil ripping by the help of the dynamite.

Every explosion is implemented not more than after filling 10 times.

The supervisor of the explosion works warns the people to leave the dangerous zone by whistling and only he has the right to implement the explosion.

The entrance of people after the explosion can be allowed only after being sure that all the fillings have been exploded. This permission can be given only by the work supervisor.

3.4.6. Filling Failure

In the case of the filling failure the following process must be implemented.

Certain time is necessary to determine the reasons of the failure of the filling.

The supervisor of the works observes and determines not exploded fillings and in the case if they are filled with explosion powder the explosion hole is filled with water.

A new explosion hole is dug and filled with water at the distance of 45cm from not exploded filling.

This process is repeated for many times until the explosion of not exploded material.

The supervisor must inform the Contractor or the Engineer for every filling that has not exploded.

3.4.7. Register

The detailed description of the daily explosion works must be registered in the register of the Contractor and must be available to the Engineer.

3.4.8. Valuation and Payment

A separate payment is not foreseen for the implementation of explosion works.

3.5. Concrete works

The Contractor must take into account and include in unit costs of bidding documents the costs related to construction and dismantling of temporary decks.

3.5.1. Structure of works

The implementation of concrete structures includes the following works:

- supply of the materials;
- test of materials;
- installation of forms;
- manufacturing of concrete mix;
- delivery of concrete mix to the construction site;
- packing the concrete into the structure and care for the concrete;
- control of the quality on all above-mentioned processes.

3.5.2. Drawings, calculations (cost estimates) and the method of the implementation of works

Before the beginning of works the Contractor must present to the Engineer's agreement:

- work drawings of the structures
- the drawings of forms
- the calculation of expenditure of the main materials
- description of methods of implementation of main works.

The description of the methods of implementation of works must contain the details on:

- production of concrete (dosage and method of production);
- method of transportation of concrete;
- packing of concrete mix into the structure;
- description of vibration system for the concrete packing;
- cure;
- control on the quality of works
- work schedule.

3.5.3. Materials

3.5.3.1. Cement

For the implementation of concrete works Portland cement (GOST 22236-85) or Portland blastfurnace slag cement is used. The improvement of the cement by additives is permitted for increasing the activity and decreasing exothermicity.

3.5.3.2. Checking of cement quality

Before the delivery of the cement on the construction site the Contractor must present to the Engineer the certificate of the quality for each lot where the main characteristics of the cement are indicated in the conformity with the requirements of GOST and TC(technical conditions).

Each certificate must show that the sample of the lot is tested by the manufacturer and corresponds to the technical certificate.

At the Engineer's request the Contractor is obliged to test the samples of cement in his laboratory. No one lot of delivery of the cement will use without the Engineer's approval. If on some reasons the Contractor wants to change the manufacturer of the cement, he should inform the Engineer, implement a new control and receive the Engineer's written agreement. The Engineer must require new test on the Contractor's account if the cement is stored for more than three months.

3.5.3.3. Transportation and storage of cement

The transportation and storage of cement is implemented according to the GOST 22237-85. The cement must be transported in the specialized cars and cement trucks, and in bags on covered vehicles.

The marking of cement in the bags is implemented on every bag and on the cement which is dispatched without package - on the labels stuck to the vehicle. The cement must be stored separately by types and marks in covered dry spaces.

The mixing of cement of different types and marks as well as its pollution with strange admixtures and humidifying are not permitted.

The storage of cement on the open air is permitted only for small works and at the Engineer's approval.

During the storage the bags with the cement are packed on the tray in the rows with the height of 1,8 m with the free access to them.

The storage of cement without the package in the warehouses is not permitted.

3.5.3.4. Measuring of expenditure of cement

The expenditure of cement is measured in tons and kilograms.

3.5.3.5. Sorting of the cement

The Engineer can reject any lot of cement according to the results of testing on the strength and chemical composition as well as in case of its damage as a result of its bad storage or other reasons.

The Contractor must immediately remove the defective cement from the construction site.

The defective cement belongs to the Contractor's account.

3.5.3.6. Quality of water

The water used for the manufacturing of concrete mix must not contain admixtures in the quantities preventing normal setting and hardening as well as the corrosion of the reinforcement and must meet the requirements of GOST 23732-79.

The Contractor must deliver the results of chemical analysis of water, which must be used for the implementation of works in order to confirm the correspondence.

The Contractor must provide a sufficient water supply for the concrete mixture, washing the aggregate and cure.

3.5.3.7. Fitness of the aggregate for the manufacturing of the concrete

Fitness of materials suggested as aggregates for concrete works is determined based on positive results of laboratory tests, about which the corresponding certificate is made. This certificate is the main document on the properties of these aggregates.

3.5.3.8. Fine aggregate

For the concrete heavy (river, quartz) sand is used. The sands of quarries of litoid pumice stones and volcanic slags are not permitted. The availability of grains of gravel more than 10mm in the sand, provided for the concrete according to the GOST 8736-93 is not permitted. The maintenance of particles smaller than 0,15 mm must not exceed 2%.

3.5.3.9. Coarse aggregate

Large aggregate for concrete can be: crushed rock, broken gravel. The sizes of stones of large aggregate for the structures with the thickness to 500 mm, are from 5 to 40 mm, and for backwater walls and other massive structures – up to 70mm. Large aggregate must use only fractionated and correspond to GOST 8267-93 and GOST 8268-82. The crushed stone without screening is not permitted to use. The large size of the stones of the aggregate of concrete mixes for the reinforced structures must not exceed one third of the distance of reinforcement bars.

3.5.3.10. Acceptance and storage of aggregates

Delivery and acceptance of aggregates is implemented by lots. The lot is the quantity of aggregate simultaneously dispatched to the client during 24 hours.

Small and large aggregates are stored separately each from other and in separate bins or on different areas.

3.5.3.11. Preparation of aggregates for testing

The Contractor is obliged to present to the Engineer the samples of small and large aggregate, suggested for use by them for manufacturing of concrete mix.

Testing of aggregates is made according to GOST 8735-88, GOST 8269-87 and GOST 9758-86. The delay of the works caused by wasting of time on the tests is not permitted. During the change of aggregates at the Contractor's suggestion and under the Engineer's approval during the implementation of works, all testing is repeated.

3.5.3.12. Testing of aggregates

During the period of the contract the small and large aggregates are tested at the Engineer's request at the Contractor's account. While using the aggregates for the first time the complete cycle of testing is implemented, during the works - the brief one.

During the complete cycle of testing the following things are determined:

- a) specific gravity of the weight of sand, crushed rock;
- b) grain composition of sand, crushed rock and the sand gradation factor;
- c) content of dusted, muddy and clayey particles in the crushed rock and sand;
- d) colorimeter test on the presence of organic admixtures in the crushed rock and sand;
- e) vacuum of crushed rock;
- f) water absorption of the crushed rock.

3.5.3.13. Presentation of samples

The samples of cement, water, small and large aggregates are presented by the Contractor for testing 2 weeks before the placement and consolidation of concrete.

3.5.3.14. Concrete admixtures

The admixtures to the concrete are used only with the Engineer's permission which is confirmed in writing. The Engineer can require the manufacturing of cubes with the admixtures as well as their testing on the Contractor's account. The Contractor presents the complete description of

chemical composition of the admixture and the complete description of its influence on the concrete mixture.

The Contractor makes the trial mix of concrete which is made and placed in the required conditions. The selected samples are tested on the strength of concrete, water absorption, density, cold-resistance placeability and settlement of cone of concrete. These data are compared with the same aggregates and cement, but without admixtures made with the testing data of concrete. If while using the admixtures the quality of concrete deteriorates, the use of admixtures is not permitted.

The additional payment, caused by the delay admixture selection, is not given. The Engineer is entitled to select the admixture and methods of their use.

3.5.4. Procedures on the mixing and testing

3.5.4.1. Concrete class

According to the given project the following classes of concrete are set up:

N	Name of parameter	Concrete preparation layer B 7.5	Concrete of foundations and walls B15F100W4	Reinforced concrete constructions B20F150W4
1.	The strength of test cubes after 28 days, kg/cm ²	100	200	250
2.	Minimum expenditure of cement, kg/m ³	180	380	400
3.	Maximum size of large aggregate, mm	40	40	40
4.	Plasticity of fresh concrete mixture Settlement of cone, cm	4-6	4-6	3-4

3.5.4.2. Proportion of materials

The proportion of the materials for concrete must be selected, taking into consideration the required concrete properties, the purposes of constructed facilities and conditions of their work.

The concrete mixture production, the receipt, control and transportation must correspond to the requirements of GOST 7473-2010 and GOST 27006-86. The composition of concrete is calculated by the specialist on the base of checked methods.

3.5.4.3. Trial mix and preliminary testing

Not later than 15 days before the beginning of the concrete works the Contractor informs the Engineer in written form about the composition of suggested mixture. The testing cubes are made from each trial mix for their further testing.

The Contractor prepares a trial mix which has required strength, placeability, cold-resistance, waterproofness, etc.

The trial mix is made and packed in the Engineer's presence, using the equipment which must be used for the implementation of works.

The standard cubes with the sizes of 200x200x200 mm or 100x100x100 mm, in 3 shapes by 3 cubes each. The cubes are stored under the temperature +20°C and humidity 80%.

3.5.4.4. Testing of samples

During the initial selection of the concrete composition, the testing is implemented on the strength, frost resistance, water resistance.

Thereafter, during each shift of the placement and consolidation of concrete, the testing is implemented only on brick strength. The checking of the concrete strength is carried out through taking by three samples from at least two different places during each shift from the mix of the same features and prepared with the same technological cycle.

During all tests, the 2 closest results are taken into account from each group of 3 cubes. The results from different groups are also averaged in the same way (3 shapes of 3 cubes).

3.5.4.5. Determination of moisture in the aggregates

The control of the precise moisture content of the aggregates is implemented before the beginning of concrete works in order to determine the quantity of water added to the mixer. For this purpose the Contractor must prepare an estimation table which gives the dependence on the moisture content, quantity of water added to the mixer, as well as on the class of concrete. This table is presented for the Engineer's approval.

3.5.4.6. Determination of the mobility of concrete

The mobility of concrete is characterized by the size of the settlement of cone and expressed by cm. The mobility of concrete is determined to the accuracy up to 1cm as the arithmetic mean of 2 determinations.

In the case when the mobility index is 0, the mixture is considered not having the mobility and must be characterized by the index of stiffness.

3.5.4.7. Determination of the stiffness of concrete

The stiffness of concrete characterizes its placeability and is measured by seconds. The stiffness is determined by the time of vibration necessary for the settlement of cone more than 12 cm. The stiffness of the mixture must not exceed 25 seconds, it is checked once or twice per shift.

3.5.4.8. Determination of the strength of concrete in the structures without destruction

The control of the mark class of concrete, reinforced concrete structures and facilities can also implemented by non-destructive methods by means of striking, acoustic, roentgenometric technique of determination of concrete strength, its homogeneity, the presence of pores, cracks, etc. If such testing shows that the concrete does not correspond the submitted requirements, the possibility and order of checking of defects are set up with the design company.

The strength of the concrete can be checked by the Schmidt dynamometer, Borovoy or Kashkarov hammer.

3.5.4.9. Weighing and mixing

The mixture must be made in facilities with weighing. The average accuracy of automatic (or semi-automatic) scale must be not less than 2%.

The volume measuring & the mixing by means of hands is not permitted. It is not permitted to change arbitrarily the speed of rotation of the drum of the concrete mixer or the quantity of materials loaded in it.

The duration of mixing of stiff mixtures is limited to a maximum of 4 minutes, and of plastic mixtures a maximum of 2 minutes.

In the case of stoppage of the mixer for more than 1 hour, it must be thoroughly cleaned.

The Engineer can require from the Contractor to clean the mixer frequently from the hardened concrete.

3.5.5. Placement and packing

3.5.5.1. Preparation works

The placement of concrete should begin only after the written permission of the Engineer and after signing the act on the hidden works.

The form-works are implemented on the construction site according to the section 3.6 Before the placement of concrete mixture the form must be thoroughly cleaned. All equipment and materials must be completely ready on the construction site before beginning the implementation of concrete works. The Engineer's permission for the implementation of concrete works is received after the implementation of preparing works according to the technical specifications.

The form prepared for the concrete will maintain sufficient moisture and not be deformed. The steeping and spraying of the form is implemented by clean water. The Engineer can forbid the placement of concrete in form if, in his opinion, it does not correspond to the requirements.

3.5.5.2. Procedure of placement

Before the placement of concrete mixture it is necessary to check the correctness and reinforcement of the form according to the design The form must be clean.

The surfaces of wooden forms adjacent to the concrete must be wet.

The surfaces of the wrapped wooden, plywood and metallic form must be covered by lubricant.

The placement of concrete mixture must be implemented without stop. In case of the interruption or break (with the Engineer's permission) in the placement and consolidation of concrete, the surface of concrete must be covered.

In case of cessation of the placement of concrete it is necessary to undertake the precautionary measures in order to provide the satisfactory adhesion of the further mixes of concrete.

If the delay of placement and consolidation of concrete is more than one hour, the joint so formed is considered as a construction joint.

The horizontal surfaces of the earlier placed concrete before the placement and consolidation of concrete after the break must be cleaned from mud and cement film and must be washed.

The height of free-falling of concrete mixture into the form must not exceed 2 m (for ordinary concrete) and 1 m (for large-pored concrete). In the case of greater height the descent must be implemented on the inclined tray, pipes, etc.

During the placement of concrete the steelman must constantly check the position of any reinforcement, if it is displaced.

The Contractor must take care not to allow the pollution of concrete during and after the termination of work.

3.5.5.2.1. Shotcrete works

The design plans lining of reinforced concrete elements with 6cm thick shotcrete layer, providing not less than 3cm thick protective concrete layer.

The shotcrete layer serves as main constructive material and is laid on the reinforcement fabric installed in advance.

The lined surface shall be cleaned in advance by sand-jet device.

The thickness of the initial lining layer is 1-1.5mm, which is cement past. Along with increase of the lining layer the particles of bigger sizes penetrate into it.

Depending on the angle of the jet to the lined surface, the number of kick-backed particles changes. It is recommended to maintain 80-100cm distance between the nozzle and the processed surface, with vertical direction. In this case a major part of the kick-backed particles falls into the jet flow and penetrates into the lining layer. In case of increasing the water amount, the adhesion increases and the quantity of kickback decreases. This explains the ratio of the quantity of kick-backed particles in case of shotcreting under “wet” and “dry” conditions.

3.5.5.2.2. Implementation of works, care, control and acceptance of works

Implementation of shotcrete jacket of surfaces is done as a rule at 3m and more height. The contractor shall take into account the costs related to the deck construction in the costs of implementation of shotcrete jacket.

The shotcreting works begin with cleaning of surface. The surfaces are cleaned by stripping, grinding by carborundum disk, metal brush or sand-jet device. During strengthening of shotcrete the surface is covered by polyethylene membrane and watered during 7 days.

The strength of shotcrete can be checked by non-destructive method, Schmidt's or Kashkarov's hammer or by other modern devices.

The quality of shotcrete depends on the quality of the filler and adhesive. Hydraulic adhesives must have a feature of adhesion in humid conditions. Portland cement, pozzolan portland cement and others.

The requirements to the inert fillers used for preparation of mortar are the same as in case of common concrete.

Before beginning the works, the Contractor must submit to the Engineer information on fillers and concrete composition.

The shotcrete is implemented on previously prepared reinforcement fabric.

The cells in the joint zones of the fabric must have 2.5-3 cells' marginal cover.

The fabric must be fastened to the lined surface with 60cm staggered step.

Shotcreting works are carried out under temperature conditions $> +5^{\circ}\text{C}$.

Before implementing the shotcreting works, it is required to:

- Clean the surface from weak concrete fragments and the reinforcement and insert elements from rust.
- Plates are spiked to the plastered surface with 60cm staggered step (if not otherwise planned under the design), or holes are drilled, into which reinforcement anchors are installed and polymer-cement mortar is injected.
- In case of two-side shotcreting of walls is carried out, open-end holes are drilled in them with 60cm staggered step (if not otherwise planned under the design), into which reinforcement anchors are installed and polymer-cement mortar is injected.

Horizontal reinforcement bars are welded or tied by reinforcement wires to the plates/anchors. In the vertical joints of walls the horizontal bars terminate because the monolithic concrete of the joints is convex.

The horizontal bars on columns are connected by k-formed beams, which are welded to each other at the two ends.

3.5.5.2.3. Measurement and payment

Shotcrete works are measured in sq. meters.

3.5.5.3. The packing of concrete

While placement it is necessary to pack the concrete by means of vibration.

In case of using internal vibrator, the thickness of concrete filling layer should not exceed 1.25 times of the vibrator's head length. The step of the removal of the internal vibrators must not exceed its 1.5 radius of its activity. During vibration it is forbidden to approach the vibrator's head to the form more than 5-10 cm and to touch the reinforcement bars.

The packing of concrete by surface vibrator is carried out continuously and with straight bands. The next band must cover the already packed part by 10-20 cm.

The Contractor must provide the sufficient quantity of vibrators for normal and timely packing of concrete loaded in the forms (not less than 4 vibrators per section). The vibration is not implemented during the concrete solidification. The vibration of concrete through the striking is forbidden. The vibrated concrete is considered not qualitative in case of breaking of the requirements of the technical specifications (paragraph 3.5.5.7).

3.5.5.4. Construction joint

Construction joints are accepted only according to the drawings and at the Engineer's permission.

Before the packing of concrete on the already packed concrete (on the construction joint), the surface of this layer is prepared by the following ways:

- If the already packed concrete was not solidified, the surface is cleared by the wired brush or by blowing (not late than 5 hours after packing).
- If the concrete was solidified, the surface of concrete must be roughly cut with the depth of 1 cm so that the damaged particles of the aggregate and the spoiled concrete leave on the surface.
- The surface must be thoroughly cleaned from the laitance, foam, mud. Before the packing of concrete the surface is moisture.
- At the Engineer's request the surface should be covered with the layer of solution or cement slurry. The new layer of concrete will be packed after the initial setting of the solution.

3.5.5.5. Placement and consolidation of concrete under the unfavorable weather conditions

The placement and consolidation of concrete is not permitted during the heavy rain, storm and snowfall.

A. The implementation of concrete works under the air temperature above +25°C

The placement and consolidation of concrete under the air temperature above +25°C is allowed only after special prophylactic activities approved by the Engineer.

During the implementation of concrete works in hot and dry weather (the air temperature is more than +25°C and related humidity 50%) the following activities must be undertaken:

- the placement of concrete in evening hours;
- the use of cold water for concrete preparation;
- permanent watering of the aggregates;
- the mounting of temporary coverings (tents) from the direct influence of sun.

For 24 hours the internal temperature of concrete must not exceed 30°C.
The placement of concrete will be allowed only after the approval of above-mentioned measures.
The requirements to the implementation of works are described in SNiP 3.03.01-87.

B. Implementation of concrete works under the negative temperatures

If the average air temperature is below +5°C the placement and consolidation of concrete is not permitted. The Contractor must organize the works so that all concrete works are to be implemented under the temperature of air and structure not less than +12°C. Under the temperature from +5°C to +12°C the water should be warmed up to +40°C and the forms should be wrapped.

The dismantling the forms is implemented with the difference of temperatures of air and concrete not more than 15°C and with the strength of concrete not less than 70% from the estimated one.

If the winter placement of concrete caused by some reasons (which will be mentioned separately) is implemented, the Contractor must present for the Engineer's approval the detailed project of works, indicating all technological estimated parameters, regimes, organizational measures and admixtures to the concrete, composition, way of el. heating of concrete.

3.5.5.6. *Duration of solidification of concrete*

After the packing of concrete the latter must be protected from temperature differences, rain, mechanical effects, direct sun exposure. All methods of protection must be approved by the Engineer.

The forms of carrying and loading during the construction structures are dismantled having the strength of 70%, and loaded by the estimated load - with the strength of 100%.

The difference of temperatures of air and concrete during the dismantling forms is allowed not more than 15°C.

The strength of concrete is estimated depending on the conditions of hardening and is checked by not destroying methods (Schmidt dynamometer, Borovoy hammer, etc.).

3.5.5.7. *Low level of works*

Any scope of concrete works having cavity or implemented on some parameters not qualitative, at the Engineer's instructions is destroyed and implemented again without additional payment.

The troweling of concrete by the solution is not allowed.

3.5.5.8. *Marking of the product*

All prefabricated concrete and reinforced concrete constructions must have the marking indicating the date of their manufacturing.

The elements which do not have the marking can be rejected by the Engineer.

3.5.5.9. *Installing elements*

The installing elements must be fixed in the positions indicated in the draft drawings.

The presence of the rust and lubricant is not permitted.

3.5.5.10. *Injection of the solution*

The solution necessary for the filling in the spaces for the equipment, concrete and metallic structures consists of one volume part (group) of the Portland cement and 3 volumes of sand.

The works on the injection are implemented at the Engineer's presence.

3.5.6. Valuation and payment

Concrete works are measured in m³.

The cost estimates and calculations of concrete works must include all expenses for obtaining the required quality of concrete, which are the following:

- purchase and storage of all materials;
- preparation and presentation of **draft** drawings and price lists;
- equipment for measuring, mixing and transportation, including the operating staff salary;
- preparation, transportation and placement of concrete, including the injection;
- surface development;
- manufacturing of brick, including laboratory testing;
- concrete care, including the necessary equipment and materials;
- the placement, storage and mounting of the prefabricated reinforced concrete constructions.

3.6. Formwork

3.6.1. Scope of works

This section of the given specifications includes: the manufacturing, transference and the cleaning of forms for the concrete structures constructions, including the drawings of the manufacturing of forms.

3.6.2. Determination (limitation) of the forms

The form is the temporary structure for the formation of concrete.

3.6.3 Drawings

The Contractor must present in time the drawings for the manufacturing of forms. The forms are manufactured according to the requirements of SNiP 3.03.01-87 and GOST 23478-79.

The forms are manufactured after the Engineer's approval of drawings and calculations.

The forms must be solid enough to prevent the loss of water, solution and concrete.

It is necessary to pay special attention on the forms where the internal and external vibrations are used.

The multi-usable forms can be taken also as a rule.

3.6.4 Divergence and sizes

Any divergence to the negative side (decrease) in the sizes of concrete and ferroconcrete constructions is forbidden.

It is permitted the increase of the sizes not more than 4%.

3.6.5. Materials for forms

The materials for forms should meet the requirements of GOST 23478-79; the wooden and glued structures- GOST 20850-84 or TC-18-649-82 ("Laminated plywood").

The elements of forms which are in contact with the concrete must be manufactured from water resistant plywood. The use of lumbers is allowed for the manufacturing of the additional elements and inventory screens with their turn-rounds of not more than 10 times.

For the manufacturing of carrying frames it is used the softwood.

The boards of forms which are in the direct contact with the concrete must be planed, but not be painted not to lose the adsorption ability.

The metallic forms are used when the plasticity of concrete is less than 4 cm.

3.6.6. Placement of the form

During the placement of the structures holding the forms the following requirements should be implemented:

- the supports must be placed on the foundation having surface of leaning sufficient for the prevention of slump of the concrete structures;
- bars, coverings and other elements of attaching must not prevent to the placement of concrete;

- the attaching of bars and braces to the earlier concrete structures must be implemented taking into consideration the strength of concrete at the moment of the transmission of the load to it;
- the foundation for the forms must be aligned before the placement of the forms.

3.6.7. Covering preventing the adhesion

The coverings which are in contact with the concrete must be covered with the anti-adhesive lubricant. The lubricant is to be used so that it will not soil the reinforcements and earlier placed concrete. In case of lack of special emulsion mixtures, it can be used only the mixture of talc with soap (1:1) by adding 2-3 parts of water. The petroleum products are not allowed to use.

3.6.8. Cleaning and repeated use of form

Before the placement of concrete the form must be cleaned and moistened.

The placement of concrete is forbidden without the preparation of the act on the hidden work and the Engineer's permission.

For the repeated use the surface must be cleaned from the remainders of concrete and solution. If at the Engineer's opinion the forms are not available for the repeated, they must be repaired and changed by others.

3.6.9. Dismantling forms

The removal of all kinds of forms should be implemented after the preliminary tearing off from the concrete. The minimum term of this process is 7 days, but the Contractor can delay the removal of forms if the concrete has not solidified sufficiently.

The dismantling forms of the structures is implemented with the Engineer's agreement. Any damage of concrete during this process is to be repaired at the Contractor's expense.

3.6.10. Valuation and payment

The cost of the manufacturing, placement and disassembly of form includes in the cost of concrete works.

3.7. Steel Reinforcement

3.7.1. Scope of works

The reinforcement works consist of:

- the purchase of reinforcement,
- the preparation of the framework of the reinforcement,
- the placement and prefabrication of the reinforcement.

3.7.2. Drawings

The reinforcements are placed in the strict conformity with the draft drawings.

The envisaged by the project change of the reinforcement on the class, mark, range of sizes and quantity must be coordinated with the Engineer.

3.7.3. Specification of the reinforcement

The specification of the reinforcement is included in the composition of the draft drawings.

3.7.4. Types and quality of the reinforcements

Hot rolled pivotal and cold rolled wire reinforcement are used. The Contractor must prepare the laboratory testing samples of the reinforcement used which are taken at the Engineer's presence and have the definite sizes.

The order of selection, testing methods and the number of samples is determined according to the GOST and TC.

The reinforcement cannot be used without the Engineer's approval of the testing results.

When the accompanying documents and the results of implemented testing do not correspond the requirements of the project, the part of the given reinforcement is not allowed for manufacturing.

3.7.5. Conditions of storage of the reinforcement

Reinforcement steel must be stored separately by groups. During this process the measures against its corrosion, pollution as well as measures on providing the maintenance of the supplier's metallic tags and access to them must be undertaken. The reinforcement must be stored under the covering, and anchors and the installing details - in the closed and dry spaces. Pivotal reinforcements must be placed on the racks and wired reinforcement in the special compartment with the metallic fence, in a insulated from the floor condition.

3.7.6. Preparation of the framework of the reinforcement

The preparation of the reinforcement bars must be implemented according to the requirements of SNiP 3.03.01-87. It is permitted the butt-joining by the resistance welding and friction welding (depending on the diameter). The cover plate and welding butts must not be more than 50% in one cross section of the structure.

3.7.7. Placement of the reinforcement

The reinforcement must be placed in such a sequence to provide its position and fixing.

In the places of the cross sections of the reinforcement bars, the reinforcements must be bound by the binding metallic wire.

The fixed reinforcement must be checked and approved by the Engineer by the beginning of concrete works, on which a corresponding act on hidden works must be prepared.

The thickness of the concrete protective layer must correspond to SNiP 2.03.01-84 and SNiP 2.06.08-87.

The divergence of the thickness of concrete protective layer must not exceed:

- 3 mm - in the case of thickness of protective layer up to 15 mm,
- 5 mm - in the case of thickness of protective layer more than 15 mm.

3.7.8. Approval before the placement and consolidation of concrete

All fixed reinforcement must be checked and approved by the Engineer before the beginning of the concrete works.

If the concrete is placed contrary to these requirements, it is removed with the reinforcement and made again at the Contractor's expense.

3.7.9. Valuation and payment

The reinforcement are measured by weight. The weight of the reinforcement is estimated on the base of the specifications.

The total cost of the reinforcement includes all expenses (purchase, storage, preparation and placement).

3.8. Prefabricated reinforced concrete constructions

3.8.1. General provisions

The prefabricated reinforced concrete constructions must correspond to the specifications of precast concrete products according to the project.

The prefabricated reinforced concrete elements must be made only in the factory conditions.

All reinforced concrete elements must have the marking, where the date of their manufacturing, the name of factory-manufacturer, the mark of the structure and the stamp of the manufacturer's department of technical control. The element which is not marked can be rejected by the Engineer.

The delivery of the prefabricated reinforced concrete constructions to the construction site is allowed only after achieving of the project strength.

3.8.2. Reinforced and not reinforced prefabricated concrete constructions

The prefabricated concrete constructions can be reinforced and not reinforced. The quality of the prefabricated concrete constructions is checked and the testing is implemented according to the points 3.5.4.8. of the given specification and must meet the requirements of SNiP 3.03.01-87 and GOST 18105-86.

3.8.3. Sizes

All elements of prefabricated concrete and reinforced concrete constructions must correspond to the sizes, indicated in the drawings.

3.8.4. Installing elements

The installing elements must not be rusted, oiled or dirty.

3.8.5. Mounting of concrete and reinforced concrete prefabricated elements

After receiving the Engineer's approval, mounting of concrete and reinforced concrete prefabricated elements is carried out by means of corresponding lifting cranes.

The prefabricated elements are mounted on a preliminarily prepared fresh cement-sand mix cushion.

Welding of insert details, their cementing against corrosion and concreting of joints is recorded through preparation of an act on hidden works.

During mounting of concrete and reinforced concrete prefabricated elements the Contractor should provide the requirements of accident prevention.

3.8.6. Quality control

The control of quality of the structures made in the factory must be implemented by the side of the manufacturing company.

3.8.7. Transportation and storage

The transportation and storage of the reinforced concrete elements is implemented protecting them from damage and the pollution of the surfaces.

The loading and storage of the prefabricated reinforced concrete elements must be implemented under the guidance of the entitled person. Any damaged element is rejected by the Engineer.

The product is stored in the storehouse on the wooden gaskets. The big-sized concrete and reinforced concrete structures are transported by the special vehicles envisaged for this purpose.

3.8.8. Valuation and payment

Prefabricated concrete and reinforced concrete constructions (f/c) are measured by m³.

The cost of prefabricated concrete and reinforced concrete constructions includes all expenses connecting with:

- purchase of prefabricated constructions,
- replacement and storage of prefabricated constructions on the construction site,
- installation of the structures, including the joint monolithic concrete.

3.9. Stone works

3.9.1 General provisions

The placement of stone consists of the materials which must be selected, transferred and placed according to the technical conditions and requirements.

The conditions and requirements are related to all stone works.

3.9.1.1. Materials

As the stone for wall laying it is used the stone from the volcanic tuff as well as stones of firm rocks - basalt.

Tuff is used in the over-soil walls of the buildings.

The stone of laying must be firm, solid and durable without defects.

The Stonework must have the sizes and shape indicated in the drawings.

The Portland cement of the solution must correspond to GOST 23464-79 and GOST 25328-82.

The solution for the stone laying must correspond to GOST 7473-2010.

The water used for the preparation of the solution must not contain silt, organic material, aggressive to the cement admixtures.

The solution for Stonework consists of one part of Portland cement, three parts of sand (clean and dry) and sufficient quantity of water for reaching the solution of the required consistency.

The methods and equipment which are used for the preparation of solution must provide the quantity of each components in the composition of the solution.

Each time it is used only such quality of the solution which is necessary for the immediate use. The solution, which is not used for 30 minutes after adding of water in it, is rejected. The repeated stirring is not permitted.

At the end of each working day the blades of the mixer must be cleaned and washed.

3.9.1.2. Stonework

Stonework is classified as follows:

- a. the laying of walls from stones of clean cutting, the thickness of wall is 500 mm,
- b. the laying of “midis” system from uncut stone with the thickness of wall -500 mm,
- c. the laying from the stones of right shape, the thickness of wall -400 mm,
- d. the laying of walls from basalt.

The types of laying are mentioned in the project.

Before the laying the stone which must be used in it must be cleaned. The laying is not implemented during the rain.

The loading on the Stonework is allowed only after the complete setting.

3.9.1.3. Maintenance of the Stonework

The Stonework, including the pointing, must be maintained with the spraying of water or other available methods, approved by the Engineer.

If after the termination of Stonework it does not correspond the sizes or grades according to the drawings, the Contractor either removes or contracts again the damaged part without additional payment.

3.9.1.4. Valuation and payment

For the payment the Stonework is measured by m^2 in case of regular masonry, or m^3 .

The payment for Stonework is implemented by the unit cost for the m^2 or m^3 according to the preliminary calculation.

The payment for the pointing up of the joints of the Stonework is implemented separately, by the m^2 .

3.10. Roof coatings

Non applicable.

3.11. Water proofing and the protection from corrosion

3.11.1 Main positions

The protection from the influence water on the constructions and structures is implemented by means of water proofing.

3.11.2 Water proofing of the concrete surfaces

The materials for water proofing are made according to the technical conditions of the manufacturing.

The concrete surfaces are cleaned, liquidated from the existing defects (see section 3.5). The roughness of the surface must not be ± 2 mm.

The surface is to be dried by air warmed up to 40°C.

The protective layer is implemented by two stages: prime coat of paint and main coating.

For the prime coat it is used the material of the main coating with adding the solvent, or it is selected the special composition.

The viscosity of the material of the prime coat must be not more than 20 seconds by the viscometer B3-4, the temperature 35-40°C, and the temperature of concrete and air - not less than 15°C.

The prime coat is spread by the spraying, by means of brush or roller in 1-2 layers (until the termination of absorption into the structure). After the covering by the prime coat (not late than in 24 hours, if some other term is not envisaged by the certificate or technical instructions of the material), the main protective coat is spread. The necessary thickness of the protective coat is 120-150 micrometer. Such a coat can be after spreading 2-3 times. Each layer is spread with a break of one day. The viscosity of the protective material must be 40 seconds by viscometer B3-4. The protective layer must be equally spread, must not contain the strange particles and drips. The presence of the holes and bubbles is forbidden. The contact with water is allowed only after complete drying and the control of quality.

3.12. Lifting equipment

Non applicable.

3.13. Pipes, shaped parts and valves

3.13.1. Classification of pipes according to materials

In designs of the water supply systems, it is planned to use steel and polyethylene (GOSTs 3262-75, 8696-74, 8731-87, 8733-74, 10704-91, 10705-80, 10706-76, 10707-80, 18599-2001, 22689.0-89, 22689.1-89, 22689.2-89) pipes. There are two types of steel pipes used in water supply system - welded and drawn. Welded pipes are produced both longitudinal and spiral ways. It is allowed to use pipes manufactured with other standards, if they are equivalent to the mentioned standards and can operate under the design heads.

In designs of the wastewater systems, it is planned to use corrugated polyethylene pipes and ductile iron pipes. The ductile iron pipes shall correspond to the ISO and EN standards (EN ISO9001-2000; EN805-2000, BS6920, BS EN545, EN14901, NF EN598, etc.) .

3.13.2. Certification

The Contractor is to provide the following certification:

- a) Pipes manufacturer's certificate,
- b) Laboratory testing certificate.

Pipes shall be factory tested and subjected to hydraulic and impact (falling weight) tests. The number and selection of samples for testing, the test procedure and the requirements are to meet GOST, BT or other adequate standards.

All imported goods is to have relevant approval certificates, as issued by the Health Ministry and the Ministry of Public Works and Regional Planning as well as other concerned agencies of the Republic of Armenia, prior to their use in Armenia.

All charges concerning tests, transportation to the laboratory, etc. are to be included in the List of Bill of Quantities in the unit rates and are not to be separately paid for.

3.13.3. Employer's Inspection

The Employer, the Engineer or their authorized representative shall be entitled to inspect pipes or witness pipe manufacturing and quality control tests. Such inspections shall in no way relieve the Contractor of his responsibility to provide products that comply with the applicable standards within this Specification.

The Contractor must submit to the Engineer certificates from approved laboratories certifying that the materials have been subjected to and have satisfactorily undergone the required tests according to the specified standards.

3.13.4 Materials already on site.

NA

3.13.5 Preparation of the edges of the existing steel pipes

Existing steel pipes to which new pipes, fittings or flange adaptors are to be fitted shall be checked for dimensional tolerances, roundness and other damage. The results of check shall be submitted to the Engineer in writing.

Where dimensions are outside the relevant standard to which the pipes, fittings and shaped parts were originally manufactured the Engineer shall instruct the Contractor as to what steps, if any, to take to rectify the lack of tolerance.

Where ovality (defined as the maximum diameter divided by the minimum diameter) exceeds 1% , the ovality shall be reduced to less than 1% at a distance 100mm from the mouth of the pipe. The Contractor shall submit to the Engineer for his approval prior to the work a method statement detailing the Contractor's proposals for reducing ovality. A minimum requirement is that the method should make use of progressively applied force through hydraulic jacks and formers which will not cause localised distortion of the pipe. Only small localised dents may be repaired using hammers.

3.13.6. Installation and connection of pipes

3.13.6.1. General provisions

It is necessary to use soft pliers, flexible ropes or other means preventing damage of the surface while transporting pipes with anticorrosion cover. While installing pipes in drinking water supply network it is required to prevent pipes from inner dust or penetration of wastewater. Before the assembling pipes, shaped parts, fittings and gathered units should be cleaned out from snow, ice, oil and other dust. Before welding the pipes it is necessary to align them . The divergence of pipeline axis on the plan should not exceed 100mm, and the divergence of the pipeline upper mark - $\pm 5\text{mm}$. Pipe installation should be done after testing conditions of trench walls, floor levels and setting on soil supporting constructions.

Any changes in diameter or direction of the pipe should be done only by using shaped parts.

While assembling reinforcements, the following requirements must be implemented:

- flanges on the pipeline to be installed vertically,
- surfaces of linking flanges should be smooth, bolts to be installed from one side of joint, screwed up evenly, in cross order,
- in case of curve, flange deficiency can not be allowed by setting laying unevenly or fixing bolts irregularly,

- in flanges and different joints welding works can be done only after even screwing up all bolts.

3.13.6.2. Pipe installation by “trenchless” technology

During the construction works it is possible to have segments where it is impossible, difficult or not advisable to implement trenches. In that case the pipes shall be installed by “trenchless” technology.

The “trenchless” technology will allow installation or rehabilitation of pipes. This technology is used mainly for installation of water and sewerage pipes in the places of crossing with railway and highway, but also in places where it is not desirable to dig a trench and where there are few connections.

The intended technologies are: (i) pipe bursting, (ii) Cured-In-Place Pipe lining process (CIPP) and (iii) Horizontal Directional Drilling (HDD). The Bidder shall provide evidences in his offer that he has sufficient references in using these technologies and give a detailed description of the methodology he intends to use.

For detailed description of the above technologies, see Appendix 1.

3.13.6.3. Steel pipes

Type of welding, type and sizes of welding seams should correspond to the design and SNiP16037-80 requirements. Pipes must be cleaned up from all kinds of dust, weld and adjacent surfaces up to 10mm up to metallic shine before installing and welding.

Divergence of pipes' edges at their welded points should be less than 20% of thickness of the pipe and not more than 3mm, in cylindrical pipes linking divergence can be up to 1mm, in case of connecting pipes by longitudinal or spiral weld and thicker than 100 mm weld divergence should be more than 100 mm. If pipe welding seams are two-sided, there is no need to follow the above mentioned requirements.

In case 'of having bigger divergence in pipes insertion it is necessary to implement at least at 200 mm length.

Welding of connective pipes should be carried out by using centralization mechanism. Flatness up to 3.5% of pipe is allowed to be strengthened if conditions permit using tools. Parts of pipeline with more than 3.5% flatness should be cut or taken away. Parts of pipes with holes up to 5 mm should also be cut and taken away. Before welding connective edges must be treated and cleaned up.

During making weld point links must confluent with general weld. Electrode or metallic wire should have the same features that are required for the main seam. Only specialists with special license have the right to carry out welding of steel pipes. Before starting the work welders must do trials in production conditions if:

- welder just begins on site to implement welding works or he has not done welding works on site for more than 6 months,
- welding materials or pipes are of other quality (electrodes, wires, flux) or new kind of welding materials and equipment are used,
- probation welding is externally investigated,
- tested roentgenographically by GOST 7512-82
- cutting and mechanical arbitration by GOST 6996-66

Welding works are allowed to carry out under lowest air temperature of -50⁰C. Therewith, without preliminary warming of welded edges for pipes containing up to 0.24% carbon and up to 10mm thick low alloyed steel pipes under temperature of up to -20⁰C. Same kind of pipes with

thicker walls can be welded under lowest temperature of -10°C . Quality of welded seams is estimated:

- by tool control, according to the requirements of GOSTs 5264-80, 6996-66
- by roentgenographic or ultrasound investigation in accordance with GOST 7512-82, GOST 14782-86.

All welding seams are investigated externally. Before investigation weld seams must be carefully cleaned out with the length of not less 20 mm from both sides.

3.13.6.4. Polyethylene pipes

Polyethylene pipe connection is possible to carry out both out of the trench, and in the trench.

Before laying of polyethylene pipes in trench, the trench floors should be cleaned of large stones and flattened.

Polyethylene pipes are laid on 100 mm thick preparatory layer, which is implemented from up to 10 mm size gravel or coarse grained sand.

Minimum thickness of the protective layer, from the top level of the pipe shall be 150 mm, while in case of using heavy ramming devices - 300 mm.

The granulometric composition of the materials used for the preparatory and protective layers, depending on pipe diameter, is provided in the table below:

The material of preparatory and protective layers (soil):

- must be with polished (pebble) grains;
- must be light, so that it can easily form a preparatory layer by spade and can easily be rammed;
- particles should not have sharp edges that can damage the pipe;
- particles of diverse element layer should not be smaller than the permissible size, not to be washed by ground waters;
- not to be crushed from ramming or humidity,
- should not cause corrosion of pipe, pipe connections or pipe case;
- concentrates should be stable while laying or compacting, to maintain the position of the pipeline;
- should be chemically stable to the soil, ground water and not to enter into reaction with the pipe material.

After implementing the installation of polyethylene pipe in trench, trench backfill from side fill excavated soils is made with ramming, therewith, on the protective layer at about 0.5 meters height, the backfill should be implemented from side fill soft soil.

In case of using the soil excavated from trench for preparatory and protective layers, its particles should meet the above requirements.

In trenches, which are fully implemented from side fill excavated soils or sand, at 30-35 cm height from the upper level of pipe 25-30 cm wide polymer reticulate alarm tape is installed.

Pipe connection is mainly done by contact manner welding. During contact welding the edges of pipes are heated by means of heating device, then the melted surfaces are connected under small pressure (0.15-0.2 MPa) and held up to 3-4 minutes.

In case of contact welding of sockets the external surface of pipe edge and internal surface of socket are melted at the same time, then the pipe is rapidly installed inside the socket.

The pipes shall correspond to the GOST 18599-2001 “Polyethylene pressure pipes” standard adopted by “National Standards Institute” CJSC and in force in the RA (it is harmonized with

International standard ISO 4427:1996, “Polyethylene pipes for water supply. Technical conditions”).

The material of the pipe used for water supply shall correspond to the PE100 criterion.

3.13.6.5. Ductile iron pipes

The ductile iron pipes shall correspond to the ISO and EN (EN ISO9001-2000; EN805-2000, BS6920, BS EN545, EN14901, NF EN598, etc.) standards. The material and the pressures of the fittings of the ductile iron pipes shall correspond to the material and pressure of the ductile iron pipe. The connections of the ductile iron pipes shall correspond to the requirements of the manufacturers and shall provide the reliability of the node.

Elastomeric gasket type joints shall be flexible spigot and socket joints with sockets integral with the pipes and incorporating rubber rings recommended by the manufacturer and approved by the Engineer or Employer.

Coating:

The exterior surface of exposed pipes and fittings whether above ground or in chambers etc., shall be coated with polyurethane with a minimum thickness of 300 microns.

The exterior surface of buried pipes and fittings shall be sprayed with a metallic zinc coating in accordance with EN 545 with a minimum thickness of 30 microns, the minimum coating mass per unit area to be 200 grams of zinc per sq.m of pipe surface.

The exterior surface of buried fittings shall be polyurethane coated with a minimum thickness of 700 microns. Polythene sleeving is to be supplied in addition to the above coating. The sleeving shall be heavy duty black polythene of not less than 250 micron thickness.

3.13.6.6. Technology on connection polyethylene pipes to steel and cast iron ones

Polyethylene pipes are connected to the steel pipes by flange or coupling. Polyethylene pipes are connected to the cast iron pipes by coupling, as well as steel and cast iron pipes. While assembling flange connections the bolts are tightened in turns – screwing the oppositely set nuts.

3.13.7. Pipe hydraulic testing

Pipeline must be tested twice:

1. Preliminary - before the implementation of the back covering,
2. Final - after back covering.

Arbitration of pipelines is carried out by Contractor in accordance with SNiP 3.05.04-85. During tests for leak-proofness and strength pressure on the pipeline is considered in accordance with SNiP 3.05.04-85, table #4. All tests to be executed before the replacement of reinforcement of the pipeline.

3.13.8. Washing and disinfecting of pipes

After the final testing of the pipeline it is to be washed and disinfected as described below.

- a) Pipelines

- ✓ After completion of the construction disinfecting of the pipeline is carried out part-by-part, therewith, the length of each part must not exceed 1-2km. Selection of the segment is done taking into account water removal possibility in natural way.
- ✓ Active chlorine concentration shall be assumed 75-100mg/l, for 5-6 hours of contact period and 40-50 mg/l for 24 hours of contact period.
- ✓ The following preparatory works are done before the disinfection.
 - installation of communications for chlorine water supply to pipeline, air removal, water sampling posts, chlorine water removal (with provision of safety rules),
 - preparation of chlorinated part plan, longitudinal profile, and segmentation schemes, with mentioning of the above mentioned communications, including works implementation schedule,
 - in case of using solid reagents, determination of the required amount of the latter, taking into account provision of corresponding concentration of chlorine.
- ✓ Chlorine water is given to the pipeline until the chlorine concentration in the sample taken at the farthest point of the disinfected segment reaches at least 50% of the preliminary value. All technological valves must operate at least once during this period.
- ✓ After providing the required contact period the chlorine water is to be removed after dechlorination by sodium hyposulfite (for reducing 1mg active chlorine 3.5mg Na hyposulfite is required), or diluting by clean water with provision of 2-3mg/l concentration of residual active chlorine, or by another method, which must be submitted in advance to the approval and permission by technical supervisor.

The standards allow using the prepared chlorine solution for disinfecting of several segments. Operation of the pipeline is allowed only after its washing, therewith the washing is continued until the residual active chlorine concentration is 0.3-0.5mg/l.

b) General

- ✓ For checking after disinfecting double bacteriological analysis of water sample is done with an interval, which corresponds to the period of full emptying of the structure.
- ✓ Disinfecting and washing of water supply pipelines and structures is implemented by the forces and means of the constructing company. The results of the works are documented in Minutes mentioning concentration of active chlorine, contact and final washing time and the results of water sample analysis. Based on the mentioned materials the local sanitary-hygienic authorities provide a corresponding conclusion on the possibility of commissioning of the structure.

3.13.9. Requirements to anticorrosion cover for ductile iron pipes

The Contractor shall make provision for anticorrosion protection of ductile iron pipes. He shall conduct soil resistivity analysis in order to define if a particular protection is required, in addition to the pipe coating.

The Contractor shall provide the Engineer with relevant investigation results and calculations demonstrating the necessity or not of such a protection.

If a particular protection is required, the cost of this protection is deemed included in the cost of the pipeline provision.

3.13.10. Requirements to anticorrosion for steel pipes

3.13.10.1. General positions

There are following requirements for anticorrosion cover of undersoil pipelines:

- Continuity which provides safety of the cover
- Water resistance which deludes wetting and consequently corrosion of metal
- Stickiness with metal and Chemical stability which provides long work of cover in conditions of aggressive soils
- Mechanical completeness which provides completeness of the pipeline while installation
- Availability for mechanical layering.

In casing pipes (in case the freezing depth is not provided), or at flight sections the pipes are thermally isolated by cellular polystyrene semi-pipes.

3.13.10.2. Bitumen mastics plasters

If water temperature does not exceed 40⁰C for pipelines with diameter up to 820mm bitumen mastic is recommended as an anticorrosion cover. Bitumen mastics on mineral base are not used in construction. There is petroleum based type bitumen such as BN50/50, BH 70/30, BN 90/10 according to GOST 6617-76.

There are the following kinds of filling materials for bitumen mastics:

- a. organic-rubber crumbled to 1mm parts
- b. polymeric-polyethylene, polypropylene etc.

3.13.10.3. Basic layer

Prior to laying anticorrosion cover pipeline is to be covered with general layer. Bitumen layer is made of bitumen and petroleum mixture 1/3 proportion according to the volume and 1/2 proportion according to the mass. This layer is useful for 10-12 days (before the creation of anticorrosion cover), and after this period of time it becomes friable and needs to be changed.

3.13.10.4. Wrapping materials

Wrap up material are used to fix cover layer and prevent pipeline from damage while replacing or back covering. PDB, PrDB (TC 102-31-74) kind of wrapping materials, BR-11 brizolum, bicarol, glassruberoid, hydrozol, wrapping materials are used.

3.13.10.5. Polymeric sticky tape for anticorrosion cover

In this case anticorrosion cover consists of pre-layer and 1-3 layers of sticky polymeric tape. Polymeric sticky anticorrosion layer consists of:

Kind of cover	Sticky or bitumen general layer	Polymeric sticky tape	External wrapping
Common (normal)	+	1 layer	+
Strengthened	+	2 layers	+
Rigorously strengthened	+	3 layers	+

Pipeline is taped just after laying the pre-layer, before its getting dry.

3.13.10.6. Nairit rust protective and waterproofing fillings

As rust protective and waterproofing paste can serve:

- lacquer ethynol, TC RA 6.165-94
- “Aerite” TC 6-01-4-81-88
- Bitumpolymeric waterproofing paste ACA, RA TC 37331832.0798-97
- BT-577 and BT-177 (silvery) GOST 5631-79, (for overground metal construction)

Lacquer ethynol is 40% solution of polymer acetylenediviny in toluol.

Lacquer ethynol has a high stickiness both with concrete and metals, is chemically stable and water proof.

Lacquer ethynol can be applied on surface through brush, roller and blow through sprayer. Time for drying and stabling the layer at an air temperature of 20°C is 4-7 hours.

Nairit water proof “Aerit” paste is a polymer composition material with chloroprene caoutchouc base. Before using it is necessary to dissolve it in solution. Time for drying the layer at an air temperature of 18-20°C is 2 hours.

3.13.11. Requirements for thermal isolation

As thermal isolation material cellular polystyrene semi-pipes are planned to be used. The semi-pipes are installed over the isolated pipe and joined by adhesive tape or reinforcement wire. The semi-pipes, depending on thickness, allow isolating the pipe with the external temperature range of -85°C to +180°C.

Cellular polystyrene features

Name of indicator	
Density,kg/m ³	15-17
Strength under compression, in case of 10% linear deformation not less than MPa	0,12
Durability border at bending, not less than MPa	0,18
Heat conduction, in dry condition, at 25±5°C temperature, no more than W/(m*K)	0,037
Water absorption in 24 hours no more than %	1,0

3.13.12 Devices and equipment installed on pipes

3.13.12.1.General Provisions

During installation, transportation, storage and operation of devices installed on the pipes and equipment (valves, sluices, water meters, flow meters, etc.) the following basic requirements are to be carried out:

- Transportation of devices and equipment are to be done with plant packing.
- Storage - with plant packaging or without packaging, in a dry place on shelves (the connecting pipes being closed is required): For a long time storage it is necessary to change the mastic on treated surfaces, clean and remove rust.
- Installation of sluice valves are to be implemented taking into account the direction of water movement.

- In case of installation of valves with flanges a similar flange is to be fixed on the pipe. The bolts are to be fastened cross-conceived in order not to bend the flanges.
- The pipe is to be cleaned from sand, slag, etc., before installing the equipment.
- During pipe hydraulic testing the reinforcement must be fully naked.
- Equipment and devices are to be installed in places accessible for operation.
- Equipment must be used only according to its destination, according to the technical conditions and standards.
- To open or close equipment additional leverage use is not allowed.
- During opening of sluices with el.drive screw with 300 mm or more diameter, el. engine should be turned off when the lock is 10-12mm lower than its upper limit position, then the sluice is fully opened manually.
- To avoid deviations, the inserts, pressing bolts and nails are to be pulled uniformly.
- The sluice axis is to be lubricated at least once a month.
- If it is impossible to regulate waterproofness of the equipment on site, it should be dismantled, thoroughly inspected, injuries eliminated and again collected, lubricating the parts.

Supply of equipment with store flanges, reinforcing parts and inserts must be carried out by an order.

3.13.12.2. Connecting elements

Choice of connection types is conditioned by the following

- Water flow
- water parameters (pressure, temperature)
- necessity of regular dismantling during operation.

Connections for the materials are selected based on a chemical activity of transported liquid. Connecting reinforcement is mostly made of sold carbon steel, copper and its alloys, aluminum and plastic.

For not corrosive environment it is necessary to use carbon steel with 340-500 MPa border strength.

The upper limit of temperature for this steels is 450°C. For corrosive media special alloyed steel is to be selected.

Connecting devices and equipment must conform to the requirements of corresponding standards values.

3.13.12.3. Installation of equipment with flanges

Sluices, valves, water meters, flow meters are to be installed with flanges. Their welding to the pipe is prohibited.

Sluices, valves, water meters, flow meters shall correspond to the requirements mentioned in the procurement package.

For installation of sluices, valves, water meters and flow meters, flange adaptors (dismantling joints) are to be used.

3.13.12.4. Some instructions for installation of devices and equipment with flanges

During installation of flow meter, strict segments of pipes are to be present before and after the flow meter.

Taking into account the circumstance that the devices and equipment manufactured by different firms have different characteristics and installation conditions, the Contractor shall agree the

characteristics of the equipment to be purchased with the Client and only after receiving the Client's agreement, purchase the equipment.

Connection of fire hydrants is implemented through the support of flanged hydrant.

Buried valves are installed on concrete basements. For regulation of the valve the stock is installed in the casing pipe rising to the earth surface where manhole with small cast iron cover is installed.

3.13.12.5. Installation of measuring/controlling equipment

To install residual chlorine detection device a corresponding joint must be on water pipe, from which the sampling is to be taken. The installation of residual chlorine detection device shall be done in accordance with the requirements by the manufacturer.

Ultrasonic level meter is to be fastened on the wall of one of the manholes of storage reservoir, taking into account the height of the cover slab at 0.3m. The ultrasonic sensor of the level meter shall be in the middle of the manhole.

3.13.12.6. Installation of domestic connections

a) Tapping:

Domestic connections shall be implemented through tapping collars. The tapping saddle shall be designed to accommodate pipelines of any kind of material, including steel, CI or DI, PVC, HDPE, etc., whatever the nominal size and the thicknesses.

The tapping saddle shall be made of ductile iron complying to EN GJS EN 1563 and protected from corrosion by epoxy coating (minimum thickness 300 microns) applied by electrostatic process.

M16 bolts shall be made of stainless steel class A2 (304) minimum.

Sealing with the main shall be ensured by a massive piece of EPDM complying with EN681-1 and that shall be centred and embedded to maintain full bore after tightening the bolts and profiled to perfectly fit the main pipeline.

A sticky label will show the tightening torque value to be applied on the bolts.

The tapping valve shall be of ball-valve type (operated in a quarter turn) and incorporated into the tapping saddle to avoid any leakage. The ball shall be made of nickel and chromium plated brass complying with EN12164 and EN12168.

For connection of the ball valve to the connection pipe, the use of PTFE tape or hemp is not allowed.

The ball valve shall be handled using a valve extension spindle compatible with the operator's equipment (T-handle key). The squares shall be of ductile cast iron with 300 micron epoxy coating and the shaft shall be of hot galvanized steel.

b) Meter box:

The water meter box shall be able to house at least 1x DN15 or DN20 water meter. It shall be supplied ready assembled as one unit with telescopic stainless steel meter setting, valves and fittings.

Valves and fittings shall be made of brass complying with EN1216X and EN1982 and shall include (for each water meter):

- a meter inlet ball valve,
- a meter outlet ball valve,
- a check valve with pressure plug and drain tap

The box shall be adjustable in height over 250 mm and tiltable for precise adjustment. Meter box depth shall be up to 1,300 mm.

The water meter box shall be insulated to prevent water meters, valves and fittings from freezing. Meters, valves and fittings shall be located not more than 400 mm below ground in order to facilitate meter reading and maintenance.

The frame and cover shall be rectangular, of cast iron and lockable with key supplied. It shall have a anti-skid surface.

3.13.12.6. Commissioning and adjustment works

Complex commissioning and adjustment works include check ups, tests for each device and pipeline. The check up and adjustment works shall be organized by the Contractor, involving the Client's representatives.

All main parameters are to be recorded in writing during these works.

The form and time periods of individual tests that provide launching-adjustment works, must be approved by a schedule agreed with organizations implementing assembly and adjustment, the main Contractor, the Client and other organizations taking part in the implementation of construction and assembly works.

The price and the costs related to all launching-adjustment works shall be determined by the Contractor and included in cost estimation of bill of quantities.

The Contractor shall take into account all the costs required for the whole complex of the launching-adjustment works, approved by corresponding normative documents. They include:

- organizational and engineering preparation of works;
- study of technical and design documents;
- study of the facility, external inspection of the carried out assembly works and equipment ;
- participation of mounting organizations during the individual testing;
- determination of correspondence of the technical characteristics of the installed equipment with the data and design provided in the technical documents of the manufacturing plant;
- adjustment of separate equipment included in operating network to provide inter-related operation;
- trial launching of equipment according to the design scheme;
- Complex testing of equipment with adjustment of technological process and setting constant technological regime, which will provide the parameters planned under the design.

The prices must include the costs for purchase of materials, fuel, energy resources, related to the launching-adjustment works, as well as the participation of the operating staff in the launching-adjustment works. The means related to the mentioned costs must be taken into account by the Contractor and included in the bill of quantities with unit prices.

3.13.12.7. Measurement and payment of works

The pipeline is measured in meters, the fittings – in tons (polyethylene fittings – in pieces), and the devices and equipment – in pieces. Payment is done based on unit price of work, including the cost of materials and equipment, transportation costs and salary.

3.14. Additional conditions of restoration and repair works

3.14.1. General provisions

3.14.1.1. Scope of works

This section includes all works related to restoration of existing structures and broken parameters.

These works are executed with the following purposes:

- restoration of previous sections;
- elimination of damages on surfaces;
- repair of structures;
- closing of water filtration ways;
- improvement of the quality of construction materials;
- protection of constructions and surfaces;
- strengthening of constructions;
- other works necessary for restoration, improvement, protection of constructions and also for increasing its reliability and durability.

3.14.1.2. Significance of additives

Additives concern the peculiarity of repairing-restoration works. These relate to used materials, preparation and implementation of works and also control on measurements and payments.

3.14.1.3. Confirmation of previous sections

All requirements of previous sections such as quality of materials, testing methods and utilization of results are to be followed during repairing-restoration works.

3.14.1.4. Changes in contents of additives

For each particular work there may be changes in additives which are related to specific conditions of works, unusual methods which are not included in general additives. These can be related to property of materials, methods of testing and checking, conditions of investigation, indexes of measurement, conditions of payment and others.

3.14.2. Concrete and reinforced concrete constructions

3.14.2.1. Materials and their testing

Suggested alternative materials can be used after the Engineer's approval. Concrete and mixture made of high class Portland cement are more preferable than others.

Usefulness of materials used in the repairing works is estimated by the following properties:

- permission for being used in drinking water supply system
- absence of aggressive influence on concrete and reinforcement
- During repairing works acquiring satisfactory strength
- integrity protection and long life provision in temperature changes, humidity and other conditions
- property level keeping during operation (water stability, long durability)
- in case of specific conditions other properties necessary for restoration of the particular object.

In case of lack of information concerning the property of materials in certificates properties can be found out by the following:

- aggressiveness to concrete and metal can be found out by comparing with requirements of SNiP 2.03.11-85 from “Protection of construction structures from corrosion” chapter
- strength, water permeability, frost-resistance, durability and other physical and mechanical indices which are tested and compared with the requirements of GOST 26633-91, GOST 10180-90, GOST 18105-86, GOST 13087-81, GOST 10060-95, etc.
- bundling property is tested by stretching resistance in accordance with international standards, membrane and painted surfaces by SNiP 3.04.08-85 appendix 3 and by grill sections by GOST 15140-78.

Approbation's are based on notes or direct disadvantages and are designed in one act.

3.14.2.2. Mode of activity

Contractor must select regime which provides best results in terms of time and gains the Engineer's approval. The suggestions of the given specifications have most advantages during the selection of the mode of activity. Methods and tools able to violate strength, stability and durability of the protected part of construction must not be used.

3.14.2.3. Restoration of damaged surfaces

3.14.2.3.1. Purpose and content of works

Wash out, wear out, breaks are surface damages and violate sanitation-hygienic requirements, release safety and durability of constructions also estimated (including hydraulic) parameters change. In this cases the purpose of works is the restoration of previous designed edges and characteristics.

3.14.2.3.2. Damage treatment

First damage is edged (chalk or pencil lead). Angles of chosen plate must exceed 30° . Turns of contour must be at least 5 cm away from each other. After the Engineer's approval the concrete is dug with the depth of not less than 3 cm and under $60-80^{\circ}$ from the surface. From all the surface of damage weak concrete and broken concrete parts are taken away. Concrete can be removed by:

- hand tools such as cutting tools, hammer of 0.5 kg weight and other tools,
- electric or pneumatic cutting tools (disc, cutter) or vibration instruments (power must not exceed 0.6 kW)

3 cm drilling of holes is allowed along the edge of damage.

Heavy and impact instruments are used only under Engineer's permission.

Strength of contacting surface concrete is tested by eye or by weak strikes. While striking deaf sound must not appear which means the existence of invisible cracks and weaknesses.

Strength is tested by Kashkarov's hammer, Borovoy's gun, Schmidt's dynamometer and other tools. Strength of concrete of contacting surface must be not less 80% of construction preserved concrete strength.

3.14.2.3.3. Preparation of contacting surface

Preparation of surface is necessary for better connection of installed material and construction concrete. In every case contacting surface is cleaned out from crumbs, dust and liquefied air is blown on surface by GOST 9.402-80.

The Contractor may suggest any way of surface preparation if it provides at least 70 % of preserved construction concrete. Prepared contacting surface is tested and approved by the Engineer.

3.14.2.3.4. Material installation in damage hole

Material is installed by layers, on all surface or height of damage from one end to the other without breaks which are not foreseen during material installation process.

Material installation can be provided by:

- concrete spraying or similar way
- hand, concentrating by vibration, pressure, tamping, leveling
- setting into form under pressure and keeping under pressure until material loses its elasticity
- any suggested way, which will provide complete and dense fulfilling of damage with material and strong connection with contacting surface.

Effectiveness of installation can be tested by sample or on damaged surface which should be carried away. Damage would be considered solved after positive strength test.

3.14.2.4. Restoration, strengthening and improvement of surfaces

3.14.2.4.1. Scope of works

According to the technologic integrity and complex significance of works the followings are including:

- a. improvement and restoration of surfaces, conditions of which do not meet hydraulic parameters or are in dangerous conditions.
- b. restoration and improvement of anti-filtration abilities of plastered surfaces of ditch, constructions and alabaster plaster.
- c. restoration and improvement of strength and quality criteria of concrete surfaces
- d. improvement of surfaces of constructions and surface layers characteristics by different methods.

For water contacting surfaces preferred kind of materials and technologies should achieve general results such as strengthening of contacting surfaces, anti-filtration stability, low hydraulic roughness.

3.14.2.4.2. Selection of materials

While selecting materials for these works contents of connection and strength, good absorption in concrete with simultaneous holes covering are considered. These materials create a membrane which strengthens connection between general and used materials. Taking into consideration the coincidence of material properties, the necessity of total results the following works are of priority according to the technological sequence:

- a. Preparation of surfaces includes removal of easy breaking parts, cleaning of surface by air.
- b. Injection by polymeric mixtures in concrete, reactives and mixtures until their visible appearance on the surface.
- c. Rubbing of injected material generally by leveling the surface.

In case of good hydraulic surface there is no need to implement the works mentioned in point C.

Material selection must guarantee according to SNiP 2.03.11-85 requirements with “V” index (water resistant). From above mentioned SNiP there are following materials manufactured in Armenia:

- a. Polyvinylacetate with calcium-chlorine addition mixed with water and added on concrete and cement mixtures,
- b. ethinol based mixtures (devynylacetate lubricant), diluted with xylol (benzol) and injection of the weak solution. According to B3-4 viscometer viscosity surfaces are fulfilled with cement mixture,
- c. airite mixture (resin + ethinol) with cement, quartz and other fillers for strengthening, protection, closing small cracks, leveling. The viscosity less than 10sec and in case of 40-50°C warming the pored concrete impregnation is available.

Water resistance of these covers lasts at least for 8-10 years.

3.14.2.4.3. Implementation of works

Surfaces can be cleaned out with hand or machines by using different tools (brush, cutter, etc.). The upper pore, weaken and shaken parts of concrete must be removed.

Striking instruments heavier than 0,2 kg must not be used. After this surfaces to be blown with concentrated air. Non pressure or low pressure (0,2atm) methods also can be used. Mixtures

made on the base of polyvinylacetate or ethinol and airite can be used. Polyvinylacetate mixture to be spread once every 10-15 minutes, air temperature must exceed 5°C. Mixtures made on the base of ethinol or airite to be warmed up to 40-50°C and be spread in case of air temperature more than 5°C with the break of 1,5-2 hours.

The spreading of next layer is allowed when finger does not stick (up to 6sec.) on the previous layer. Covering layer is spread as a plaster by hand or machines. There is no valuation on viscosity of covering layer, but at the same time it must not flow on covered material. The thickness of layer of cement (concrete) and polyvinylacetate mixtures are not limited. Ethinol mixture should be spread with the thickness of not more than 2 cm.

3.14.2.4.4. Approbation, control, measurement and payment

Impregnation component depends on the quality of pores on concrete surface. Impregnation component is selected so during at the process of drying it will manage to absorb not less than 2 cm. If the testing index of the strength of treated concrete is less than 30% of the previous one, consequently mixture is not good for using. Also if mixture is not being absorbed in concrete at least for 2 cm, it is also useless. In these cases methods must be reviewed.

In some cases a sample can be drilled. By means of this sample about the degree of the strength and depth of the absorption can be estimated. If the strength is sufficient, covering layer strength with old concrete can not be tested. If covering plaster is lubricated without previous hole, strength of cover is checked out by knocking with wooden hammer.

For measurements it can be used the treated surface unit or cost of the spent materials estimated by the Engineer's previous approval.

3.14.2.5. Liquidation of defects of reinforced concrete constructions

3.14.2.5.1. Scope of works

Defects of reinforced concrete constructions differ from concrete construction defects only by the divergence of designed position reinforcements and absence of protecting concrete layer. All above mentioned procedures concerning to restoration of concrete constructions, are used for the restoration of reinforced concrete constructions as well. All materials used for change or intensifying of reinforcement are used in the similar way as in new structures.

For this reason only reinforcement supervision and restoration forms are presented in this section.

3.14.2.5.2. Preparation of treatment works

Purpose of the preparation of defect surfaces reinforced concrete constructions is to provide connection between reinforced units and operating reinforcement. Rusted concrete protecting layer of reinforcement is destroyed with the purpose of work with the restored (intensified) reinforced concrete layer. In case of two side welding the length of weld must be 5d, in case of one side welding length of weld must be 10d.

If reinforcement diameter is over than 24 mm the strengthening is implemented by two side installing details.

If there are cracks in concrete along the reinforcement, the concrete of protecting layer of reinforcement must be removed. In areas of high pressure after resistance on construction old and new concrete connection is to be provided by additional zones, anchors or other procedures. In case of difficulties while cleaning the damaged reinforcement from rust, one day before concrete bars can be lubricated with the mixture of 9/1 proportion of 40% orthophosphorus acid and zink powder. All methods of treatment of reinforced concrete constructions must be approved by project Engineer and a designer.

The scope of works of the liquidation of defects of reinforced concrete constructions is estimated by the volume reconstructed concrete and the weight of used reinforcement.

3.14.2.6. Deficiencies of prefabricated concrete and reinforced concrete

3.14.2.6.1. Scope of works

Defects of prefabricated concrete and reinforced concrete are the same as monolith ones. Treatment methods are the same.

There are the following characteristic defects of prefabricated reinforced concrete constructions:

- a. dangerous cracks
- b. break of the connection of prefabricated parts, sizes of construction and water resistance
- c. break of water resistance of welds

3.14.2.6.2. Deficiencies removal

Stability of prefabricated elements not diverged from designed position can be provided by the following ways:

- a. restoration of connections with installing elements which are designed to fix position of the structure
- b. connecting with foundation or with other stable parts of the structure
- c. making additional structures as well as constructing the bases, foundations, connections, etc. removing the such distances which allow the shakings of the structures.

All above-mentioned works are implemented by using the materials and ways of work described in the given specification.

Diverged from the designed position the prefabricated elements should be disassembled and installed again providing the stability mentioned in design. Reasons for divergence can be the same as above-mentioned ones as well as unforeseen influences on the structure (such as water overflow of channel, foundation weakness, earthquake and others).

3.14.2.7. Strength of foundations and supports

3.14.2.7.1. Solving of deficiency causing reasons

Reasons for defects can be caused by decay of artificial foundations, natural foundations weakness or subsidence, insufficient depth of foundation in general one, insufficient cross section of structure.

The reasons are solved by water outlet organization, leakage removal, foundation strengthening or another option intended by the design.

Surface or spring water outlet is organized by making a possibly biggest flow ditch.

Organization of water outlet is discussed and approved by the Engineer.

3.14.2.7.2. Preparation for deficiency removal

The defected part is freed from loading. Afterwards, it is prepared for repair or strengthening or is destroyed if construction is completely decayed.

3.14.2.7.3. Strengthened constructions concrete works

Usually the limited thickness has strengthening. For this reason it is necessary to use more than usual plastic mixtures made of smaller fill. In all cases of strengthening or restoration the

Contractor presents his suggestions about the materials, the content of concrete, forms, the detailed description of work methods which must be approved by the Engineer.

The Engineer has the right to require for approbation of suggested method on any kind of any similar structure.

3.14.2.7.4. Control, measurement and payment

All materials are selected and checked according to the requirements of previous sections of the given specification.

During works sizes of connections, plasticity of concrete mixtures, operations concerned to connection of old and new concrete, breaks are being controlled.

The scope of implemented works is measured by payment units assumed for the given works.

3.14.2.8. Peculiarities of works in winter see corresponding specifications of Section #6

3.14.2.8.1. Preparation and storage of the materials

In winter time it is necessary to be careful of the freezing of materials which can lose their quality while freezing.

It must be taken into consideration the cold state of concrete, metal, soil, water. There must be special facilities necessary for the warming of materials on the places of works. The warming of materials must be implemented with the keeping of safety conditions, especially it concerns to the explosive materials.

The concrete can be warmed by hot air. The materials which must be used in hot state can be warmed in small doses immediately before use.

Aqueous solution of polyvinylacetate and water for the concrete mixtures can be warmed up to 80-90°C.

Combustible materials (xylol, benzene, etc.) must not be warmed more than up to the half of temperature of inflammation (ignition).

3.14.2.8.2. Antifreeze and other admixtures

In winter conditions it is recommended to use antifreeze admixtures in concrete mixes. The type and quantity of the admixtures are to be agreed with the Engineer and the designer.

3.14.3. Metallic pipes, reinforcement, shaped parts

3.14.3.1. Materials and testing

For the restoration works it is used such a metal which compatible by its deformative and technological characteristics with the metal of the structure.

It is allowed to use steels only of the group “B” (according to GOST 380-2005), having the indexes of the strength corresponding to SNiP 11-23-81.

It is not recommended to use the steels of groups “A” and “B” of the low rating and calorific value.

The preference is given to the steels having good weldability and normative corrosion resistance. Basically it must be used the steel with the mark $\text{Ñ}\text{ò} -3$ of any melting in such a case the preference should be given to the steel of semi-calm melting with the increased content of manganese which is indicated by the index “T”, i.e. the steel БСтГпс 5.

For welding works it is used the electrodes of the factory manufacturing according to GOST 9467-75, GOST 2246-70 corresponding to the marks and characteristics of the welding steels.

For the welding of the steels $\text{A}\tilde{\text{N}}_3$ it used $\text{Y}-42(\text{Y}-42\text{A})$ type of electrodes, produced from metallic wire $\text{N}\hat{\text{a}}-08$, $\text{N}\hat{\text{a}}-08\text{A}$ according to GOST 2246-70.

The welds must correspond to the SNiP 3.03.01-87, i.e. must have in the angle shearing connections the estimated resistance not less than 180 MPa according to SNiP 11-23-81.

On the contacts of fusion the resistance must be not less than 90 MPa. In the estimations of the structures it is taken the estimated resistance of the metal $235:1,1=210$ MPa, and in the angles welding seams -90 MPa. on the shearing - not less than 50 MPa.

All welds are implemented protuberant, the leg on the borders of fusion must be not less than the thickness of the thinner one from welding elements. The delivered materials must have the certificate of quality and the marking indicating the mark of steel.

The checking of quality of steels can be implemented by testing of samples in the tension (MCP type of cars) or in the hardness (by Brinell, Rockvel, Shore) tests.

3.14.3.2. Billets, equipment, tools

The billets intended for the strengthening of the existing structures, struts, bolts and other materials in necessary volume of the estimated period or section of works must be prepared and delivered to the site before the beginning of the works. The billets are checked by the Engineer according to the conformity of their destination by sizes, the preparation of edges for welding, etc.

It is checked the quantity (sufficiency) of equipment and tooling, preparation of work conditions (SNiP III-4-80*), including the qualification of staff.

3.14.3.3. Implementation of works

The works on the restoration of water conduits with steel pipes usually consist of removal of the defective sections, welding of changing or strengthening shaped billets, flattening of bulging and flexures, attaching of unsteady elements. All welding works are implemented by hand electric arc welding. The defective sections can be cut by gas-flamed methods.

The repair plate must be wider than the cut-out on the whole contour at least by the triple thickness of metal. The edges of cut-out are developed by hand grinding machines up to the GOST standard surface finish #1 admitting the roughness ± 200 micron. On the contour of welding the metal is cleaned from rust to surface finish #2.

During the welding the repair plate is pressed by the jack, struts or other improvised means. In the beginning the plate is tack welded along the edge of the plate with the length of 4-5 cm in each 200-300 mm (in general case - thickness of the plate is not more than 30-fold), then these welded parts are lengthened till their join. For each pass it is implemented the thickness of weld up to 5-6 mm.

During the strengthening of welds by the plates the welding is implemented only on the sides along the strap crossing the weld, it is permitted to close the weld on the whole contour of the strap not to create the cutting effect.

In all cases the welds must be implemented from below upwards.

3.14.3.3.1. Repair of Valves, Fire Hydrants And Pumps

To repair the fire hydrants and the pumps it is necessary to dissemble them. To replace all the worn out, bent, broken parts and to oil and clean all the parts before gathering them. In the case if the breakage or fracture of the body the equipment is to be replaced by a new one. The fact of repair of equipment shall be registered by act with participation of operating company's representative.

3.14.3.3.2. Leakage detection and repair

In parallel to construction work, instrumental detection of leakage from repaired or reconstructed segments must be implemented by a professional organization.

Identified and potential new emergency parts can be of the following main types.

- a) a hole in the pipe,
- b) welded seam opening.
- c) deteriorated pipe segment.

Illegally connected pipes are also considered as leakage.

In case of a hole in the pipe the leakage is repaired by patch.

In case of welded seam opening the leakage is repaired by patch or collar.

In case of deteriorated pipe segment it is replaced.

Leakage repair is implemented jointly by Contractor and Engineer, based on the jointly prepared act, which must include the type of break and the repair method.

3.14.3.3.3. Capital repair of chambers

The chambers are mainly of two types: circular and rectangular. Circular chambers are made from precast reinforced concrete. Rectangular chambers are made from monolithic concrete or stone masonry. Chambers' cover slabs are from precast reinforced concrete. The main repair works for chambers are:

1. cleaning of chambers (from silt, stones)
2. repair of deteriorated walls (concreting, rehabilitation of stone masonry, plastering, waterproofing, installation of brackets)
3. repair of deteriorated floor (concreting, rehabilitation of stone masonry, plastering, waterproofing)
4. repair of cover slab (concreting, replacement of cast iron manhole and its cover)
5. installation of cover slab.

3.14.3.4. Control, measurements, payment

To all welding seams of the structures are submitted the requirements of the strength and density according to the operative standards.

The scope of works implemented during rehabilitation or repair is estimated and paid by:

- welding seams - the quantity (weight) of metal spent during the work with the separate estimate of not normative expense of electrodes, spent man/days.
- repaired reinforcement – by unit
- concrete and reinforced concrete structures – m³
- leakage detection – m
- earthwork – m³
- destruction of concrete and reinforced concrete structures, masonry wall – m³
- cleaning of chambers – quantity of chambers, m³, man-day.

3.15. Liquidation of constructions

3.15.1. Objectives and description

The structures or constructions, restoration of which is considered not rational, are liquidated. Partial excavation and removal can be necessary also during the connection of new structures with the existing ones.

For the distracted structures it is indicated the precise sizes, borders, marks, characteristic of the material, the presence of reinforcements, installing details. The elements of the structures which must be removed without destruction are mentioned.

3.15.2. Ways of excavation and removal

The ways of excavation and removal are selected depending on the characteristics of structures and place.

3.15.3. Control, measurements, payment

The Engineer controls the completeness of the removal of the structures in the envisaged sizes, safety of the kept structures, the placement of wastes in the indicated place.

Damage of the kept structures caused by the not corresponding method of works must be repaired by the Contractor without payment.

The paid scope of works is estimated in the units of volume, area of facings, quantity of cutting of reinforcement and other metals.

3.16. List of proposed construction machinery, equipment and devices, according to the required quantities

	Duration of construction works	months
	List of required machinery	
<i>Nº</i>	<i>Name</i>	<i>Q-ty, pcs.</i>
1	Backhoe excavator, V = 0.5-0.75 m ³	6
2	Dump truck – 10 t capacity	14
3	Crawler bulldozer	4
4	Autocrane, (arm flight - 16m, capacity - 6t)	4
5	Telescopic crane (with 12.0m and 250kg elevating power)	2
6	Pneumatic hummer	3
7	Portable concrete mixer, V=3.0m ³	4
8	Motor-truck concrete mixer, V=5.0m ³	1
9	Portable electric welding equipment	8
10	Pipe carrier truck	2

11	Scoop loader	4
12	Roller Q=5.0 t	3
13	Welding equipment for polyethylene pipes	3
14	Surface vibrator	4
15	Internal vibrator	14
16	Compactor	4
17	Leveling instrument	3
18	Theodolite	3
19	10x10cm or 15x15cm sized cubes for testing of concrete sample	18
20	Saw for cutting of asphalt-concrete cover	6
21	Electrical saw for cutting of metal profiles and reinforcement bars	4

3.17. List of proposed staff

<i>Nº</i>	<i>Position</i>
1	Construction Manager
2	Construction works Civil Architect, chief engineer
3	Foreman
4	Head of earthworks staff
5	Head of concrete works staff
6	Head of staff implementing water supply and wastewater works
7	Engineer-geodesist
8	Metal construction welder
9	Steel pipes welder
10	PE pipes welder
11	Metalworker for reinforced concrete
12	Concrete worker
13	Locksmith of W&W systems