

VOLUME 3
TECHNICAL SPECIFICATION

VOLUME 3 - TECHNICAL SPECIFICATION

Table of Contents

	<u>Page</u>
1.1	
PREAMBLE TO SPECIFICATION	1
LOCATION MAP OF THE PROJECT AREA.....	2
Part 1 – Technical Specification - General	3
1.1 Description of Works.....	3
1.2 Scope of Works	3
1.3 Indicative Time Schedule.....	3
1.4 Drawings	3
1.5 Standard Specifications	3
1.6 Levels and Setting Out	5
1.7 Offices	6
1.8 Contractors Access and Storage Area	7
1.9 Site Investigation	7
1.10 Survey of Existing Structures.....	7
1.11 Protection of Existing Structures/Services	8
1.12 Noise Suppression.....	8
1.13 Not used	8
1.14 Working Area.....	8
1.15 Work on Roads.....	8
1.16 Traffic Requirements	8
1.17 Interference with Access to Properties.....	9
1.18 Health and Safety Regulations.....	9
1.19 Sanitary Accommodation	9
1.20 Power Supplies.....	9
1.21 Water for Works.....	9
1.22 Private and Publicly Owned Services.....	10
1.23 Temporary Works	10
1.24 Connections to be made by the Contractor	10
1.25 Responsibility for Ordering Materials	11
1.26 Contamination of water supplies	11
1.27 Groundwater and Surface Water	11
1.28 Packing and Storage of Materials	11
1.29 As-built Drawings.....	11
1.30 Operating and Maintenance Instructions.....	12
1.31 Records	13
1.32 Progress Reports and Meetings.....	13
1.33 Photographs	13
1.34 Signboards	13
Part 2 - Technical Specification - Preparatory Works	14
2.1 Staking out of the route.....	14
2.1 Removing trees	14
Part 3 - Technical Specification - Civil Works (Earthworks).....	15
3.1 Classification	15
3.2 Excavation - General	15
3.3 Excavation for Foundations	15
3.4 Trenches for Pipelines	15
3.5 Excavation in Rock	16

3.6	Removal of Faulty Ground	17
3.7	Over Excavation	17
3.8	Protect Existing Buildings	17
3.9	Timbering Excavations.....	17
3.10	Timber Left in Trench.....	17
3.11	Dewatering	17
3.12	Removal of Offensive Matter.....	18
3.13	Lay Temporary Drain	18
3.14	Backfilling (in normal ground).....	18
3.15	Backfilling (in Rock)	18
3.16	Granular Backfill	19
3.17	Deficiency of Material for Fill	19
3.18	Disposal of Surplus.....	19
3.19	Forming Embankments.....	19
3.20	Reinstatement.	19
3.21	Green areas.....	20
Part 4 – Technical Specification – Civil Works (Concrete).....		21
4.1	Concrete	21
4.2	Samples and Testing	21
4.3	Cement.....	21
4.4	Water	21
4.5	Aggregates	21
4.6	Grading of Aggregates.....	22
4.7	Concrete Mix Design	22
4.8	Grades of Concrete	22
4.9	General Quality of Concrete	24
4.10	Workability	24
4.11	Batching and Mixing	24
4.12	Trial Mixes	24
4.13	Works Tests.....	24
4.14	Records	25
4.15	Admixtures.....	25
4.16	Ready-Mix Concrete	25
4.17	Transport and Placing.....	26
4.18	Compaction of Concrete	26
4.19	Joints	26
4.20	Curing of Concrete.....	28
4.21	Early Loading.....	28
4.22	Formwork - Construction.....	28
4.23	Formed Surfaces - Classes of Finish	28
4.24	Preparation of Formwork	29
4.25	Removal of Formwork.....	29
4.26	Steel Reinforcement	30
4.27	Bending of Reinforcement	30
4.28	Fixing Reinforcement.....	30
4.29	Welding of Reinforcement.....	31
4.30	Precast Concrete	31
4.31	Grouting.....	31
4.32	Concrete Screeds.....	31
4.33	Tolerances.....	31
Part 5 – Technical Specification – Civil Works (Drainage).....		33
5.1	General.....	33
5.2	Tests on Completion.....	33

5.3	Jointing	35
5.4	PVC Pipes and Fittings	35
5.5	Concrete Pipes	35
5.6	Street gullies	36
5.7	Back filling	36
5.8	Curbstones	37
5.10	Joints	37
5.11	Manhole and Access Covers and Frames and Surface Boxes	37
5.12	Keys	38
5.13	Handling Pipes	38
5.14	Cutting Pipes	39
5.15	Cleaning	39
5.16	Manholes and Chambers	39
5.17	Tolerances for Gravity Pipelines	39
5.18	Pipe Bed	39
5.19	Pipe Support in Bad Ground	39
5.20	Pipe Surround	40
5.21	Concrete Arch and Surround	40
5.21	Abbreviations	40
Part 6 – Technical Specifications – Civil Works (Roadworks and Siteworks)		41
6.1	General	41
6.2	Stone Materials for Road Construction	42
6.3	Traffic signs	51
Part 7 – Building works -		52
7.2	Earthworks	52
7.3	Concrete	52
7.4	Block Work and Brickwork	52
7.5	Plaster and Rendering	53
7.6	Screed	54
7.7	Doors and Windows	54
7.8	Hydro Insulation	55
7.9	Roof Frame Work	56
7.10	Rainwater Gutters	57
7.11	Upstand Capping	57
7.12	Damp-proof Course	57
7.13	Handrails	57
7.14	Roofs - Slating and Tiling	57
7.15	Tiling	57
7.16	Painting	58
7.17	Flooring	59
7.18	Step Irons	59
7.19	Wooden Structures	59
7.20	Parquet Flooring	59
7.21	Roller Shutters and Curtains	59
7.22	Masonry Works	59
7.23	Metal Works	59
7.24	Wood Work	60
7.25	Fire Extinguishers	61
Part 9 –General - Electrical and Telecommunications Installation		62
9.1	General information	62
9.2	Connecting power cables	62
9.3	Trenches for power cables and telecommunication conduits	62

9.4	Mechanical cable protection	63
9.5	Clamp connections	63
9.6	Earthing rope	63
9.7	Safety distances of 10(20) kV cables from other underground installations	63
9.8	Cable laying.....	64
9.9	Cables and Flexible Cords.....	65
9.10	Building Services Installation	66
9.11	Lighting.....	67
9.12	Street Lighting	68
9.13	Protection from electric shock.....	69
9.14	Earthing System	70
9.15	Lightning Protection System	71
9.16	Spare Parts.....	72
9.17	Taking over the equipment	72
9.18	Commissioning.....	75
Part 10 – Water Supply and Sewerage Installation		76

PREAMBLE TO SPECIFICATION

This section of the Tender Documentation comprises the Technical Specifications for the project – Building of Bicycle path "šećeransko jezero" with belonging subjects that is being funded by the European Commission through the IPA Cross border Hungary- Croatia 2007-2013 programme.

The Conditions of Contract, the Technical Specifications, the Drawings and the Bill of Quantities are to be read in conjunction with each other.

Notwithstanding the subdivision of the Specification under different headings, every part of it shall be deemed supplementary to and complementary to every other part.

The headings in the Specification shall not be deemed to be part thereof or be taken into consideration in the interpretation of the Contract.

Where the specifications refer to proprietary processes, technologies or equipment, this implies equivalent processes, technologies or equipment.

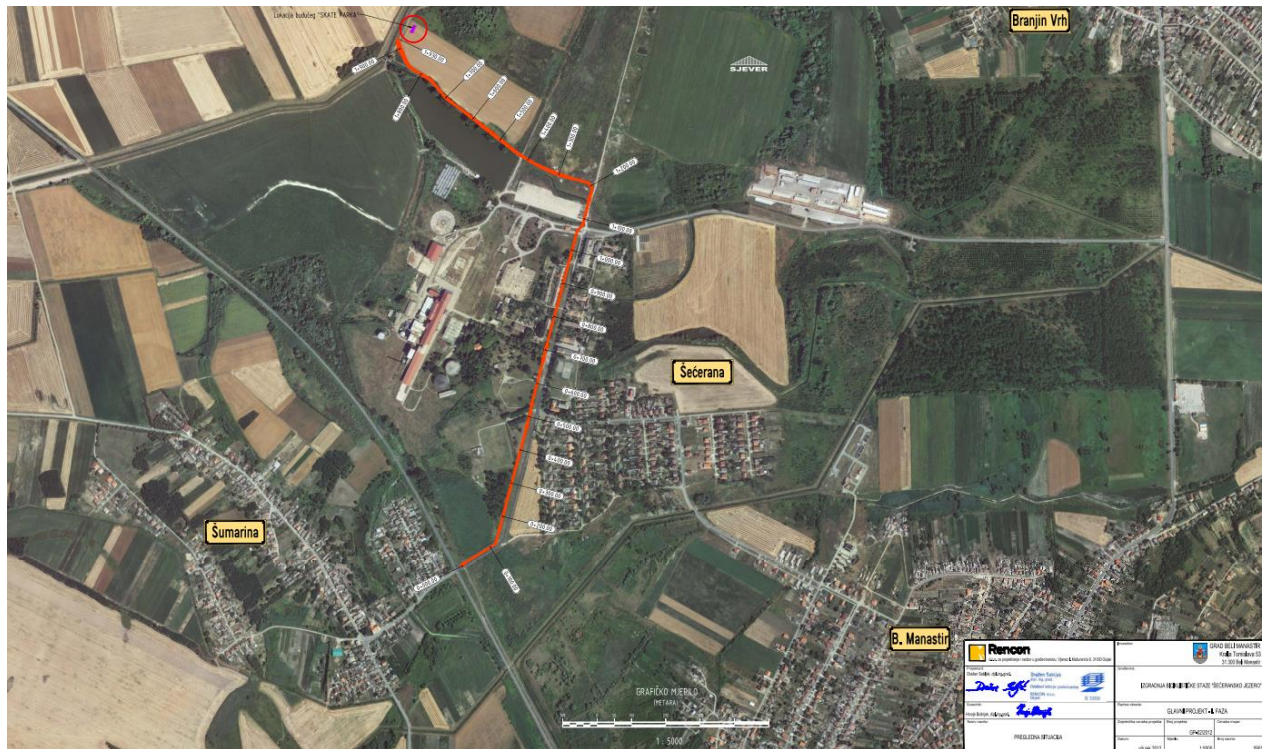
All references made in the Specification will be references to Clauses or sub-Clauses hereof, unless specified otherwise.

The works are as described in the Invitation to Tender and the Contractor will be deemed to have entered rates in the Bill of Quantities to cover all the requirements set out in these Specifications. No other payments will be allowed.

The Specification shall not be considered as being exhaustive and the Tenderer will be deemed to have included all necessary plant and equipment whether specified or not.

The designs for the five schemes were prepared by different designers in accordance with normal Croatian procedures and the documentation was prepared in the Croatian language. These documents will be available for the Contractor to consult and use as clarification for the Contract Documents in English if necessary.

LOCATION MAP OF THE PROJECT AREA



Part 1 – Technical Specification - General

1.2 1.1 Description of Works

1.1.1 The scope of work includes the completion of all civil works and the supply and installation of all mechanical & electrical equipment associated with the construction, listed below in 1.2 – Scope of Works

1.1.2 The contract includes for the supply of all materials, plant, labour and temporary works required to complete all the work as scheduled, and in accordance with these Tender Documents.

1.1.3 The Contractor shall allow in his programme for the required phasing of the work to allow co-ordination between the all works defined in Bill of quantities (both lot 1 and lot 2).

1.3 1.2 Scope of Works

Bicycle Path connects Town of Beli Manastir with nearby lake. Works are planned according to Main project design made by "Rencon d.o.o." Works planned for reconstruction of SUPERVISORY INFORMATION CENTRE are planned according to Main project design made by "Tetraedar d.o.o."

A summary scope of works is shown in the list below.

Sidewalks

- Length 1.930 m¹
- Area 4.911 m²
- wearing course asphalt-concrete AB 8 d=4.0cm

Supervisory information centre

- Building Area 96,56m²
- Site area 864,0 m²
- Terrace area 32,0 m²

1.4

1.5 1.3 Indicative Time Schedule

1.3.1 The Tenderer shall provide with his tender a tentative time programme with Form 4.6.3 indicating the duration of the various activities at location.

1.6 1.4 Drawings

1.4.1 The Drawings relating to this Contract are included as Volume 5 of the Tender Dossier

1.4.2 Additional drawings and construction details may be issued to the Contractor during the course of the Contract.

1.4.3 The Contractor is required to complete all working drawings necessary and these must be approved by the Supervisor.

1.7

1.8 1.5 Standard Specifications

1.5.1 Any acceptable national Specification quoted or referred to in the Specifications is thereby made part of the General Specification. Where reference is made to a Standard

Specification the reference shall be deemed to apply to the issue of the specification with amendments or addenda, if any, current at the date of invitation to tender for the Works.

1.5.2 All materials which the Contractor proposes to use in the construction of the Works shall comply with the requirements of the Specification.

1.5.3 Materials and workmanship shall be according to approved national or international standards.

All materials, components and workmanship shall conform to a National Standard of a Member State of the European Union, or Croatia (HRN) or Codes of Practice. ISO, DIN, UNI, Croatian or Member State standards may be acceptable. Where a National standard and an international standard exist for the same material or workmanship the more stringent shall apply. The Contractor may propose alternative national standards to those specified; a copy (with English translation) of the proposed alternative must be submitted to the Supervisor for review and approval. A copy (with English translation) of all approved standards shall be maintained on site by the Contractor. If no appropriate Standard Specification has been published, the materials and workmanship shall be to the best standard available and shall be subject to approval by the Supervisor. Where proposed works connect to existing facilities the new materials must be compatible with the existing. A copy of all standards in English shall be provided by the Contractor for the Supervisor.

Tenderer's attention is drawn to the existence of following specific Croatian Regulations:

*	Construction Law	(NN 175/03, 100/04)
*	Environment protection Law	(NN 82/94, 128/99)
*	Fire protection Law	(NN 58/93,59/96, 94/96)
*	Law on public roads	(NN 100/96, 76/98)
*	Law on safety at work	(NN 59/96)
*	Law on transport of dangerous materials	(NN 97/93)
*	Law on waters	(NN 107/95)
*	Nature protection Law	(NN 30/94, 72/94)
*	Regional planning Law	(NN 30/94, 68/98, 35/99, 61/00)
*	Road Traffic Law	(NN 36/98)
*	Safety at work Law	(NN 59/96, 94/96, 114/03)
*	Standardization Law	(NN 55/96)

1.5.4 Standards

The Construction Law (NN 175/2003) proscribes the proof of suitability of construction products which can be used for building; therefore it has been proscribed that the products are suitable if their features meet essential requirements for a building, which has been proved by

a certificate of consistence, or
a contractor's statement on consistency

The certificate of consistency has been proscribed in the articles 13 – 31 of the Standardization Law (NN 55/96). The obligation of obtaining the certificate of consistence rests with the Contractor, according to the article 18 of the mentioned Act, and according to the "List of Regulations and Authorized Corporations for Implementation of Procedure of Obligatory Confirmation" issued by The State Institute for Standardization and Measurement, the Contractor must supply the Supervisor with following certificates before building – in:

the graded stone aggregate for concrete and asphalt
cement
concrete additives

hydro-insulation materials impregnated with bitumen and bituminous strips
screws, nuts and pads for bases for bearing structural steelwork

All other products needed for construction of buildings, which are the subject of this project, are subjected to the Contractor's statement on consistency according to the Article 32 of the Standardization Law.

1. Earthwork

Levelling material for pipes:

- granulation metric structure (sand, fine gravel $\varnothing \leq 16$ mm)
- non – aggressiveness of structure

2. Concrete and reinforced – concrete work:

- water (according to HRN EN 1992-1:2004.058)
- steel for reinforcement:
 - smooth and ribbed (The Book of Regulations for Concrete and Reinforced Concrete, The Official Gazette 11/87, articles 63 – 72)
- steel mesh (HRN EN 1992-1:2004.091)

3. Tradesman's work:

- lime (according to HRN B.C1.020)
- cement for mortar (HRN B.C1.011)
- sand for mortar (HRN U.M2.012)
- water for mortar (HRN U.M2.012)
- mortar for walls (HRN U.M2.012)
- water-tight coating (suitability for the use with drinking water)
- cold bituminous coating (HRN U.M3.240 or HRN U.M3.242)

4. Assembly work:

- PVC pipes and pipe fittings, HRN U.G1.500
- non-corrosive steel according to DIN 2463, material DIN 17455 (W.N.1.4301, AISI 304 and W.N. 1.4401, AISI 316)
- Cast – iron covers: material, cast iron according to HRN C.J2.020 - the bearing capacity of the cover according to a declaration

1.5.5 If no appropriate Standard Specification has been published for an item or material, it shall be to the satisfaction of the Supervisor.

1.5.6 Nothing stated in this Specification is to be construed as discriminating against products and materials manufactured in any of the Member States of the European Community or CARDS Country.

1.9 1.6 Levels and Setting Out

1.6.1 All levels shown on drawings refer to sea level Ordnance Datum at Trieste, unless otherwise stated. Where flood levels, tide levels, river levels, lake levels, stream levels and culverts are given, these are based on the best available information but are not guaranteed and Contractors must verify such levels for themselves before using them.

1.6.2 Before work commences the Contractor shall satisfy himself that existing ground levels, as indicated in the contract, are correct. Should the Contractor wish to dispute any levels he shall submit a schedule of such disputed levels to the Supervisor and existing ground levels relevant to these levels shall not be disturbed before the Supervisor's decision as to the correct values is given.

1.6.3 The Contractor shall set out the works prior to the commencement of construction and obtain the approval of the Supervisor.

1.10 1.7 Offices

1.7.1 Supervisor's Office Facilities

Before commencing the Contract, the Contractor shall supply and erect on the site offices for the exclusive use of the Supervisor's staff at a location to be agreed with the Supervisor. The offices shall include the following minimum accommodation:

2 No. separate offices:	6 metres X 5 metres
Kitchen Area:	3 metres X 2.5 metres
Washroom and WC:	3 metres X 2.5 metres

The accommodation is to be connected by internal corridors.

The Contractor shall include in his rates for regularly daily cleaning and maintaining of those facilities and all utility services including a private telephone with an international line for the Supervisor's sole use. These offices shall be provided for the total construction period.

The washroom shall be provided with a washbasin, hot and cold water supplies and a flush operated WC connected to the existing sewer.

The Contractor shall provide and install within one week after commencement of the works the following new or nearly new furniture and equipment in the premises to the approval of the Supervisor:

1. Desks with lock up drawers both sides, size min.: 1400 x 800 mm, h = 750 mm	2 No
2. Pentium PC equipped with Windows XP and Office software package (or equivalent) and inkjet printer	2 No
3. PC-station, size app. 1100 x 600 mm, with drawer and one adjustable shelf	2 No
4. Office chairs with arm rest	2 No
5. Table, size app. 2000 x 750 mm	1 No
6. Chairs	6 No
7. Cupboards, 2000x 800x 350 mm with four adjustable shelves	1 No
8. Filing cabinet, 3 drawers with file suspension and pockets, approx. 1000x600x350	1 No
9. Photocopier A3/A4 including 2 spare toner cartridges	1 No
10. Facsimile machine	1 No
11. Refrigerator 140l.	1 No
12. Fire extinguisher, 10 kg	1 No
13. Steel tape 50 m	1 No
14. Steel tape 30 m	1 No
15. Pocket tapes 3 m	2 No
16. Electric kettle 1l.	1 No
17. Crockery set for 6 persons	1 No
18. Three stage electric heater with ventilator, max, 2000W	2 No

After issue of the handing over certificate, above items shall remain the property of the Contractor.

The Contractor shall be responsible for the security of the Supervisor's office and all equipment therein until the office is finally closed.

The Contractor will maintain, light, heat and clean the offices for the duration of the contract. The Contractor shall be responsible for the insurance of the offices for the duration of the contract.

The Contractor shall arrange for the provision of two telephone lines and instruments for the sole use of the Supervisor and his staff. An internet connection must be provided on one of the telephone lines. A facsimile machine and automatic message recorder shall be provided. The Supervisor will pay the cost of his calls.

The Contractor shall supply the Supervisor with all surveying, testing and measuring equipment, labour and other items necessary for checking, testing, or measuring up the work.

The Contractor shall insure the offices and the contents provided by him, against fire, burglary and other risks ordinarily insured against during the period of the Contract.

1.7.2 Contractor's Office Facilities

The Contractor will be responsible for arranging for his own accommodation and office facilities.

1.11 1.8 Contractors Access and Storage Area

The Contractor will be responsible to arrange for intermediate storage of pipes, materials and equipment. He shall maintain clean and repair all public roads, access roads, storage areas, or other areas used, whenever it becomes necessary, or by order of the Supervisor.

The Contractor shall be responsible for provision and removal of the necessary access to all work sites. For all paved and unpaved existing roads normal wear and tear due to site traffic is accepted. The Contractor shall take care that no paved roads are damaged by tracked equipment. Any damage resulting shall be repaired at the Contractor's expense.

Where, in the Supervisor's opinion, damage to paved roads is due to poor original road construction, the reinstatement shall be paid for under the Contract.

1.12 1.9 Site Investigation

1.9.1 Site investigations have not been carried out specifically for the contract with a view to establishing the ground conditions.

1.9.2 The Contractor shall carry out all investigations he considers it necessary and these must be to the approval of the Supervisor.

1.13 1.10 Survey of Existing Structures

1.10.1 Prior to any construction works, the Contractor shall carry out a comprehensive survey of all walls, structures etc., adjacent to the proposed works.

1.10.2 Close up photographs shall be taken of all adjacent structures, walls, bridges etc. All defects shall be identified and recorded, and detail photographs taken of them. All photographs and records shall be properly catalogued, to the satisfaction of the Supervisor.

1.10.3 A Sum is included in the Bill of Quantities to cover the cost of the photography. The selection of the photographer shall be subject to the Supervisor's approval.

1.10.4 The Contractor shall arrange for representatives of the Contracting Authority and the Supervisor, to be present during the survey.

1.10.5 A Sum is provided in the Bill of Quantities to provide record progress photography during the course of the Contract. The selection of the photographer shall be subject to the Supervisor's approval.

1.14 1.11 Protection of Existing Structures/Services

1.11.1 All necessary precautions shall be taken during the course of construction to prevent movement or damage to the existing premises, outbuildings, walls, services etc.

1.15 1.12 Noise Suppression

1.12.1 The Contractor shall ensure that the level of noise resulting from the construction of the works does not constitute a nuisance, and that noise emissions conform to Croatian regulations. All plant shall be adequately silenced to conform to the relevant Croatian regulations.

1.12.2 These restrictions shall apply particularly to all hours outside normal working hours. Normal working hours exclude Public Holidays.

1.12.3 Noise restrictions shall be generally as follows:

Normal Working Hours	: 65 dB(A)	- Equivalent continuous sound level
Outside Normal Working Hours	: 55 dB(A)	- Equivalent continuous sound level
Night Time (10.00 pm to 6.00 am)	: 40 dB(A)	- Equivalent continuous sound level

1.12.4 The noise levels given above shall apply at the fencing surrounding the work areas, and may be varied at the discretion of the Supervisor if he deems necessary.

1.16

1.17 1.13 Not used

1.18 1.14 Working Area

The area of land required for construction works shall be limited to the smallest possible area and be agreed upon with the Supervisor and the local authorities prior to execution.

1.19 1.15 Work on Roads

Throughout the execution and maintenance of the Works, the Contractor shall co-operate with the Highway and Police Authorities and Beneficiary, concerning works affecting any road. The Contractor shall inform the Supervisor of any requirements of, or arrangements made with, the Highway and Police Authorities or beneficiary. Before any work affecting the use of any road, public or private, is commenced, the Contractor's proposed method of working shall be approved in writing.

1.20 1.16 Traffic Requirements

The Contractor shall provide all items and take such measures as may be necessary to comply with the relevant provisions of the traffic safety measures.

The Contractor shall keep clean and legible at all times all traffic signs, road markings, lamps, barriers and traffic control signals and he shall position, reposition, cover or remove them as necessitated by the progress of the Works.

The Contractor shall take every precaution to prevent dirt and mud or other material being dropped or spread by traffic from the Works on roads and paths.

The Contractor shall also clean roads and paths of any dirt and mud that is unavoidably spilled by traffic travelling to and from or on the Site in connection with the Works. The Contractor may be directed to carry out such cleaning work outside normal working hours to minimise traffic disruption.

The Contractor shall construct temporary diversion ways wherever the Works will interfere with existing public or private roads or other ways over which there is a public or private right of way for any traffic. Nevertheless, where approved, the Contractor may make arrangements for temporary closure of such public or private road or right of way.

The standard of construction and lighting shall be suitable in all respects for the class or classes of traffic using the existing way and the width of any diversion shall not be less than that of the existing way unless otherwise necessary and approved by the Supervisor.

1.21 1.17 Interference with Access to Properties

Before interfering with access to any property, the Contractor shall provide satisfactory alternative arrangements. The Contractor shall notify the Supervisor and the relevant occupiers in writing 14 days in advance of any such interference.

1.22 1.18 Health and Safety Regulations

The Contractor shall comply in all respects with all health and safety regulations and with any associated statutory instruments.

The Contractor shall ensure that all plant used on the contract is adequate for the duty proposed and does not cause public nuisance due to fumes, noise or leakages.

The Contractor shall provide competent watchmen as may be required at all times outside working hours. Warning lights shall be erected at suitable intervals along the work and shall be maintained outside normal working hours.

The Contractor must take all the necessary measures to ensure that his equipment, vehicles, staff, activity and work do not cause unnecessary inconvenience to the local population.

The installation and plant shall comply with the current I.E.E. Regulations for the Electrical Equipment of Buildings, the E.T.C.I. Rules for Installation Work and the relevant national acts and regulations.

1.23 1.19 Sanitary Accommodation

The Contractor shall provide and maintain and keep in good sanitary condition adequate sanitary accommodation for the use of all men engaged on the Works, and shall remove, disinfect, and clear away on completion.

1.24 1.20 Power Supplies

Unless particularly specified the Contractor shall provide all power supplies required for the construction of the works. He shall make all the necessary arrangements with the relevant authority for the provision of the power supply and shall include for any costs arising in his rates for the works.

1.25 1.21 Water for Works

All water required for the construction of the Works, testing pipelines and tanks or for any other purpose shall be provided by the Contractor.

1.26 1.22 Private and Publicly Owned Services

The positions of all existing services which may be affected by the Works shall be determined by the Contractor before work commences and record them on the base drawings to be used for the as-built details of the works.

The Contractor shall take all measures required by the Service Authority or the Supervisor to support or protect adjacent services during the course of the work and, in the case of damage the services shall be restored by the Contractor without delay.

Trial holes to locate existing underground services shall be dug where required by the Supervisor. Wherever it is necessary, in the opinion of the Supervisor, to relocate any service the Contractor shall carry out the work or such portion of it as the Supervisor may direct.

1.27 1.23 Temporary Works

The design, fabrication and installation of all temporary works, necessary for the Works to be constructed, shall be the responsibility of the Contractor. He shall submit detailed proposals and drawings of such temporary works for the Supervisor's approval before commencing work. Approval of such proposals or drawings shall not relieve the Contractor of his total responsibility for the adequacy or safety of such temporary works.

1.28 1.24 Connections to be made by the Contractor

1. Existing water mains are defined as mains carrying raw or treated water, including all pipe work supplying the existing service reservoirs.
2. Connections to existing water mains shall be provided as specified or as shown on the Drawings or as otherwise required by the Supervisor.
3. The locations of connections are only nominally indicated on the Drawings and their precise locations and diameter shall be determined by the Contractor after consultation with the Supervisor and the Beneficiary. Such connections may comprise a tee-branch inserted into the pipeline together with associated valves and couplings.
4. The Contractor shall submit a programme for connection works to the Supervisor and the Beneficiary for approval,
5. Subject to the approval of the Contractor's programme by the Supervisor and the beneficiary, the procedure shall be as follows:-
 - a) The Contractor shall expose the existing main at a location directed by the Supervisor for the purposes of locating the main. Location, depth and sizes shall be recorded and be the responsibility of the Contractor.

Upon receiving confirmation from the Supervisor and the Beneficiary regarding the suitability of the connection point the excavation shall be backfilled and the ground reinstated.

Costs incurred by labour and plant in carrying out this exploratory work shall be included in the Contractor's rates.

- b) The Contractor shall supply all materials (pipes, specials, fitting, valves, couplings etc.) necessary for the proper and adequate execution of the connection.

Prior to placing an order for connection materials the Contractor shall submit his design and schedule of proposed materials for approval by the Supervisor.

- c) The Contractor shall give the Supervisor a minimum of two weeks notice in writing before a connection is required.

Such notice shall only be given by the Contractor when all materials required for the connection are available and on site. Materials shall be made available for checking and verification by the Beneficiary's staff.

- d) Subsequent to receiving approval to proceed, the Contractor shall excavate and expose the existing pipe at the previously approved connection point to allow the connection works to proceed.
- e) The cutting of the existing main and connection to the existing main shall be supervised by the Beneficiary's operations staff, or by authorised sub-consultants.

1.29 1.25 Responsibility for Ordering Materials

The responsibility for ordering and delivery of materials and manufactured articles and samples, (that may be tested upon request sufficiently well in advance of the works as not to delay the works) shall rest upon the Contractor. Any delay caused by his neglect to order sufficiently well in advance, or payment of any costs the Contractor may incur as the result, shall be to his account.

Before incorporating in the finished works, the Contractor shall submit samples, as far as requested for in the Specification or the Bill of Quantities, for the Supervisor's approval. Such samples shall be delivered and kept at the Supervisor's office. The materials incorporated in the works shall be at least of the same quality as the approved samples.

1.30 1.26 Contamination of water supplies

Before any person is engaged on work prescribed by the Contract which involves a risk to the purity of potable water supplies, he shall be tested to indicate that he is not a carrier of typhoid or other waterborne disease and he shall be informed of the dangers of contamination. The Contractor shall notify the Supervisor of any person who has been off work because of gastroenteritis or because of prolonged feverish illness, the cause of which has not been diagnosed, and no such person shall be employed on such work until he has been examined and certified by a doctor that it is safe for him to be so employed.

1.31 1.27 Groundwater and Surface Water

The Contractor shall include in his rates for controlling and disposing of all groundwater and surface water which effect the works during the construction. The method of disposal shall be approved by the Supervisor.

1.32 1.28 Packing and Storage of Materials

All materials delivered shall be packed and marked in accordance with international standards for export from the country of manufacture. The Contractor shall store the materials in the way to avoid deterioration or damage. Manufacturers' instructions must be followed. Damaged materials will be rejected.

1.33 1.29 As-built Drawings

The Contractor will be required to record all works during execution. These have to be compiled in as-built drawings in appropriate scales for the pipelines and structures (e.g. 1:1000 for pipelines, 1:50 for treatment plants, 1:25 for chambers) to enable the relevant utility company to maintain the newly laid pipes and installations at a later date. These as-built drawings must contain but are not limited to:

- all structures and existing and record them on the base drawings to be used for the as-built details of the works services
- exact position of pipe axis and pipe depth
- all structures including manholes, valve chambers and associated structures
- position and specification of any connection to the pipe
- all crossings with all other services including sewers, telephone, electricity cables and water pipes.
- reference points, e.g. buildings, for pipeline locations are to be included.

As-built drawings will be required for all structures and shall include all mechanical and electrical details in addition to the civil works details

The as-built drawings must be approved by the Supervisor and handed over to the relevant utility company at the latest at the date of commissioning the respective works.

The drawings shall be presented as a simple hard copy with digital copying contained on a CD. Digital information shall be compatible with the latest version of AutoCAD.

1.34 1.30 Operating and Maintenance Instructions

Three copies of fully detailed manuals for the operation and maintenance of all major items of equipment provided as part of the works, in the Croatian language and one in the English language shall be issued to the Supervisor a minimum of three weeks before the Date for Completion.

The Supervisor will not provide a Certificate of Completion until the Operating and Maintenance manuals including appendices are in his possession.

The Manuals must include as a minimum:-

- A full description of the system installed, written to ensure that the operational staff fully understand the scope and facilities provided.
- A description of the mode of operation
- Diagrammatic drawings of each system indicating principal items of plant, equipment, valves, etc.
- As-built drawings to A3 size, and a CAD format (AutoCAD) disk
- Legend for all colour-coded services
- The name, address and telephone number of the manufacturer together with catalogue list numbers
- Manufacturer's technical literature for the plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions
- A copy of the Test Certificates (including but not limited to, electrical circuit tests, corrosion tests, type tests, work tests, start and commissioning tests) for the equipment, valves, etc., used in the installations
- Starting-up, operating and shutting down instructions
- Recommendations as to the preventative maintenance frequency and procedures to be adopted to ensure the most efficient operation of the systems
- Lubrication schedule

- A list of normal consumable items
- A list of recommended spares to be kept in stock by the end user, being those items subject to wear or deterioration and which may involve the Authority in extended deliveries when replacements are required at some future date
- Procedures for fault finding

The manual shall be presented in A4 size, in plastic covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover titled

1.35 1.31 Records

The Contractor shall keep daily records of his activities stating the location, weather condition, type of work, personnel and equipment used in a Site Diary as required under Croatian law. Any special circumstances shall be reported to the Supervisor at the following day.

1.36 1.32 Progress Reports and Meetings

The Contractor shall submit to the Supervisor during the first week of every four week period two copies of a progress report in such form that actual progress to the end of the preceding four week period may be compared with the Contractor's programme. The general format of the report will be established at the start of the Contract and will be subject to the Supervisor's approval. The Supervisor may, from time to time as the Works progress, issue revised requirements regarding the format.

1.37 1.33 Photographs

2. The Contractor shall, at the beginning of every four week period, or as directed by the Supervisor, supply one set of photographs showing progress of the Works. This shall continue until the Taking-Over Certificate has been issued.

3. The photographs will be an integral part of the Contractor's progress report. These photographs shall be taken by an approved professional photographer and shall be taken as directed by the Supervisor.

4. The photographs shall be gloss finish, full colour and 250 mm by 175 mm minimum size. 24 photographs shall be taken during each four week period and one set of all prints together with digital copies shall be supplied to the Supervisor.

5. The photographs shall be suitably titled, dated, coded in numerical order and suitably bound in albums.

6. The Contractor shall supply any further sets of prints and/or photographs that may be required by the Supervisor.

6.1 1.34 Signboards

The Contractor shall provide, erect, maintain and remove on completion weather resistant signboards, at such locations as shall be determined by the Supervisor and in accordance with the requirements of the European Union as set out in the EC Visual Identity Guidelines available on http://www.europa.eu.int/comm/europeaid/visibility/index_en.htm

Part 2 - Technical Specification - Preparatory Works

6.2 2.1 Staking out of the route

2.1.1 Staking out of the route and of the structures includes all geodetic survey transferring the data from the design onto the field or vice versa, provisions for the axis of the staked out route, profiling, renewal and maintenance of staked out marks on the field during the whole construction period, until delivery of works to the Investor.

6.3 2.1 Removing trees

Cutting brushwood and trees of all sizes, cutting off the branches, cutting of trees and thick branches to the length appropriate for transportation, extracting roots, brushwood and old stumps, extracting stumps of newly cut trees, hauling of brushwood, branches, logs and stumps outside the road section, to the dump area at the distance up to 10 km.

Hollows from extracted stumps on the foundation soil must be backfilled with the same material as in the surrounding soil and compacted to the required compactness grade.

Removing brushwood and branches (up to Ø10 cm) is accounted per square meter of cleaned grown surface.

Removing trees and stumps is accounted per unit, taking into account the thickness (profile) of the tree (measured at 1 m height)

Part 3 - Technical Specification - Civil Works (Earthworks)

6.4 3.1 Classification

3.1.1 Excavation materials shall be classified in accordance with the Croatian standard "General Technical Conditions for Road works" – 2nd edition of 2001 (OTU). The categories are defined in the following clauses:

Category "A" – Clauses 02.1 and 07 (rock)

Category "B" – Clauses 02.2 and 07

Category "C" – Clauses 02 and 03 (soft excavation)

Excavation in solid rock shall mean excavation in rock found in ledges or masses in its original position, which would normally have to be loosened either by blasting or by pneumatic tools, or if excavated by hand, by wedges and sledge hammers. All solid boulders or detached pieces of rock exceeding 0.20m³ in size in trenches or exceeding 1m³ in general excavation, but not otherwise, shall be regarded as solid rock.

6.5 3.2 Excavation - General

3.2.1 The Contractor shall first remove all debris or rubble, and then all soil and vegetable matter to a minimum depth to underside of topsoil, if any, over the site of all excavations for all permanent structures and pipelines, and over any area which will be disturbed during the construction. He may then select any method of excavation below the surface soil to the final formation or commencement level. The last 75mm depth of excavated material, together with any additional local excavation required for foundations, drainage sumps or similar items shall be excavated in an approved careful manner and the entire formation shall be trimmed neatly and accurately.

3.2.2. Any excavation taken out below permissible formation level, due to Contractor's error, shall be filled in with approved material at the Contractor's own expense.

3.2.3. When excavating humus, care should be taken to enable the transversal and longitudinal drain. Surfaces on which the fill is foreseen after humus removal should be immediately prepared and compacted and the fill first layer should be made.

3.2.4. Accounting of works per cubic meters of actually excavated topsoil, measured in grown state.

3.2.5. The work also include loading of excavated material into means of transportation, transport to the dump area, lodgement and regulation of dump area. The dump area must be insured by Performer. A part of material which will be used for earth filling should be temporarily disposed on construction site.

6.6 3.3 Excavation for Foundations

3.3.1 The sides of all excavations shall be adequately supported at all times or battered to a safe angle where such battering is acceptable.

The bottom of all excavations shall be carefully levelled and accurately shaped to receive the structure to be placed upon them and all concrete shall be laid on an even and solid foundation.

6.7 3.4 Trenches for Pipelines

3.4.1 Trench sides shall be adequately supported, shored, or safely battered back at all times.

3.4.2 Unless otherwise specified, shown on the drawings, or directed by the Supervisor trenches for pipelines shall be excavated to the following limits:

Width : (at crown of pipe)

Minimum	Nominal pipe diameter plus 300mm No trench to be less than 450mm wide
Maximum	Nominal pipe diameter plus 600mm.

In rock, greater widths may be allowed by the Supervisor at the Contractor's own expense.

Sufficient width shall be allowed at pipe joints to give adequate room for jointing operations.

Depth:

Except where the pipeline is graded to specified levels as shown on the Drawings, the minimum trench depth shall be such that the minimum cover on the pipes measured from original ground level to the top of the pipe barrel shall be 1,200mm in roads adjacent margins and paved areas, and 900mm otherwise.

Allowance shall be made in the trench depth for the required thickness of pipe bedding material over the full trench width.

3.4.3 Trenches shall be excavated to the widths shown on the relevant drawing or as may be specified in any particular case. Maximum widths shall not be exceeded without the express approval of the Supervisor.

6.8 3.5 Excavation in Rock

3.5.1 Where rock is met with in excavations as much as possible of it is to be removed by means other than blasting.

3.5.2 The use of explosives for loosening or splitting up hard material will be permitted only with the prior approval of the Supervisor. The manner, times and method of blasting shall be subject to the approval of the Supervisor. Any approval, permission or advice given by the Supervisor shall not relieve the Contractor of any of his responsibilities for injury to persons or property.

The Contractor shall comply with all current regulations for the purchase, transport, storage and use of explosives.

Blasting shall be carried out by experienced personnel only and adequate warning shall be given to all persons in the vicinity.

The Contractor shall give adequate notice to the Supervisor of his intention to use explosives so that the relevant authorities can be informed.

Explosives shall be used in such a manner as to impart the minimum vibration to the surrounding ground. Resultant ground wave peak particle velocities shall not exceed 25mm/sec at adjacent structures, pipes etc. Vibrograph readings shall be taken to determine the resultant ground wave velocities for all blasts.

The site of the blast shall be adequately covered with blasting mats, heavy timbers etc., to prevent fly rock and all exposed pipelines, services, structures etc., shall be adequately protected from the results of the blast. Any damage done to structures, services, pipelines etc., shall be immediately repaired by the Contractor at his own expense. The Contractor shall indemnify the Contracting Authority against any loss or damages caused by his blasting operations.

6.9 3.6 Removal of Faulty Ground

3.6.1 All soft places, faults etc, in the bottom of the excavations and trenches shall be excavated to such depths as may be directed and then filled in with approved material.

6.10 3.7 Over Excavation

3.7.1 Any excavation carried out inadvertently by the Contractor below the required depth for the structure or pipeline shall be filled and compacted with approved material up to the required level, at the Contractor's expense.

6.11 3.8 Protect Existing Buildings

2.8.1 The Contractor shall make all necessary provision for shoring, strutting, underpinning or supporting any walls, foundations or other built structures, the stability of which may possibly be endangered by the execution of the works.

6.12 3.9 Timbering Excavations

3.9.1 The Contractor shall furnish, put in place and maintain such sheeting, bracing etc., as may be required to support the sides and roof of the excavation and to prevent any movement which can in any way injure the masonry, concrete or pipeline, diminish the necessary width of excavation, or otherwise injure or delay the work or endanger adjacent pavements, buildings or other structures. If the Supervisor is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports put in at the expense of the Contractor and the compliance with such orders shall not release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside the sheeting, but if voids are formed they shall be immediately filled and consolidated to the satisfaction of the Supervisor.

6.13 3.10 Timber Left in Trench

3.10.1 The Contractor shall leave in place to be embedded in the backfill of excavations or tunnels all sheeting, bracing etc., not so shown on the plans which the Supervisor may direct in writing to be left in.

All other sheeting and bracing shall be removed in such a manner as not to endanger the constructed structure, pipeline or properties whether public or private. All voids left or caused by the withdrawal of sheeting shall be immediately refilled and compacted.

3.10.2 The right of the Supervisor to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders and the non-exercise of this function shall not relieve the Contractor from liability for damages to persons or property, occurring from or upon the work, occasioned by negligence or otherwise, growing out of the failure on the part of the Contractor to leave in place in the excavations and trench sufficient sheeting and bracing to prevent any caving or moving of the ground adjacent to the banks of the excavations and trench.

6.14 3.11 Dewatering

3.11.1 Where required for the protection of road sub-grade or the subsoil beneath the foundations and pipelines the Contractor shall remove by pumping, baling or otherwise any water, from any source whatever, which may accumulate or be found in the excavations and trenches and other openings made under this contract and shall form all dams, flumes or other works necessary to keep them entirely clear of water while pipelines are being laid and backfilled

and foundations, structures and roads are being constructed. The Contractor shall have at all times upon the works sufficient pumping machinery ready for immediate use.

3.11.2 Water from the trenches and excavations shall be disposed of in such a manner as to avoid damage to roads, public or private property, silting of drains or blocking water courses, the work completed or in progress and it shall not cause unnecessary interference with the use of the roadwork or access ways by the public or become a public health hazard.

6.15 3.12 Removal of Offensive Matter

3.12.1 All filth or other offensive matter met with during the excavation of the works immediately it is encountered shall be moved to a suitable approved dump and shall not be deposited upon the surface of any street, or any place near a dwelling house or where it is likely to be a nuisance.

6.16 3.13 Lay Temporary Drain

3.13.1 Whenever so directed by the Supervisor, the Contractor shall excavate a trench or lay a temporary pipeline from the excavations to a natural water course.

6.17 3.14 Backfilling (in normal ground)

3.14.1 Unless otherwise directed all excavations shall be backfilled as soon as the structures therein have acquired adequate strength or pipelines have been laid and tested. Once started backfilling shall be carried out expeditiously.

3.14.2 Excavated material shall be used for backfilling where approved by the Supervisor. It shall be laid and compacted in 200mm layers. Compaction shall be by means of six passes of a vibrating-plate compactor or approved equivalent. If the Contractor allows material, which, on excavation, is suitable for re-use to become unsuitable for backfilling he shall replace it with approved material at his own expense.

6.18 3.15 Backfilling (in Rock)

3.15.1 Where the filling material contains broken rock and stones special precautions shall be taken to protect structures or pipelines within the excavations.

3.15.2 Protective sand or granular surround to a minimum depth of 300mm shall be placed over pipelines to the full width of the trench before rock backfill commences.

Backfill of the first 600mm layer of rock or stones shall be carried out carefully and no rock or large stones shall be allowed to protrude into the protective clay layer. The interstices of the rock backfilling shall be filled with smaller stones and clay and the whole compacted carefully.

3.15.3 Any damage caused to structures or pipelines during the backfilling operations shall be rectified at the Contractor's expense.

3.15.4 The materials used must comply with the quality provisions of:

HRN B.B0.001,	natural aggregates – sampling
HRN B.B3.010,	stone for the base and surface of cobble pavements
HRN B.B8.012,	pressure strength testing

6.19 3.16 Granular Backfill

3.16.1 Granular backfill shall be crushed rock graded within the following limits and compacted in 225mm layers:

Sieve Size	Percentage by Weight Passing
75 mm	100
40 mm	85-100
10 mm	40-70
5 mm	25-45
0.6 mm	8-22
0.075 mm	0-10

6.20

6.21 3.17 Deficiency of Material for Fill

2.17.1 Should there be a deficiency of suitable material backfilling, the Contractor shall supply and place such additional materials as may be required.

6.22 3.18 Disposal of Surplus

3.18.1 As each excavation and trench is refilled the surplus excavated materials shall be at once removed, the surface having been properly restored to its original level.

6.23 3.19 Forming Embankments

3.19.1 The Contractor shall form any embankments to the lines, levels, slopes and profiles shown on the drawings.

Only suitable excavated material shall be used to form embankments and such material shall be deposited in layers within the range of 225-325mm loose depth subject to the approval of the Supervisor and thoroughly rammed and compacted. Should the quantity of suitable excavated material from the works be insufficient to make up the embankments, the deficiency shall be made good with imported suitable material from sources approved by the Supervisor.

The embankment shall be allowed to stand until all settlement has ceased and after any subsidence has been made good a 100mm layer of soil shall be spread and sown with best quality grass seed.

6.24 3.20 Reinstatement.

3.20.1 Following backfilling all excavated surfaces shall be returned to a condition at least comparable with the original surface condition to the approval of the Supervisor

3.20.2 The ground shall be graded and topsoil spread to a minimum depth of 100mm over the entire disturbed area including slopes of cuttings and embankments.

3.20.3 Where topsoil - which had been stripped from the site is found to be insufficient, additional topsoil shall be imported as necessary.

6.25 3.21 Green areas

3.31.1 Levelling, compacting and spreading of humus layer of green surface beside green islands at parking sites, footsides in the centre of town. The item includes material supply, delivery and levelling of the humus layer $d=20$ cm according to the design . The humus layer have to be rolled with light static roller. If the weather if too dry or/and too hot, humus layer have to be damped. On the arranged humus layer grass is sowed. The seed type and mixture is chosen depending on environmental conditions, as to provide for the growth of vegetation. Seed quantity amounts to ca. 5.1-8.0 g/m², and that of fertilizer ca. 80 g/m². Upon execution of humus layer and grassy vegetation the surfaces need to be cured until final growth and mowed 1-2 times.

Part 4 – Technical Specification – Civil Works (Concrete)

6.26 4.1 Concrete

4.1.1 At execution of concrete and reinforced – concrete work the existing regulations and norms should be applied in everything, and especially according to "The Book of Regulations on Technical Normative Standards for Concrete and Reinforced Concrete".

4.1.2 The quality of materials and the standard of workmanship for reinforced concrete shall comply with the relevant clauses of the HRN EN 1992-1:2004, HRN U.M8 and HRN U.E3 in regard to all requirements not otherwise described in this Specification.

6.27 4.2 Samples and Testing

4.2.1 When directed by the Supervisor representative samples of any materials used in the concrete works shall be tested in accordance with the relevant Standards and Codes of Practice.

Tests which are not normally field tests shall be carried out in a laboratory to be approved by the Supervisor. The Contractor shall maintain on site appropriate equipment for routine site testing of materials. Materials from which samples have been found to fail any test shall immediately be removed from the site.

4.2.2 All materials delivered to site or manufactured on site shall be equal to or superior in quality to that of the tested and approved samples.

6.28 4.3 Cement

4.3.1 All cement used in structural work shall, unless otherwise specified, comply to HRN B.C1.011 for Portland cement. The Contractor shall on request produce the invoices of the various consignments for the inspection of the Supervisor.

4.3.2 Normal Portland cement used in concrete, concrete products and other cement based products shall be certified as complying with HRN B.C1.009-014 as amended, in accordance with the Croatian Standards (HRN). Manufacturers' or suppliers' certificates of compliance with the Standard shall be provided when requested by the Supervisor.

4.3.3 All cement used in the Works shall be stored under dry conditions.

4.3.4 Cement damaged in storage or handling shall not be used and shall be removed off the site.

6.29 4.4 Water

4.4.1 The Beneficiary shall provide all water necessary for mortar, concrete or other purpose on the works. All water used on the works shall be fresh clean water of potable quality and must meet the normative standard HRN EN 1992-1:2004.058

6.30 4.5 Aggregates

4.5.1 Fine and coarse aggregates shall comply in all respects with HRN B.B3.100, HRN B B2.009, HRN B.B2.010 and HRN B.B8.042,

4.5.2 The fine aggregate shall be a natural pit or river sand passing a 5mm BS sieve and shall be thoroughly washed in a mechanical washing plant.

4.5.3 The coarse aggregate shall consist of the following sizes:

- (1) Passing 40mm BS Sieve, retained on 20mm BS Sieve
- (2) Passing 20mm BS Sieve, retained on 10mm BS Sieve
- (3) Passing 10mm BS Sieve, retained on 5mm BS Sieve.

It shall be composed of clean washed gravel or crushed stone of approved quality free from laminated and flaky particles, dust and other impurities.

4.5.4 The graded fine aggregate and each size of coarse aggregate shall be stock piled separately on clean impermeable concrete, macadam or other approved surface with provision for drainage. Grading analysis shall be in accordance with HRN B.B8.029.

6.31 4.6 Grading of Aggregates

4.6.1 The grading of the fine and coarse aggregates shall be suitable for making a dense concrete or appropriate workability and strength with the proportions of cement and water with which the aggregate is to be used. The proportion of fine aggregate to coarse shall be in accordance with Table 4.1 of the Specification for prescribed (nominal) sizes. In the case of a designed mix the proportions shall be submitted to the Supervisor for approval.

6.32 4.7 Concrete Mix Design

4.7.1 Concrete mixes shall be either designed, where the Contractor will be responsible for selecting the mix proportions to achieve the required strength and workability and the Supervisor will specify the minimum cement content, or prescribed (nominal) where the approximate mix proportions and minimum cement content are specified.

Designed and prescribed mixes shall be in accordance with the latest Croatian Standards. The cement content in any mix shall not exceed 540kg/m³ of concrete. The quantity of water used shall not exceed that required to produce a concrete with sufficient workability to be placed and compacted in the required location. In all cases the Contractor shall be responsible for producing concrete of the required strength.

6.33 4.8 Grades of Concrete

4.8.1 The grades of concrete to be employed shall be indicated on the Drawings/Specifications or in the Bill of Quantities. In no case shall the grade of concrete be altered except by written instruction of the Supervisor.

4.8.2 The grades that will generally be used are set out in Table 4.1 along with their required proportions. The minimum compressive strength of 7 days after mixing shall be two-thirds of the 28 day strength for the particular grade.

Table 4.1 - Prescribed (nominal) mixes

Concrete Grade	Nominal Max. Size of Aggregate	40		20		10	
Workability		Medium/High		Medium High		Medium/High	
C 25/30	Cement Kg/m ³	370	390	400	430	460	510
	Total Aggregate Kg/m ³	1750	1700	1700	1650	1650	1550
	% Fines	30-50	30-40	30-40	35-45	40-50	45-55
C 20/25	Cement Kg/m ³	340	360	360	390	400	450
	Total Aggregate Kg/m ³	1800	1750	1750	1700	1700	1600
	% Fines	0-35	30-40	30-40	35-40	40-50	45-55
C 16/20	Cement Kg/m ³	300	320	320	350	360	410
	Total Aggregate Kg/m ³	1850	1750	1800	1750	1750	1650
	% Fines	30-35	30-40	30-40	35-45	40-50	45-55
C 12/15	Cement Kg/m ³	250	270	280	310		
	Total Aggregate Kg/m ³	1850	1800	1800	1750		
	% Fines	30-45	30-45	35-50	35-50		

TABLE 4.2 - Designed Mixes kg/m³

Concrete Grade	Minimum Cement (kg/m ³)	Minimum Compressive Strength 28 Days after Mixing			
		Preliminary Test (N/mm ²)	Works Test (N/mm ²)	Water/Cement Ratio	Max. Agg. Size (mm)
50	400	70	50	0.45	20
40A	325	65	40	0.50	20
40	325	55	40	0.55	20
35	300	50	35	0.60	20
30	275	45	30	0.65	20
25	300	40	25	0.65	40
20	250	35	20	0.65	40
15	200	25	15	0.65	40
10	160	17	10	0.65	40

4.8.3 The maximum size aggregate is to be 20 mm unless otherwise approved by the Supervisor.

4.8.4 All concretes of grade 30 or lower may be produced in accordance with the Prescribed Mixes included in Table 4.1 above. All grades higher than 30 must be prepared in accordance with the Designed Mix, included in Table 4.2 above, the necessary preliminary tests being completed prior to concreting works.

4.8.5 The use of pulverized-fuel ash (p.f.a.) or ground granulated blast furnace slag (g.g.b.f.s.) will be accepted provided that the concrete grade complies with the same grade as

achieved by the Portland cement concrete. Trial mixes must be prepared to confirm strength achievable.

6.34 4.9 General Quality of Concrete

4.9.1 Concrete to be used in the Works shall be of such consistency that it can be readily worked into all parts of the formwork and to unformed surfaces and around reinforced and built-in parts without segregation or voids and without the use of an excessive water content. It shall present finished surfaces which are free from honeycombing, dusting, marks caused by bleeding of free water, marks caused by air bubbles, cracking, discolouration caused by mould oil, or other blemishes.

6.35 4.10 Workability

4.10.1 The workability of the concrete shall be controlled by maintaining a water/cement ratio that is found to be sufficient, but not more than sufficient, to produce a dense concrete of adequate workability and strength for its purpose, which shall surround and properly grip all the reinforcement. The workability of the concrete shall be frequently checked in accordance with HRN EN 1992-1:2004.

6.36 4.11 Batching and Mixing

4.11.1 Batching and mixing of concrete shall be carried out in accordance with the requirements of HRN EN 1992-1:2004.

6.37 4.12 Trial Mixes

4.12.1 Where the Contractor designs the mix, he shall before the commencement of concreting in the work, make trial mixes with the materials and plant which he intends to employ or with alternative equipment if permitted by the Supervisor. Six test cubes shall be made from each of three consecutive batches of each mix proposed for the various grades of concrete and mix proposed for the various grades of concrete and maximum sizes of aggregate. Three of each set of six cubes shall be tested at seven days and three at twenty-eight days, or as directed by the Supervisor. The average of the test results shall exceed the required minimum strength; see Table 4.2, by a margin of 15 N/mm² for concrete of Grade 20 or above and of two-thirds of the minimum strength for concrete of Grade 10 and 15.

4.12.2 The Contractor shall submit for approval full details of the trial mixes, and of the mixes to be used in the works which must be based on the satisfactory results of the preliminary tests and on the methods of mixing and placing the concrete which are proposed for the works. When the proposed mixes have been approved they shall not be altered without the permission of the Supervisor. No structural concrete shall be placed in the works until the relevant mix has been approved by the Supervisor.

6.38 4.13 Works Tests

4.13.1 Concrete should be tested according to the provisions of The Book on Regulations on Technical Normative Standards for Concrete and Reinforced Concrete (The Official Gazette 11/87 – the articles 28 – 51) and it consists of the production control at the spot of mounting.

4.13.2 Concrete should be checked pursuant to the provisions of the articles 71 and 72 of The Book of Regulations for Concrete and Reinforced Concrete (The Official Gazette 11/87) by taking 10 samples at 100 t of reinforcement and by sending them for testing of characteristics to the authorized organization.

4.13.3 The sampling and testing of concrete for strength, workability, analysis of freshly-mixed concrete and unit weight shall be carried out in accordance with HRN EN 1992-1:2004.. Such

tests as are not normally field tests shall be carried out in a laboratory to be approved by the Supervisor. The Contractor shall provide everything for the proper storage and transport of samples for testing. Three cubes shall be made per 20m³ of concrete placed per day or as directed by the Supervisor. The samples of concrete for the test cubes shall be obtained at the place of deposition when the concrete is being placed in position. The test cubes shall be marked clearly in an approved manner.

4.13.4 The works cube results shall be examined individually in sets of three and as a series during the progress of the works. The following conditions shall at least be necessary for compliance with this specification:-

- (a) Less than 5%, or more than one per set, of the individual results shall fall below the specified minimum cube strength.
- (b) Each individual test result shall be greater than 85% of the specified minimum cube strength.
- (c) The average strength derived from testing any set or any group of consecutive test results shall exceed the specified minimum cube strength by not less than 7.5 N/mm², or whatever margin the Supervisor considers appropriate.

4.13.5 If in the opinion of the Supervisor test results or the quality of the finished concrete indicate that the specific requirements have not been or may not be complied with, all concreting work shall be suspended until tests have been carried out and the defect causes ascertained. Concrete which does not in the opinion of the Supervisor comply with this Specification shall be removed and replaced by the Contractor at his expense to the satisfaction of the Supervisor even though this may require the removal and replacement of otherwise sound concrete associated with the defective material.

6.39 4.14 Records

4.14.1 Records shall be kept by the Contractor of the location in the works of each day's output of concrete and of the test cubes, cores, and other specimens taken from it. Copies of these records shall be supplied to the Supervisor.

6.40 4.15 Admixtures

4.15.1 The use of admixtures for damp-proofing, water-proofing, hardening, frost-proofing, or as workability aids shall only be used where and as directed by the Supervisor and then subject to his express permission, and at the Contractor's expense. Where the use of admixtures is allowed by the Supervisor, they shall be used strictly in accordance with HRN EN 934-2.2004.

6.41 4.16 Ready-Mix Concrete

4.16.1 Ready-mixed concrete may be used only with the agreement of the Supervisor and shall comply with all requirements of the contract.

The concrete shall be carried in purpose-made agitators, operating continuously, or truck mixers. The concrete shall be compacted and in its final position within two hours of the introduction of cement to the aggregates, unless a longer time is agreed by the Supervisor. The time of such introduction shall be recorded on the delivery note together with the weight of the constituents of each mix.

4.16.2 When truck-mixed concrete is used, water shall be added under supervision, either at the site or at the central batching plant, as agreed by the Supervisor but in no circumstances shall water be added in transit.

6.42 4.17 Transport and Placing

4.17.1 The method of transporting and placing concrete shall be to the approval of the Supervisor. Concrete shall be so transported and placed that contamination, segregation or loss of the constituent materials does not occur.

Concrete shall not be placed in any part of the structure until the Supervisor's approval has been given.

If concreting is not started within 24 hours of approval being given, approval shall again be obtained from the Supervisor. Concreting shall proceed continuously over the area between construction joints.

4.17.2 Fresh concrete shall not be placed against in-situ concrete which has been in position for more than 30 minutes unless a construction joint is formed.

4.17.3 Concrete, when deposited, shall have a temperature of not less than 5°C and not more than 32°C. It shall be compacted in its final position within 30 minutes of discharge from the mixer unless carried in purpose-made agitators, operating continuously, when the time shall be within 2 hours of the introduction of cement to the mix and within 30 minutes of discharge from the agitator.

4.17.4 No concreting shall be carried out during cold weather until the shade temperature does not reach 1°C on a rising thermometer nor shall concreting be continued on a falling thermometer below shade temperature of 4°C. A suitable maximum/minimum thermometer shall be installed on site in an appropriate location for this purpose.

4.17.5 Except where otherwise agreed by the Supervisor, concrete shall be deposited in horizontal layers to a compacted depth not exceeding 450mm, where internal vibrators are used or 300mm in all other cases.

Unless otherwise agreed by the Supervisor, concrete shall not be dropped into place from a height exceeding 2 metres. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation.

6.43 4.18 Compaction of Concrete

4.18.1 All concrete shall be compacted to produce a dense homogeneous mass. Unless otherwise agreed by the Supervisor, it shall be compacted with the assistance of vibrators. Spare equipment in working order shall always be available on site in the event of breakdowns.

Vibration shall not be applied by way of the reinforcement. Where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided, so far as is practicable.

Concrete shall not be subjected to vibration after it has been placed 4 hours.

6.44 4.19 Joints

4.19.1 Construction Joints

The position and detail of any construction joints not described in the contract shall be subject to the approval of the Supervisor and shall be so arranged as to minimise the possibility of the occurrence of shrinkage cracks.

All vertical construction joints shall be formed with well braced timber stop ends. The vertical joints shall be in approved positions and such joints shall not be located at or adjacent to corners.

In the event of unavoidable stoppage in positions not predetermined, the concrete should be terminated on horizontal places and against vertical surfaces to the Supervisor's approval.

Before concreting against any temporarily stopped work or construction joints the procedure shall be as follows:-

(a) Bonding to Concrete 30 Minutes - 4 Hour Old

The surface of the hardening concrete shall be wetted with a fine soft spray. At the same time the surface shall be gently brushed with a soft brush to remove the cement film from the coarse aggregate without disturbing the hardening concrete. The prepared surface shall be lightly coated with a neat cement grout immediately before any subsequent concrete is cast. The first two batches out of a clean mixer shall not be used against existing work. Alternatively the surface layer shall be struck off and lightly coated with neat cement grout immediately before the fresh concrete is poured.

(b) Bonding to Concrete - Over 4 Hours Old

Brushing or chipping to remove laitance and expose the aggregate shall roughen the surface. The roughened surface shall be washed with clean water to remove loose particles.

4.19.2 Joint Fillers for Expansion Joints

Unless otherwise shown on the drawings joint fillers will be resin bonded cork with the following minimum characteristics:

Density	200 kg/m ³
Maximum load to compress to 50% of original thickness	0.55 N/mm ²
Recovery after compression	95%

4.19.3 Joint Sealing

Sealant slots to expansion, contraction and, where included, construction joints shall be carefully constructed to the dimensions detailed on the drawings or, subject to approval by the Engineer, to the manufacturer's recommendations.

The Contractor shall take care to avoid spalling of concrete on the edges of slots. Slots to expansion joints may be formed by installing joint filler to the concrete surface and then using a special cutter to remove filler to the required depth. Alternatively, and for contraction joints, slots may be formed by pre-formed PCC or timber formers with sloping sides to assist removal.

Before placing sealants, the slots must be thoroughly cleaned and all laitance and oil removed by an abrasive method. Immediately prior to sealing the slots, all loose surface debris, sand and dust must be blown out using compressed air, and the slots must be dry and free from collected rainwater etc. to ensure maximum adhesion.

Sealants must in all cases be carefully selected as appropriate for their climatic and environmental exposure and must, where appropriate, be resistant to bio-degradation. The Contractor must supply to the Engineer copies of written recommendation(s) and guarantee(s) from the manufacturer as to the suitability of the product(s) for each individual structure and for the methods of installation.

Where required, masking tape shall be applied to protect the concrete surface, on either side of the joint during priming and sealing operations. Such masking tape must be carefully stripped away after joint sealing to leave neat edges to the seal.

6.45 4.20 Curing of Concrete

4.20.1 Immediately after compaction and for 7 days thereafter, concrete shall be protected against harmful effects of weather, including rain, rapid temperature changes, frost and from drying out. The methods of protection used shall be subject to the approval of the Supervisor. Alternatively when elevated-temperature curing is used, 4 hours must elapse from the completion of the placing of the concrete before its temperature is raised. The rise in temperature within any period of 30 minutes shall not exceed 10°C and the maximum temperature attained shall not exceed 70°C. The rate of subsequent cooling shall not exceed the rate of heating.

4.20.2 The method of curing shall minimise the loss of moisture from the concrete. On concrete surfaces which are to be water-proofed, curing membranes shall not be used. Details of all curing methods to be used shall be subject to the approval of the Supervisor.

6.46 4.21 Early Loading

4.21.1 Concrete shall at no time be subjected to loading, including its own mass, which will induce a compressive strength in it exceeding 0.33 of its compressive strength at the time of loading or of the specified 28 day strength. For the purposes of this clause the assessment of the strength of the concrete and the stresses produced by the loads shall be subject to the approval of the Supervisor.

6.47 4.22 Formwork - Construction

4.22.1 Formwork shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Materials shall be in accordance with HRN D.C1.041, and HRN D.C1.052

4.22.2 Design and construction of wooden scaffolding and formwork, HRN U.C9.400.

4.22.3 All formwork shall be so constructed that there shall be no loss of material from the concrete. After hardening the concrete shall be in the position and of the shape, dimensions and surface finished described by the Contract.

4.22.4 Where internal metal ties are permitted, they or their removable parts shall be extracted without damage to the concrete and the remaining holes filled with mortar. No permanently embedded metal part shall have less than 40mm cover to the finished concrete surface or the specified cover to the reinforcement whichever is the greater. Formwork nuts and bolts shall be in accordance with HRN C.U2.021-030.

6.48 4.23 Formed Surfaces - Classes of Finish

4.23.1 Unless stated otherwise on the Drawings, the requirements extra to those given in Clause 3.22 to provide the class of finish described in the contract shall be:-

Class F1: Nil.

Class F2: The irregularities in the finish shall be no greater than those obtained from the use of wrought thickened square edged boards arranged in a uniform pattern. The finish is intended to be left as struck but imperfections such as fins and surface discolouration shall, if required, be made good by methods approved by the Supervisor.

Class F3: The formwork shall be lined with a material approved by the Supervisor to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure. The Contractor shall make good any imperfections in the finish as required by the Supervisor. Internal ties and embedded metal parts will not be allowed.

Class F4: The requirements for Class F4 are for Class F3 except that internal ties and embedded metal parts will be permitted. The ties shall be positioned only in rebates or in other positions as described in the contract or as agreed by the Supervisor.

Permanently exposed concrete surfaces to Class F4, F3 and F2 finish shall be protected from rust marks and stains of all kinds.

4.23.2 Unless otherwise described in the contract, all formwork joints for exposed surfaces of concrete to Class F2, F3 and F4 finish shall form a regular pattern with horizontal and vertical lines continuous throughout each structure and all construction joints shall coincide with these horizontal or vertical lines.

6.49 4.24 Preparation of Formwork

4.24.1 The inside surface of forms shall, except for permanent formwork or unless otherwise agreed by the Supervisor, be coated with a release agent approved by the Supervisor. Release agents shall be applied strictly in accordance with the manufacturer's instructions and shall not come into contact with the reinforcement or prestressing tendons and anchorages. Different release agents shall not be used in formwork to concrete which will be visible in the finished Works.

Immediately before concreting, all forms shall be thoroughly cleaned out.

6.50 4.25 Removal of Formwork

4.25.1 The Supervisor shall be informed in advance when the Contractor intends to strike any formwork.

The time at which the formwork is struck shall be the Contractor's responsibility. Subject to the provisions of the Specification the formwork may be struck when either:-

- (i) The concrete has in the opinion of the Supervisor attained a compressive strength of not less than 10 N/mm^2 or
- (ii) The following minimum periods have elapsed between the completion of placing concrete in a section of the work and the removal of forms:

Sides of beams, walls, columns and piles:	18 hours
Soffits of beams and slabs:	7 days

The periods stated in (ii) above are based on a constant surface temperature of the concrete at 16°C and the use of ordinary Portland Cement. They shall be increased during cold weather as directed by the Supervisor, and may be changed if other types of cement are used, subject to the Supervisor's agreement.

4.25.2 Formwork shall be constructed so that the side forms of members can be removed without disturbing the soffit forms and, if props are to be left in place when the soffit forms are removed, these props shall not be disturbed during the striking. All formwork shall be removed without damage to the concrete.

6.51 4.26 Steel Reinforcement

4.26.1 Rolled steel bars, cold twisted bars, hard drawn steel wire and high tensile fabric reinforcement shall comply with the requirements of HRN EN 1992-1:2004.091, HRN C.K6.013, HRN C.K6.020, HRN C.B6.021 respectively. The Contractor shall on request supply a signed certificate from the manufacturer that each consignment of steel complies with the relevant specification.

4.26.2 All steel shall be free from oil, grease, dirt and paint and all loose rust and mill scale shall be carefully removed before use. It shall be stored clear of the ground on a clean site with adequate protection to prevent deterioration.

6.52 4.27 Bending of Reinforcement

4.27.1 Reinforcement shall be bent to the dimensions given in the Bar Schedules. All reinforcement shall be bent at temperatures in the range of 5°C to 100°C.

4.27.2 Cold worked and hot rolled high yield bars shall not be straightened or bent again once having been bent. Where necessary to bend mild steel reinforcement projecting from the concrete, the internal radius of bend shall be not less than twice the diameter of the bar.

4.27.3 Heating of reinforcement will not be permitted without the Supervisor's approval.

6.53 4.28 Fixing Reinforcement

4.28.1 The number, size, form and position of all reinforcement shall be in accordance with the contract. It shall be secured in an approved manner so as to withstand, without displacement, the placing and compaction of the concrete. Where reinforcing bars project from the concrete, precautions shall be taken to prevent the bars from being struck or jarred in such a way as to impair the bond between the steel and concrete.

4.28.2 Unless otherwise permitted by the Supervisor, all bar intersections shall be tied together and ends of the tying wire shall be turned into the main body of the concrete. Stainless steel wire, 1.2mm diameter, shall be used for in-situ members having exposed soffits. Soft annealed iron wire, 1.6mm diameter, shall be used elsewhere. Tying wire shall be in accordance with HRN C.B6.010.

No splices shall be made in the reinforcement except where described in the concrete or where approved by the Supervisor.

Support chairs for top mat reinforcement shall be designed by the Contractor and approved by the Supervisor.

4.28.3 Concrete shall not be placed until reinforcement has been checked and approved by the Supervisor. Such approval shall not, however, absolve the Contractor from his liability if bars are found subsequently to be placed otherwise than as shown on the drawings.

4.28.4 No alterations or substitution shall be made in the lengths, sizes or arrangement of the reinforcement without the prior written approval of the Supervisor.

6.54 4.29 Welding of Reinforcement

4.29.1 Reinforcement in structures shall not be welded.

6.55 4.30 Precast Concrete

4.30.1 All precast concrete units shall be manufactured to comply with HRN U.E3.050 and shall be cased in strong, rigid moulds, clean, wetted before concreting and with fillets fixed to the angles to give chamfered arises as necessary. Moulds shall not be removed until the concrete is sufficiently hard to permit this being done without detriment. The concrete shall be as specified for the particular section. The concrete shall be kept wet for seven days by means of sacking covers or other approved means. No cracked, spalled, crooked or otherwise defective units shall be used.

6.56 4.31 Grouting

4.31.1 Grouting up supports to mechanical equipment or in any other position as necessary shall be carried out with 1:3 mortar, or as otherwise directed to the satisfaction of the Supervisor. The grout shall be worked well into all recesses and corners and all air forced out and, when directed, the surface of the concrete shall be first hacked over and cleaned.

6.57 4.32 Concrete Screeds

The mix for heavy duty concrete screeds shall be 1:3 (by weight) sulphate resisting Portland cement, fine and coarse aggregate (10 mm nominal maximum aggregate size). The water content shall be kept to the minimum consistent with the required workability.

Heavy duty concrete screeds should preferably be placed and compacted within three hours of casting the base in which case the base concrete shall be left rough and the screed shall be spread and consolidated on to the whole of each bay or structure. Where this cannot be achieved the base concrete shall be cast with a rough surface. Weak surface laitance and any other contaminating material must be completely removed and the coarse aggregate cleanly exposed. This surface shall be thoroughly cleaned and then soaked overnight, any surplus water being removed. The surface shall then be brushed with a 1:1 sand/cement grout and the heavy duty concrete screed applied.

The concrete shall be compacted and screeded to levels or falls with a screeding board and wood float. Further trowelling shall be done with a steel trowel after about two hours. The thickness of a surfacing where it is inclined at 45° or greater to the horizontal shall not exceed a nominal 15 mm and if this is inadequate to complete the work the surface shall be left rough and keyed with a trowel. A further surfacing coat shall be applied within 24 hours.

6.58 4.33 Tolerances

4.33.1 The setting out and dimensions of the finished work, unless otherwise shown on the drawing or specified, shall be within the permissible tolerances given hereafter and the Contractor will be held responsible for the cost of all corrective measures required by the Supervisor to rectify work which is not constructed within these specified tolerances.

On dimensions of 3m and over a tolerance of plus or minus 5mm, and on dimensions of less than 3m a tolerance of plus or minus 2mm will be allowed.

A tolerance of plus or minus 2mm will be permitted on the cross sectional dimensions of structural members.

The top surfaces of floors, roof slabs and beams shall be within 5mm of the lines and levels shown on the drawings.

Columns and walls shall not be more than 5mm out of plumb in their storey heights, nor more than 10mm out of plumb in their full height.

Part 5 – Technical Specification – Civil Works (Drainage)

6.59 5.1 General

5.1.1 The Contractor shall provide all skilled and unskilled labour to complete the installation of all pipelines included under the Contract.

Where erection proceeds simultaneously with adjacent civil engineering or building work, the Contractor shall protect the pipelines against water, debris, dust, paint, etc. to the satisfaction of the Supervisor.

It shall be the Contractor's responsibility to safeguard by means of temporary or permanent support or otherwise all pipes, cables, land drains, structures and other items which would be liable to suffer damage as a result of his work, if such precautionary measures were not taken.

Temporary and permanent safeguards shall be to the approval of the Supervisor.

Excavation of pipe trenches shall follow the profiles shown in the design drawings. Deviations from the drawings shall be agreed by the Supervisor and are fully at the Contractor's risk. Deviations will be permitted only with the written consent of the Supervisor. Payment will be made only on actual executed works.

5.1.2 All pipes and fittings shall conform to the standards specified, and shall be marked with the manufacturers name or identification mark, date of manufacture, nominal size and class of pipe.

6.60 5.2 Tests on Completion

5.2.1 Pressure pipelines

The duration of the test for the entire pipeline shall be at least 48 hrs, or whatever time agreed by the Supervisor. The sectional tests shall have a duration of at least 6 hours, loss readings shall be taken at 15 minutes intervals, or as otherwise agreed with the Supervisor. The losses shall be determined by a calibrated tank, or any other suitable means.

The sections which do not passed the initial test, shall then be tested individually by subdividing these sections. The applied test pressure shall be 1.5 times the working pressure. The individual sections shall have passed the test, as long as the following losses per kilometre of pipeline are not exceeded or other values accepted by the Supervisor.

DN 80mm	20 l/hr
DN 100mm	25 l/hr
DN 125mm	30 l/hr
DN 150mm	40 l/hr
DN 200mm	50 l/hr
DN 250mm	60 l/hr

The field test for pipes shall be a hour steady pressure at 24 bar. At the end of the 1 hour period, the quantity of water required to restore the pressure to 24 bar shall not exceed 0.125 litre/km of pipe tested/3 bar/25mm of internal diameter. If a positive result is obtained, i.e. volume of water required to restore original pressure is less than that calculated, the test is to be repeated for a 12 hour period with the same restriction on volume of water required to restore pressure. Tests shall be repeated until positive 1 hour and 12 hour results are obtained in succession.

5.2.2 Non-pressure pipelines

Where possible, non-pressure pipelines shall be tested in sections between manholes or chambers. A hydraulic test, using water from an approved source, shall be performed as described below.

The pipeline shall be slowly filled with water from the upper end. A test pressure of 1.2mWG above the soffit of the pipe at the higher end, shall be applied by standpipe; the pressure at the lower end shall not exceed 6mWG above the pipe soffit. For absorbent pipes, e.g. concrete or asbestos cement, a period of 1 hour shall be allowed for absorption. The loss of water over a period of 30 minutes shall be noted by adding water to the pipeline to maintain the original level, at 10 minute intervals, and measuring the volume used in topping up. The volume of water added shall not exceed the volume calculated as follows:

- for pipes ≤ 300 mm dia. 0.06 litres per hour per mm dia. per 100m of pipe length
- for pipes > 300 mm dia. ≤ 750 mm dia; 0.12 litres per hour per mm dia. per 100m of pipe length
- for sewers and outfalls > 750 mm dia. testing shall be by air test; a pressure of 0.1mWG shall be applied and shall not fall below 0.075mWG for a period of 5 minutes, after allowing a 2 minute stabilisation period.

5.2.3 Testing

The Contractor shall provide all necessary labour and equipment for the testing. Water will be provided free of charge, but the Contractor must allow for possible transport or pumping.

The Contract shall include for any pressurising pumps, blank flanges, pressure gauges, etc., required for the purpose of pressure testing all pipe work included in the Contract. The pressure tests and recording shall be carried out according to DIN 4279 or other equivalent standard.

Arrangements for final testing and commissioning shall not be made until all the pipelines have passed the initial tests satisfactorily and been disinfected.

The Contractor shall carry out final testing of the equipment and commissioning of all pipelines to the satisfaction of the Supervisor and shall also demonstrate to the Employer the operation of the equipment.

After the pipelines, or individual sections, have been satisfactorily commissioned, arrangements shall be made for the taking over of the pipelines by the relevant utility companies.

The prices in the Bill of Quantities for testing shall include, but is not limited to, following works:

Access to testing location
Installation of pressure test equipment
Provision of water
Provision of all necessary blocks, strutting and bracing
Execution of pressure test
Test certificate agreed by the Supervisor

6.61 5.3 Jointing

Except in the case of flanged joints and where otherwise specified or approved by the Supervisor pipe joints shall be flexible and sealed with a rubber ring or gasket to the approval of the Supervisor and shall withstand the various tests specified in the applicable standards. For pipes with a nominal bore of 100-230 mm the joints shall be capable of withstanding a deflection of not less than 3.0 degrees in any direction and for pipes with a nominal bore of 250-330 mm a deflection of 2.0 degrees and from 350 to 600 mm 0.5 degrees in any direction. All pipes shall be capable of withstanding a "draw" of 13 mm over and above the initial jointing allowance. The initial jointing allowance is the gap measured parallel to the centre line of the pipeline and shall not be less than 6 mm or more than 13 mm or as otherwise recommended by the pipe manufacturer and approved by the Supervisor. Pipes and fittings shall be indelibly marked prior to laying to indicate the correct initial jointing allowance.

6.62 5.4 PVC Pipes and Fittings

Unplasticised PVC pipes, joints and fittings for gravity sewers shall comply with the relevant provisions of HRN G.C. 501-503, or DIN 8062.

PVC pressure pipes shall be spigot and socket type, PN10 in 5.50m or 6.00m lengths, including rubber gaskets, with the following properties:

Specific gravity (according to DIN 53479)	min 1.400kg/m ³
Linear expansion	max 8 x 10 ⁻² mm/degree C
Thermal conductivity	min 0.15 W/degree C

All joints and fittings shall be approved and shall comply with DIN 8063 "Joints and fittings for use with unplasticised PVC pressure pipes". All PVC pressure pipe fittings except bends and U-pieces shall be made out of cast iron (according to DIN 1691) or ductile iron (according to DIN 1693) PN10, with internal and external epoxy coating protection, permitted for use in contact with drinking water, minimum thickness 200µ.

Flanges shall be drilled to PN10 unless otherwise stated.

The pipes shall clearly identify the manufacturer.

6.63 5.5 Concrete Pipes

Unreinforced and reinforced pipes shall comply with the following requirements as appropriate:

- (i) Materials: Constituent materials shall generally comply with Section 3 (Concrete) of this Specification. Cement shall be Ordinary Portland Cement unless otherwise specified. Aggregates may have a grading selected to suit the manufacturing process, but the nominal maximum aggregate size shall not exceed the least of the following:
 - (a) 20mm;
 - (b) The concrete cover to reinforcement;
 - (c) One quarter of the pipe wall thickness.

Water shall be clean, and free from harmful matter. Admixtures may be permitted, provided they do not impair the durability of the concrete, or of any reinforcement. The chloride ion content of admixtures used in reinforced pipes, or pipes using Sulphate resisting cement, shall not exceed 2% by mass of the admixture, or 0.03% by mass of the cement.

(ii) Reinforcement: Reinforcement shall be of one of the following types: Hot rolled steel bars, cold worked steel bars, cold reduced steel wire, or steel fabric. Transverse reinforcement shall be located in a circular, or helical arrangement, and shall be fixed in such a manner as to prevent displacement during concreting. The thickness of concrete cover to all reinforcement shall be nowhere less than 12 mm.

(iii) Concreting: The Concrete mix shall have a maximum water cement ratio of 0.45, and the fully compacted concrete shall contain not less than 360 kg of cement per cubic metre. The concrete shall be placed and compacted so as to ensure that the correct dimensions are uniformly achieved, and that the concrete itself is dense, homogeneous, and free from honeycombing, individual voids having a dimension of 6mm or more, and from any form of discontinuity. Pipes shall not be demoulded until they have gained sufficient strength to resist disruption during demoulding and subsequent handling. The internal surface of the finished pipes shall be essentially smooth. Any protruding aggregate shall be removed, and all voids, other than occasional isolated voids not exceeding 5 mm diameter, shall be made good.

(iv) Joints: Except where otherwise indicated below, pipes shall have integrally cast socket (bell) and spigot joints, sealed by rubber rings. Pipes for installation in headings may have (in-wall) ogee joints. Pipes for installation by jacking shall have either (in-wall) ogee joints, or sleeve type joints. The dimensions and tolerances to which the jointing surfaces are formed shall be such as to ensure proper sealing around the whole circumference with the adjacent pipes in any relative angular orientation.

(v) Dimensions: The length of individual pipes shall not exceed 2.5 metres. Pipes for use adjacent to structures shall have lengths such as to permit the joint spacings specified in Clause E3.15 to be provided. The actual internal diameter of the pipe shall not differ from the specified diameter by more than +6% or -3%. The radial thickness of the pipe wall, at any point on the pipe barrel, shall be not less than 95% of the design wall thickness stated by the manufacturer and not more than 105% of the average wall thickness of pipes used in the crushing strengths tests.

6.64 5.6 Street gullies

Execution of gullies of prefabricated elements with circular section, of class C 40/45 concrete (min C25/30).

The work includes excavation, loading and transport to the dump area, hauling to the area, lodgement and arranged area.

The dump area must be insured by Performer.

Gullies are installed to the prepared concrete base according to the detail from the design.

Connection to inspection shaft or directly to the sewage pipe is executed with gully connections (items 3.18.2, 3.18.3, 3.18.4).

To the mounted gully a gully grate must be installed, with the frame of dimensions 400x400mm, bearing capacity 250 kN. The price includes all material and works.

6.65

6.66

6.67 5.7 Back filling

Backfilling of sewer ditch with sand or with material from excavation. The work includes spreading and levelling of the material in layers, compacting with light compacting devices or manual compacting with tampers.

The work from this item is accounted per m³ of applied material in the ditch, with deduction of the volume of sewer pipe with the section provided in the design.

6.68 5.8 Curbestones

Supply and installation of concrete curbstone of cross section 18/24 and 8/16 cm to the previously executed base of fresh concrete, according to the detail from the design. The concrete of the curbstone must be of class C 40/45 (MB 45) – w/c factor less than 0.45, resistant to frost and defrosting salts.

6.69 5.10 Joints

5.10.1 Flanged Joints

All flanges shall conform to DIN 2500 unless otherwise specifically mentioned. Flanged joints for cast (spun) and ductile iron pipes, specials and valves shall be made, unless specified otherwise, with full face rubber joint gaskets and cadmium plated or galvanised steel bolts and nuts which shall include two washers per bolt. Joint gaskets shall be made from 3mm thick rubber to DIN 2650 and of such physical properties as to be capable of forming permanent watertight joints. The use jointing paste or grease will not be permitted. No jointing material shall be left protruding into the bore of the pipe work.

All bolts shall first be tightened by hand and bolts, on opposite sides of the joint circumference, shall then be alternatively and progressively tightened with a standard spanner so as to ensure even pressure all round the joint.

Where flanged joints are to remain exposed in ducts and buildings, all damaged sheathing or coatings to the barrels of pipes, adjacent to joints, shall be made good by cleaning the affected areas which shall then be primed and re-sheathed or re-coated to the same thickness as the original protection. All other surfaces of joints shall be cleaned, painted with an approved rust inhibitor and then shall receive one coat of an approved bituminous paint.

Where pipes or joints have been supplied with their external surface uncoated, or primed only with a rust inhibitor, to facilitate painting at a later date the with non-bituminous gloss paints, instead of the application of one coat of a bituminous paint they shall receive one coat of red lead primer, before painting.

Where flanged joints are to be buried, the exterior of all joints and their parts and the barrels of pipes, for a distance of a 150mm from the backs of both the joint sides, shall be cleaned of any rust, and any damaged or loose coating, then dried. The prepared pipe surfaces, and the joint, shall then be protected by lap wrapping, with approved water-resistant tape in accordance with the manufacturer's instructions. The cost of this protection shall be included in the rate for making the joint.

6.70 5.11 Manhole and Access Covers and Frames and Surface Boxes

Access covers and frames and surface boxes shall be to the dimensions, duty and general design as detailed on the drawings or specified elsewhere.

Unless otherwise detailed all access covers and frames shall be of cast grey iron or ductile iron, non-ventilating, having keyways closed on the underside with no projections above cover levels. Manhole covers shall, with their frames, incorporate a non-rock triangular point suspension (machine faced seatings are not acceptable for manhole covers). Seating points shall bear on sloping mating faces to minimise risk of grit, etc., lodging on them. Double triangular covers shall have two keyways on each half cover to facilitate lifting. Frames shall

incorporate recesses for prising bars. Unless otherwise detailed, manhole covers shall have a minimum clear opening 675mm x 675mm.

Undersides of covers and frames exposed to sewage vapours shall be protected at the place of manufacture with the specified coating system appropriate to the environment. Where detailed, covers shall also be protected by a gas-tight RTR sealing plate. Sealing plates shall be seated in a lip formed near the bottom of the frame and shall be supplied with the cover and frame.

Surface boxes for valves or below ground hydrants shall be manufactured of grey cast iron and shall be properly bitumen coated. The minimum load test for the lid shall be 200kN and for the body 400kN. Surface box covers shall show a conical seat.

Any transit damage to the approved coating system shall be made good prior to installation.

6.71 5.12 Keys

Valve keys, lifting keys, tee keys and hooks for manhole and other covers shall be black japanned steel suitable for use with the valves or covers supplied and shall be obtained from the armature or cover manufacturer.

6.72

6.73

6.74 5.13 Handling Pipes

The Contractor shall submit, prior to undertaking any work, his proposals for handling pipes and all fittings to the Supervisor for approval. Such proposals shall ensure that all pipes are properly handled both by his staff and by any cartage contractor. During transport, pipes shall not be allowed to rest on narrow cross-members of vehicles or anything else that might give concentrated loads, due to the weight of the pipe or bumping of the vehicle, but shall be properly supported on soft material. Sufficient labour and equipment shall be on hand before loading or unloading is commenced and under no circumstances shall any material be dropped from a vehicle. PVC pipes and fittings shall be protected from bright sunlight and freezing conditions at all times. Pipes shall be unloaded and stored by the Contractor in stacks only up to such heights which prevent the lower layers from deformation or other damages.

The first layer shall be placed on beams, large enough to keep the pipes well above ground. Pipes shall be held by wedges, each layer shall be isolated from the next by an adequate number of beams. Pipes shall only be handled with ropes and canvas slings or any other device recommended by the manufacturer. Damage to the lining of ductile iron pipes shall be made good by the Contractor by appropriate repair with mortar recommended by the manufacturer and to the satisfaction of the Supervisor.

The handling of pipes exceeding 200mm diameter, other than by means of a crane, is specifically forbidden. The Contractor shall maintain a suitable mobile crane on the site and shall use it for all loading, unloading, transferring between vehicles and lowering into the trench of such pipes. The crane shall be fitted with a sling of ample width. Wire rope slings or hooks in the end of pipes shall not be used.

When formulating his proposals for handling pipes, the Contractor shall take into account the manufacturer's recommendations for such operations.

The Supervisor shall have the right to reject consignments, or stocks of piping, from which failed pipes have been drawn, or order them to be pressure tested before installation, even though no defects are apparent.

6.75 5.14 Cutting Pipes

Pipes shall be cut by an approved method which provides a clean square cut of the pipe and lining (if applicable) without damage. All cut or trimmed ends shall be cleaned and in the case of metal pipes coated with phenol-free bitumen before the pipes are laid. The external surfaces of cut spigot ends of ductile-iron pipes shall be ground for at least 125mm from the joint.

6.76 5.15 Cleaning

All debris shall be cleared from the inside of the pipe before a joint is completed. Before testing is undertaken on a pipeline section, the pipeline shall be cleared internally to ensure that no foreign matter remains inside the pipes. Pigs or polyurethane swabs may be used for this purpose provided that the Contractor takes all necessary precautions using this equipment.

6.77 5.16 Manholes and Chambers

Manholes and chambers shall be constructed as detailed on the drawings. On completion of construction, all manholes and chambers shall undergo a water retaining test. The test shall consist of filling the structure with water, to within 200mm of the underside of the roof slab, and maintaining it filled for a period of 2 days. At that stage, the water shall be replenished to the original level and left for a period of 1 day. The drop in level, if any, during that 24 hours shall not exceed 50mm.

Man entry covers and frames shall be in cast iron; light duty on structures not subject to vehicular loads, medium duty in footpaths and heavy duty in footpaths alongside roads and roadways. Stepiroons shall be provided at 300mm horizontal spacings and 300mm vertical (staggered) intervals.

6.78 5.17 Tolerances for Gravity Pipelines

The line and level of gravity pipelines shall not deviate from that described in the Contract by more than 20mm.

6.79 5.18 Pipe Bed

Unless shown otherwise on the Drawings, where the bottom of the trench is in rock it shall be excavated to 200mm below the bottom of the pipe barrel.

Imported sand or granular bed material shall then be spread over the trench bottom to 50mm above the pipe invert and the pipes shall be laid and worked into their true line and level so that they are firmly bedded over their entire length.

For ductile iron or steel pipes, the trench bottom shall be excavated so that the pipes shall rest on undisturbed ground for their length.

Allowance shall be made for pipe joints and couplings when forming the pipe bed.

6.80 5.19 Pipe Support in Bad Ground

Where pipes are to be laid in bad ground, approved type joints shall be used and the pipes supported in such manner as may be particularly specified or directed.

6.81 5.20 Pipe Surround

Unless particularly specified or otherwise directed the pipes shall be surrounded to a depth of 300mm over the top of the pipe barrel with material to the same standard as that specified for the pipe bedding, the surround being carefully compacted around and over the main.

The surround shall be placed and compacted carefully to avoid displacing or damaging the completed pipeline.

6.82 5.21 Concrete Arch and Surround

Where the cover over the pipe is less than 1200mm in roads, margins and paved areas or 900mm elsewhere, a concrete arch to the dimensions given on the drawings shall be placed over the pipeline.

Where the cover over the pipe is less than 600mm in roads, margins and paved areas or 500mm otherwise the pipe shall be bedded and surrounded in concrete, Grade MB-20/40, to the dimensions given on the drawings.

A 15mm wide joint, filled with an approved filler shall be provided at every pipe/joint interface along the section to be arched.

6.83 5.21 Abbreviations

AV	Air valve	E-KS	Flanged socket
B	Bellmouth	F	Flanged spigot
BV	Ball valve	FF	Flanged pipe
C	Zibo coupling	FFK 45°	Flanged bend 45°
DI	Ductile iron	FFR	Flanged reducer
EC	Electrofusion coupling	FV	Flap valve
GGG	Ductile iron	PRV	Pressure reducing valve
HDPE	High density polyethylene	PVC	Polyvinyl chloride
IST	Inlet strainer with valve	Q	Flanged bend 90°
IS	Inlet strainer without valve	ST	Steel
M	Flowmeter	SV	Sluice/gate valve
N90	90° Duckfoot bend	T	Tee piece
NRV	Non-return valve	TT	Cross
P	Manometer	U	Collar
PA	Flanged adapter	WO	Washout
PAF	Dismantling piece	X	Blank flange
PF	Stub flange x PE pupped	mWG	metre water gauge

6.84

Part 6 – Technical Specifications – Civil Works (Roadworks and Siteworks)

6.85 6.1 General

All items must be executed in compliance with "General Technical Conditions for Road Works" issued by "Hrvatske ceste" d.o.o. (Croatian Roads) and current regulations and standards. General technical conditions for road works are in Content books.

Content book 1 - General provisions and preliminary works

Content book 2 - Earthworks, drainage and walls.

Content book 3 - Road surface structure

Content book 4 - Concrete works

6.1.2 The Contractor shall include adequate excavation to the levels detailed to provide a smooth, gentle gradient to meet the adjacent ground surface

6.1.3 For the sub-grade preparation he shall scarify a layer of an adequate area and suitable depth not less than 300mm, and the soil shall be crushed, mixed, shaped well watered and compacted, and finished. All materials within the top 450mm below sub-grade level shall be an approved material.

6.1.4 Unless otherwise specified, and approved by the Supervisor, the excavated materials shall be used as fill material. Unsuitable material shall be removed and the surface of the cut section shall be compacted to a depth of 150mm below surface of cut before placement of approved fill material.

6.1.5 Borrow materials shall be placed in horizontal layers of uniform thickness (not exceeding 150mm compacted) and the work shall be carried out to adhere to the lines, levels and slopes. Moisture Content shall be adjusted in order to attain maximum density; the loose materials compacted to obtain the required density.

6.1.6 Prior to placement of any borrow materials; the Contractor shall carry out trial tests as directed by, and for the approval of, the Supervisor.

6.1.7 After primary levelling, compaction operations shall be carried out by means of approved self-propelled vibratory mechanical rollers in order to obtain the 95% of maximum dry density - to a minimum depth of 300mm when tested in place.

6.1.8 The surface shall be levelled horizontally and transversely and rolled to achieve uniform compaction, free from undulations, soft spots and depressions. The rolling shall be carried out in the direction of the road axis until the fill material reaches the required density. In order to compensate for water lost through evaporation in the course of compaction, additional quantities of water shall be added as required.

6.1.9 The entire sub-grade shall be shaped to a smooth uniform surface. Surplus material shall be disposed of by placing as sub-grade areas deficient in materials and well watered and compacted as necessary to yield a true finished sub-grade as above.

6.1.10 Once prepared the sub-grade shall be maintained in the finished, completely satisfactory condition until the next course has been placed, and the Contractor shall take all precautions to protect same from damage from any cause - both from his own and from general public traffic.

6.1.11 The sub-base course shall consist of an aggregate material, placed and compacted on the previously prepared sub-grade.

6.1.12 The material shall be broken stone from 50 – 80mm and shall be subject to the approval of the Supervisor. The specific gravity of aggregates shall not be less than 2.4

6.1.13 This work covers all operations in connection with the completed construction of a crushed aggregate base course on a sub-base as prepared above in strict accordance with the lines, grades, thickness, typical cross-sections shown on the Drawings or as directed by the Supervisor.

6.1.14 The Crushed Aggregate Base Course shall be formed of the aggregates specified in Table 5.1 below, mixed, spread and compacted on a carefully prepared sub-base course.

Table 5.1 – Base Course Material Grading Requirements	
Sieve Size	Percentage by Weight Passing
50 mm (2")	100
25 mm (1")	35-60
12 mm (½")	20-40
4.76 mm (No. 4)	10-30
420 micron (No 40)	5-15

6.1.15 The aggregate material shall consist exclusively of fragments of rock. It shall be free from clay, organic matter and other deleterious materials. It shall be hard and sound and shall not contain more than 20% of flat or elongated pieces. A flat piece is one where the breadth is three times greater than the thickness and an elongated piece is one where the length is three times the thickness.

6.1.16 Road surface construction of an asphalt road surface construction according to the method of Croatian norms HRN U. C4. 012.

a) Roadway

The making of roadway with asphalt curtain. The road surfaces are in following layers:

- wearing course of asphalt – concrete AB 11 d = 4cm
- bituminous bearing course BNS 22 B d = 6cm
- sub-base layer of mechanically rammed stone material d=30cm
(Ms = 100.0MN/m²)
- the bed of mixed materials (Ms = 40.0MN/m²,
Sz = 100%)

b) Footway

The asphalt construction of a pavement consists of following layers:

- wearing layer made of asphalt – concrete AB 8 d = 5.0cm
- bearing layer of mechanically rammed grain stone material (a buffer) d = 15 cm

6.86 6.2 Stone Materials for Road Construction

6.2.1 The condition of the base

This layer can be laid only after the Supervisor inspects the base for level, of design slope, of drainage and required quality conditions. The Contractor shall keep the bed in the condition as it was when the Supervisor inspected it. If, for any reason, the base condition deteriorates, the

Contractor shall put it again into the condition required at his own cost and request a further inspection by the Supervisor.

6.2.2 The regulations by which the quality is controlled

HRN B.B0.001/84	taking samples of stone and stone aggregates
HRN B.B8.035/84	determining the humidity
HRN B.B1.018/80	determining the granulation metrical structure
HRN B.B8.031/82	determining the volume mass and water absorbing
HRN B.B8.048/60	testing the shape of grain of stone aggregates
HRN B.B8.037/86	determining weak grain
HRN B.B8.044/82	testing the persistence to frost with sodium-sulphate
HRN B.B8.045/78	testing the natural and crushed aggregate by a machine "Los Angeles"
HRN U.B1.042/68	determining the contents of burnt out and organic materials of soil
HRN B.B8.034/86	determining the light particles
HRN B.B1.038/68	determining the optimal water contents
HRN B.B8.039/82	approximate determining the pollution with organic matter
HRN U.B1.042/69	determining Californian bearing index
HRN U.B1.046/68	determining the compactness module by a method of circular plate
HRN U.B1.016/68	determining the volume weight of soil

6.2.3. Materials

For making the bearing layer of mechanically rammed grain stone material, the following materials can be applied:

- a/ natural gravel,
- b/ crushed stone material
- c/ a mixture of natural gravel and crushed stone material
- d/ a mixture made of several fractions

Each of these materials must meet certain requirements considering:

- physical, mechanical, mineral and petrography features of grains (Table 6.1),
- granulation – metrical structure of the whole material (Table 6.2),
- bearing capacity, and
- fraction of organic matters and lighter particles.

Physical, mechanical, mineral and petrography features

Natural gravel and crushed stone material must meet requirements from the Table 5.1

Table 6.1: Required physical and mechanical features of grain stone material for loose bearing layers

Features and condition	Requirement
Form of a grain- share of grain of unsuitable form (3:1), at the most, % (m/m) HRN B.B8.048	40
Water absorption, at the most, % (m/m) HRN B.B8.031	1.6
Bad grains and of a low quality, at the most, % (m/m) HRN B.B8.037	7
Resistance to freezing with sodium – sulphate. The loss of a mass after 5 cycles, at the most, % (m/m) HRN B.B8.044	12
Resistance to crushing and wearing by the Los Angeles method, at the most % (m/m) HRN B.B8.045	45

6.2.4 Grading

Grading curve of grain material must be within the limits in the Table 5.2

Table 6.2: Granulation metrical requirements for grain material of loose bearing layers

Opening (square) of sieve in mm	Passing through a sieve % (m/m)
63	100
50	90
31.5	73 – 100
16	54 – 90
8	40 – 75
4	29 – 60
2	20 – 48
1	13 – 38
0.5	7 – 28
0.2	3 – 20
0.1	2 – 15

In some cases grain materials with a bit different structures can also be allowed, if the organization for quality control proves in testing their suitability and if it is allowed by the Supervisor.

Beside the conditions given in the Table 6.2, the grain material also has to fulfil these granulation metrical conditions:

- the fraction of grains smaller than 0.2 mm cannot be more than 3 % (m/m),
- the level of unevenness $U = d_{60}/d_{10}$ must be within regular limits:
 - a/ for gravel U 0 15 to 100
 - b/ for crushed material $U = 15$ to 50

Material with such properties can be obtained in following ways:

- by choosing the natural material of regular granulation metrical structure,
- by correction of granulation metrical structure of natural material with additives and mixing with appropriate fraction of other grain material,
- by putting more fractions together

The mixing of fractions for correction with basic material or mixing of several fractions can not be done at the site of the road, but in the plant for mixing or with suitable machines with strict control, in order to guarantee required homogeneity of material.

6.2.5 Bearing capacity of material

The bearing capacity of material shall be evaluated by the Californian Bearing Ratio (CBR) determined in the laboratory. The value of CBR stone material is listed in the Table 6.3.

Table 6.3: The requirements for bearing capacity of material shown by the CBR

	Material	Material
Properties and condition	Natural gravel or mixtures of gravel with less than 50 % of crushed stone material	Crushed stone material or mixtures of natural gravel with more than 50 % of crushed stone material
CBR, at least %	40	80

6.2.6 Construction

Bearing layer of stone material can be done in two ways on the regulated and prepared bed:

- by spreading stone material with graders and by ramming,
- by spreading of grain material with a spreader with packing.

In the first case, the needed material quantity is brought and spread with a grader in a thickness necessary to obtain a layer of project thickness after packing, what has been determined at the beginning of work. During work, the segregation of grain material should be avoided. In the other case, the spreader is used, which gives immediately the layer of uniform thickness. Before and during packing, the moisture content of the material should be regulated in order to be within optimal limits.

The moisture content limits for work are:

$W_{opt} \pm 1\%$, where

W_{opt} – optimal humidity has been determined by HRN U.B1.038, point 4.1

Compaction starts after finished levelling

Compaction is done with vibration devices for packing: vibro-panels, compactors, vibro-rollers or rollers with rubber wheels, separately or in a combination.

Compaction must be done carefully over the whole surface of a layer. All places which are not accessible to compacting machines shall be compacted according to required demands with other devices and in other ways. Such places, as well as the ways of working must be approved by the Supervisor.

6.2.7 Quality control

Quality control encompasses:

- previous testing of material
- determining the technology of building-in on the experimental section,
- control testing during work,
- current testing during work

a) Previous testing of material

Before supply of material to the site, the Contractor shall deliver to the Supervisor the report of organization for quality control on suitability of proposed material for making the base layer. The supply of material can start only when the Supervisor approves of material according to the documentation on suitability of material made by the organization for quality control (a report on suitability).

The documentation must contain testing of following features:

- physical and mechanical features,
- granulation metrical structure,
- bearing capacity,
- mineralogical – petrography analysis, and
- the portion of organic matters and light particles.

According to the results of testing of these features, the opinion on suitability of material for application should be given in the report. The representative samples must be taken for this testing, whereby the representatives of the organization for quality control must be present.

If there are changes in features of grain material at the source, as well as the change of source, the Contractor is obliged to re-obtain the documentation of material quality and hand it to the Supervisor. Even in the case of uniform conditions at the source, the documentation is valid one year.

b) Determining the method of construction of the experimental section

If there is no experience in packing the material with certain packing devices, the suitability of devices and their effect must be determined by the Contractor at the beginning of work in the experimental section. It is a section of the road in an area of 600m², with at least six tests of compactness level and six tests of compactness module for each phase of work of ramming devices (defined amount of crossings). After the way of work by which the requested demands of quality has been achieved, it must be confirmed and approved of by the Supervisor.

c) Control testing during work

Control testing of bearing layer is made by the Supervisor, and it serves as a confirmation of achieved work quality.

This testing encompasses:

- the testing of compactness module with circular plate,
- the testing of compactness grade compared to the modified Proctor's procedure.

The compactness can be tested with non-destructive method, by nuclear densitometer, with a condition that in every particular case the reliable correlations with compactness are established, determined with tested densities:

- testing of granulation – grading,
- testing of level of a layer with a straight edge 4 m long.

Control testing should be done in this way:

By testing the compactness module at least at every 500 m², or

By testing the compactness grade by volume meter at least at every 500 m², or

By testing the compactness module at least at every 1000 m² and testing the level of compactness by volume meter at every 1000 m²,

By testing the level of a surface with a straight edge 4 m long in every transversal profile or by a static random method at the request of Supervisor.

d) Current testing during work

Current testing is done by the Supervisor, and it serves for personal orientation, securing the economical nature of work and preparation of bearing layer for control of testing. The methods of

testing and the scope of testing are the same as at control testing, i.e. at least one current testing comes to one control testing.

6.2.8 Quality requirements

Final bearing layer of mechanically compacted stone material must fulfil the requirements of the project.

If it has not been otherwise determined, these criteria must be fulfilled:

- a) A compactness module and the compactness level must meet the requirements in the Table 6.4
- b) Grading must comply with the Specification
- c) Level measured by a straight edge 4 m long must not vary more than 2 cm

Table 6.4:

	Requirement	Requirement
Layers which come above the bearing layer of mechanically rammed grain material	Compactness module Ms (a plate ø 30 cm) MN/m ²	Compactness grade Sz (compared to the modified Proctor), %
Asphalt curtain, bituminous bearing capacity and bearing layers stabilized with hydraulic joints of the total thickness > 40 cm	50.0	95
Asphalt curtain and bituminous bearing layers of the whole thickness > 15 cm or asphalt layer, bituminous bearing layers and bearing layers stabilized with hydraulic connections of 30 to 40 cm of thickness	80.0	98
Asphalt curtain and bituminous bearing layers of the total thickness < 15 cm	100.0	100

6.2.9 Making of bituminous bearing layer (BBL)

Bituminous bearing layer is a bearing layer in road surface construction made of a mixture of stone flour, stone material and the bitumen as a binder.

6.2.10 The structure of asphalt mixture

- Grading

For making the BBL of a grain of medium size, the mixture of graded mineral material of a grain size of 0 – 31.5 mm shall be used.

- Bituminous mortar

The volume concentration of bituminous mortar in the asphalt mixture must be adjusted in order not to exceed the concentration of disposable space in pore and integral space of stone structure (particles bigger than 0.09 mm), whose particles are placed in the maximum possible contact.

- Filler

The main part of filler depends on its properties, the grading of the stone structure and its bituminous coating.

- Bitumen

The quantity of bitumen in the asphalt mixture must be adjusted in order to fill the pores and to coat the surface of grains of stone structure with a film of bitumen of sufficient thickness. Besides, all the cavities in the dry-rammed condition of filler which is situated in the asphalt mixture must be filled with bitumen.

6.2.11 The properties of asphalt mixture

Physical and mechanical properties of asphalt mixture are tested in the laboratory for:

- the stability at 60 C
- the relationship of stability and deformation at 60 C
- the portion of cavities
- the filling of cavities of stone mixture with bitumen

6.2.12 The properties of the completed BBL

Physical – mechanical properties

Physical – the following mechanical properties are tested on samples taken from the completed layer:

- the portion of cavities
- the level of compactness

- the thickness of a layer

The completed thickness of BBL if different from the design thickness must not be less than the value from the Table 54 OTU.

- the height of a layer

Permitted height deviation of a surface of completed BBL is +/- 10mm.

- the crossfall of a layer

The crossfall of a layer can vary from the design crossfall for separate profile at the most +/- 6% aps.

- the position of a layer

The allowed deviation of horizontal position of the left and right edges of the completed layer is +/- 2 mm to +/- 50mm of the design position, depending on category of importance.

- the level of a layer

The deviation of surface of the completed layer with reference to a flat surface of a measuring device can be at the most from 8 to 10mm, depending on category of importance.

6.2.13 Quality assurance of asphalt work

The control of quality of asphalt work is divided into:

- activities before the beginning of asphalt work
- activities during making of asphalt work

Activities before the beginning of work:

- previous testing of material
- making of previous sample of asphalt mixture
- transmission of previous sample of asphalt mixture to asphalt plant
- making of work structure (proof of production)
- making of experimental section (proving of building-in)

Activities during construction:

- current control
- control testing

6.2.14 Making of wearing course

A wearing course of asphalt – concrete is an asphalt layer made of mixture of stone flour, stone material and bitumen as a binder, where the grading of the stone mixture has been made according to the principle of very compacted stone material.

6.2.15 The structure of asphalt mixture

Grading

Stone mixture for making the asphalt – concrete for wearing courses consists of fractions of fine stone pieces, fine sand and stone flour.

Bituminous Mortar

Volume concentration of bituminous mortar in the asphalt mixture must be adjusted in order not to exceed the concentration of disposable space in pore and inter-granular space of stone structure (the particles bigger than 0.09 mm) whose particles are situated in maximum possible contact.

Filler

The mass part of filler in stone mass depends on its properties, grading of stone structure and its bituminous coating.

Bitumen

The quantity of bitumen in the asphalt mixture must be adjusted in order to fill up the pores and coat the grain surface of stone structure with a film of bitumen of sufficient thickness. All the cavities in dry-rammed condition of filler situated in the asphalt mixture must be filled with bitumen.

6.2.16 The properties of asphalt mixture

Physical and mechanical properties of asphalt mixture for rolled asphalts which are tested:

- | | |
|--|-----------------------------|
| - stability at 60 °C | HRN U.M8.090 or EN 12697-34 |
| - deformation at 60 °C | HRN U.M8.090 or EN 12697-34 |
| - space mass of asphalt sample | HRN U.M8.092 or EN 12697-6 |
| - density of asphalt mixture | HRN U.M8.082 or EN 12697-5 |
| - the proportion of cavities | EN 12697-8 |
| - the filling of cavities of stone mass with bitumen | HRN U.E4.014. |

The change of properties of bituminous connections of asphalt mixtures for wearing layers is controlled by testing the point of softening and penetration of ekstrahiran joints.

6.2.17 The properties of completed wearing course

- physical and mechanical properties
- physical and mechanical properties are tested on the samples made of the completed layer, which are:
 - the proportion of cavities
 - water absorption in a volume
 - the level of compactness (coalescence)

The thickness of a layer

The finished thickness of a wearing course I, because of deviation of project thickness at doing works cannot be less than a value from the Table 75 OTU.

The depth of a layer

Allowed height deviation of a surface of the finished wearing course is from +/- 5mm to +/- 8mm, depending on the group of loading.

Crossfall of a layer

The crossfall of a finished layer can vary from the design crossfall for a certain profile by +/- 0.4 % at the most.

The position of a layer

The allowed deviation from horizontal position of a left and right edge of finished layer and the right edge of executed layer ranges from +/- 25mm to +/- 50mm from the design position, depending on a group of loading.

Level of a layer

The deviation of surface of finished layer can range at the most 4mm t 6 mm, depending on a group of loading.

Roughness and capturing of a layer

The surface of the finished wearing course must be rough, and resistant to sliding.

6.2.18 Quality assurance of asphalt works

There are two kinds of activities:

- before the beginning of asphalt works and
- during executing of asphalt work.

a) Activities before the beginning of asphalt works

The activities before the beginning of asphalt works include:

- Prior testing of usability of material,
- Making of the prior structure of asphalt mixture,
- Making of working structure (proof of production capability),
- Making of experimental section (proving of building-in) and
- Making of the programme of quality control of material and work.

The Contractor is obliged to complete all these activities at his own cost. The Contractor shall prepare a report in two copies for each activity and give it to the Supervisor, who will verify it by his signature on the first page of the document. One copy of the verified document is returned to the Contractor, and the other copy is kept by the Supervisor.

b) The activities during executing of asphalt work

These activities comprise:

- Current testing as an obligation of the Contractor and
- Control testing as an obligation of the contractor.

6.87 6.3 Traffic signs

Supply and mounting of all types of traffic signs, has to be done in accordance with the design of traffic road equipment.

The type of traffic signs, their meaning, shape, colour, size and way of placing must be in accordance with the "Regulation" and with Croatian and European standards.

Traffic signs are fixed to the aluminium or to the posts executed of Fe pipe and protected against corrosion by hot galvanisation.

When mounting a traffic sign, it should be turned by 3-5° with respect to the road axis, as to avoid the intense reflection and to reduce the contrast of denotations, of the signs and of the lit background. A maximum of two traffic sign may be installed to one post.

Sign posts are placed into concrete foundation executed of concrete of minimal quality C 20/25 (MB-25), shaped as edged pyramid with lower rectangle side 30 cm and upper rectangle side 20 cm.

Execution of pavement marks for traffic control has to be made as defined in the Regulation and General Technical Conditions.

The colours and dimensions of marks are determined in the Regulation and in respective standards. "General Technical Conditions for Road Works"

Longitudinal pavement marks include lines marked parallel with the pavement axis, serving for detailed determination of the way in which the pavement surface is to be used.

Part 7 – General Building Works

7.1 Demolition

The contractor's work plan is to phase all of these demolition works with the reconstruction in such a way as to minimise the risk of rain ingress into the building with the use of suitable temporary covering.

Demolition, are to be taken down carefully so as to minimise dust and disruption to others. The debris arising from this work is to be transported off site as the contractor's own responsibility and disposed of safely

7.2. Earthwork

Earthworks – General

Earthworks under this section include excavation for small embankment fill, trench excavation and backfill where pipes are placed below ground and excavation for structures foundations for reinforced concrete slabs etc.. Everything contained in the Specification with regard to the execution of the excavations, disposal of excavated material, etc shall equally apply to the various types of soil unless otherwise stated.

Classification of Excavation

Excavation will be classified as "excavation in rock" or "common excavation" in accordance with the following:

- (a) "Rock" is defined as material which is of such hardness and texture that it cannot be loosened or broken by hand drifting picks, mechanical excavators or power driven hand tools, but requires drilling and blasting, or wedging, barring and sledging where blasting is not permitted or unsuitable for proper execution of the work, and also all boulders or detached pieces of rock more than one cubic metre in volume in open excavation or more than 0.5 cubic metre in volume when excavating in narrow trenches.
- (b) The excavation of all other materials to which the definition of "rock", does not apply shall be considered as "common excavation".

General and Foundation Excavation

Everything contained in this clause with regard to the execution of excavations, disposal of excavated material etc shall apply to all material, unless otherwise stated.

All excavations shall be carried out to the lines and limits shown on the excavation plan and other drawings, or defined in the Specification. Said lines and limits may be amended by the Engineer to suit soil and other conditions encountered during actual excavation and field inspection. When excavating in any material other than rock for formation levels under any structure, the last 15cm of excavation shall be taken out not more than 24 hours before placing of foundations or fill. The bottoms of excavations shall be levelled and trimmed to full width to required lines and levels and where under foundations shall be well watered and rammed before placing of concrete.

The Contractor shall well and effectively hold up the sides and ends of all trenches and excavations wherever necessary with strong, close timbering, and shall prevent any fall or run of earth or sand from any portion of the ground outside of the trench or excavation. If, despite such precautions, or by reason of their neglect, any portions of the bottoms sides or ends of any trenches or excavations shall give way or be excavated without instructions from the Engineer, the Contractor shall at his own expense excavate and remove all the ground thereby disturbed both within and without the limits of the trench or excavation.

Should the Contractor exceed in depth or extend the excavation of the formations or be ordered to take out extra excavation for the reasons given above, no payment will be made for such extra excavation, and he shall, if ordered by the Engineer, make it good with well rammed fill or in such class of concrete as may be ordered by the Engineer and at the Contractor's expense.

Should any existing subsoil or field drains be uncovered during any excavation, the Contractor shall carefully replace them when backfilling or, if this is impossible, he shall divert them to new drains or ditches, otherwise relay them as the Engineer may direct. Payment for this work shall be by Daywork and will be met from the Contingencies.

Preparation of the Working Area

The Contractor has to prepare the working area in a way that the works can be carried out without any hindrance.

The Contractor must check if the required permits are available for the construction of the working area

7.3. Concrete

As defined in Part 4

Cement

As defined in Part 4

7.4. Block Work and Brickwork

Unless shown otherwise on the Drawings, aerated clay blocks shall be used for external walls and shall be of one of the following sizes, the thickness to be used is described in the Bill of Quantities.

- 240 x 300 x 238mm
- 300 x 240 x 238mm
- 365 x 240 x 238mm

The blocks shall have a specific weight of 0.8 and a crushing strength of not less than 6N/mm², K-value 0.32 to 0.34W/m².

Internal walls may be made out of aerated bricks or of perforated clay bricks. The bricks shall be sound, hard, square, well burnt and of uniform size in shape and colour with straight arises. Blocks and bricks shall be laid to break joint in alternate courses and shall be bedded in lime - cement mortar.

The materials used must comply with the quality provisions of:

- HRN U.M2.010, mortar for bricklaying
- HRN U.M2.012, mortar for plastering
- HRN B.C1.010-012 cement for mortar
- HRN B.C1.020, lime for mortar
- HRN B.C1.030, gypsum for mortar
- HRN B.D1.011, full clay bricks

- HRN B.D1.014, hollow façade brick and clay blocks
- HRN B.D1.015, hollow brick and clay blocks

Testing of the material will be performed in accordance with:

- HRN U.M8.002, methods for testing bricklaying and plastering mortar
- HRN B.D8.011, testing bricks and clay blocks

7.5. Plaster and Rendering

Mortar for plastering should be tested according to HRN U.M8.002 by taking the series of samples for each plastered control manhole, and the walls and floor of the building

All surfaces to be plastered or rendered, shall be brushed clean and well wetted before the plaster is applied. All plastering and rendering shall be kept damp until it has sufficiently hardened.

All arises shall be finished true and slightly rounded, except where otherwise stated, and shall be run at the same time as the adjoining plaster. No partially or wholly set plaster or rendering will be allowed to used or re-mixed.

The Contractor shall cut out and make good all cracks, blisters and other defects and leave the works perfect on completion.

1. External plastering shall be lime- cement plaster, the last layer shall be white coloured epoxy-latex plaster, two to three mm thick.
2. Internal plaster shall be of two layer lime cement plaster, trowelled to smooth finish
3. Thermo plaster shall be applied to the outside walls of the valve chambers down to 500mm below finished ground level, and shall be of approved system. Following systems may be used, according manufactures instruction.
4. Polystyrene sheets, 50mm thick, glued to the concrete surface, one layer cement putty followed by one layer PVC reinforcement mesh and a second layer of cement putty. The final layer shall be white coloured epoxy-latex plaster.
5. Polystyrene-cement plaster, 50mm thick, applied by spraying or by hand, followed by one layer lime-cement plaster and a final layer as above.

The Contractor shall be free to propose any other common system, which shall be subject to the Supervisor's approval. In all cases the external angles and the lower ends shall be protected by white PVC sheeted cornices fastened to the concrete outside walls.

7.6. Screed

Screed, either called sand cement- or granolithic screed, shall consist of one part of normal Portland cement and three parts of well graded aggregate, effective size 0/8mm. The water/cement ratio shall not exceed 0.45, including any moisture in the fine aggregate. No water shall be added after mixing.

No screed shall be laid earlier than 28 days after concreting of the covered area. Prior to laying of any screed, the concrete surfaces shall be thoroughly cleaned and flushed with water. Any excess water shall be removed. Areas bigger then 6 x 6m shall be divided by butt joints.

7.7. Doors and Windows

Unless specified otherwise frames and leaves of external doors shall be made out of PVC (UV resistant) or aluminium, insulated according to DIN 4108 or Croatian standards. Recesses to the openings shall be provided for doors or windows set into concrete walls, to avoid inside plastering.

External doors shall be fitted outside with door knobs, inside with handle. All external doors at project location shall be fitted with a master lock system.

Internal doors shall consist of metal frame, and wooden leaves not less than 40mm thick. The leaves shall be of natural colour as agreed with the Client, transparent factory sealed. Frames shall be painted twice with approved white paint after installation. Pre-assembled hinges shall be used. All doors shall be furnished with solid handles and locks.

All measures for joinery are to be checked on the spot. All internal joinery, that is, doors are anticipated for placing with, that is, without blind door jambs. All windows are to be placed without blind window jambs. Pay attention to cleanness of placing - repeated painting is not planned.

The materials used for wooden doors and windows shall comply with the quality provisions of:

- HRN D.E1.001, construction joinery, windows and balcony doors
- HRN D.E1.011, quality of construction joinery
- HRN D.E8.012, wind resistance of wooden external material
- HRN D.E1.025-040, internal doors
- HRN D.E1.110-142, windows
- HRN D.E1.150, 160, balcony doors
- HRN M.K3.010-324, hardware for construction joinery
- HRN D.E8.193, construction joinery, external windows and balcony doors, air and water permeability requirements
- HRN U.J6.041, acoustics in construction, laboratory measuring of sound insulation ability of construction materials.

Testing of the material for wooden door and windows will be in accordance with:

- HRN D.E8.011, resistance of external joinery to freezing
- HRN D.E8.012, resistance of external joinery to wind
- HRN D.E8.013, testing air permeability

All external joinery must be tested in accordance with HRN U.J6.201/89, acoustics in building construction for the class I, with $R_w = 35-39$ dBa

All external joinery must be tested in accordance with HRN U.J6.201/89, acoustics in building construction for the class II, with $R_w = 30-34$ dBa

All external joinery must be tested according to provision HRN D.E8.193/89, resistance of doors and windows to air/water permeability, for C/C class.

The glass for glazing shall comply with the quality provisions of:

- HRN B.E1.011, flat, extruded glass
- HRN B.E1.050, flat, cast glass
- HRN U.C6.050, glass sealants
- HRN B.E1.080, flat reinforced glass

Testing of the glass for glazing will be performed in accordance with:

- HRN.B.E8.300, 308, glass, viscosity and characteristic viscosity points
- HRN.B.E8.310, glass, determination of coefficient of middle linear heat spreading

7.8. Hydro Insulation

The materials used must comply with the quality provisions of:

- HRN U.M3.227, bituminised glass fibre material
- HRN U.M3.230, bituminised strip with aluminium sheet insertion.
- HRN U.M3.240, bituminised hydro insulating material with organic solvent for cold working
- HRN U.M3.242, hydro insulating material based on bituminised emulsions for cold working
- HRN U.M3.244, hydro insulating material for hot working
- HRN U.M3.300, bituminised strips for welding
- HRN U.M9.015, mineral wool
- HRN G.C7.202, light panels for heat insulation

Testing of the material will be performed in accordance with:

- HRN.B.H8.605, testing bitumen
- HRN.U.M8.080, testing bituminised strips for hydro insulation
- HRN.U.M8.085, testing hydro-insulating material
- HRN.U.M8.225, testing material impregnated with bitumen

Following hydro insulation shall be used for the different parts of building substructure, walls and roofs.

1. Insulation between blinding and structural concrete shall be either hot applied bitumen, min. 500gm/m² or bituminous felt 300gm/m² properly overlapped by at least 150mm and glued. Care shall be taken that the melted bitumen is uniformly distributed. In case bituminous felt is used the Contractor shall ensure that no damage arises due to upstands or rough blinding surface.
2. Insulation of earth covered walls shall be hot applied melted bitumen, min. 500gm/m². Prior to application the walls shall be brushed or rubbed down, to ensure that all loose particles, dirt or remaining release agent are removed.
3. Insulation of earth covered roof slabs shall be executed as follows:
 - Aerated concrete
 - Diffusion layer
 - Moisture barrier
 - Two layers bituminous felt 500gm/m²

The bituminous felt shall be overlapped and glued by at least 150mm. The first layer shall be laid parallel to the fall, the second layer in right angle to fall. All layers shall terminate at the outside walls 200mm below the underside of the roof slab.

At valve chamber roofs the internal angles shall be covered, and the insulation brought up to the top of the upstand and fastened by a galvanised apron strip.

7.9. Roof Frame Work

Roof framework, battens, fascia board and cladding shall be treated prior to erection with two coats of approved protective paint, min. 100gm/m², against rotting and insect attack. All visible timberwork shall be planed prior to painting and fixing.

The materials used must comply with the quality provisions of:

- HRN D.C1.040-041, Cut wooden material (fir tree and spruce tree)

Testing of the material will be performed in accordance with:

- HRN D.A1.040-053 testing of wooden material

- HRN D.A1.058, testing wood resistance to fungus
- HRN D.A1.059, testing chemical substances for wood protection

7.10. Rainwater Gutters

The materials used shall comply with the quality provisions of:

- HRN C.B4.081, galvanized sheet metal
- HRN U.N9.052, window sills
- HRN C.E1.041, soldering alloy

Gutters shall be of galvanised steel with a minimum thickness of 0.8mm formed from pressed elements, fitted with stop end pieces, and shall be fixed by gutter brackets, fall not less than 1% to the rafters. Down end pieces shall be tapered to fit a 100 x 100mm down pipe. Eaves flashing shall be made off min. 0.5mm galvanised iron sheets.

Down pipes, swan neck pieces, bends and down pipe shoes shall be prefabricated, and made out of 0.8mm galvanised steel. The down pipes shall be properly fastened to the walls by galvanised brackets, distance not more than 1.50m.

7.11. Upstand Capping

Roof upstands shall be covered by galvanised capping, watertight fastened to the concrete. The capping shall extend at the inner side 100mm below the top of the roof insulation, the edging strip shall extend 50mm from the wall outside. Joints shall be double seamed.

7.12. Damp-proof Course

All block or brickwork resting on concrete shall be isolated from the concrete by a damp proof course. The bituminous felt sheeting for damp proof courses shall be three-ply approved membrane, weighing not less than 500gm/m². The sheeting is to be lapped 150mm at running joints and the full width of walls at angles.

7.13.

7.14. Handrails

Handrailing shall consist of 25mm internal diameter heavy duty water tubing, galvanised after being cut and welded to size, including fastening plates. The heights shall be 900mm, stands equally spaced, distance not more than 1.50m, and shall have one runner in between. The railing shall be fastened to the sides of the walkway by 10mm galvanised bolts.

7.15. Roofs - Slating and Tiling

Slating and tiling work shall comply with the relevant Croatian standards

7.16. Tiling

The materials used must comply with the quality provisions of:

- HRN B.D1.310, 320, 322, 335, unglazed floor tiles
- HRN B.D1.305, 306, 450, glazed floor tiles
- HRN B.D1.300, 301, tiles for wall cladding
- HRN B.C1.010-015, cement mortar
- HRN U.F2.017, terrace works
- HRN U.F3.053, terrazzo tiles
- HRN U.F2.011, ceramic works

Testing of the material will be performed in accordance with:

- HRN B.D8.054, determination of resistance to temperature changes (by a Harkort method)
- HRN B.D8.056, determination of water absorption
- HRN B.D8.058, determination of freezing resistance
- HRN B.D8.060,062, determination of wearing resistance
- HRN B.D8.064, hardness determination (per Mos)
- HRN B.D8.066, determination of flexural strength
- HRN B.D8.068, control measures and appearance of visible surface
- HRN B.D8.450, testing resistance to fine cracks
- HRN B.D8.099, quality control of ceramic tiles

All sheet or tiles of the same type, colour and pattern, which will be visible together, shall be from the same batch. Quarry floor tile joints shall be not more than 3mm. Glazed ceramic wall tile joints shall be minimum 2 mm wide.

7.17. Painting

The materials used must comply with the quality provisions of:

- HRN C.T7.326, 327, alkhyd red lead
- HRN H.C5.020, varnish from linseed oil
- HRN C.T7.328, 329, oil based red lead
- HRN U.F2.013, general conditions for house-painting works
- HRN U.F2.015, general conditions for varnishing works.

Testing of the material will be performed in accordance with:

- HRN F.S3.020, validation of paint resistance to light
- HRN H.C8.032, paints and varnishes, taking samples
- HRN H.C8.051, paints and varnishes, determination of expiry date
- HRN H.C8.052, paints and varnishes, determination of ground material fineness
- HRN H.C8.054, paints and varnishes, determination of covering ability
- HRN H.C8.059, paints and varnishes, determination of coating adhesion degree

6.15.2 Surfaces shall receive the number of applications stated in Table 6.1

TABLE 6.1 – PAINTING APPLICATIONS								
Description	Iron & Steel	Galvanised Steel	Copper & Brass	Aluminium	Softwood External	Softwood Internal	Untreated Hardwood External	Walls & Ceilings
Degreasing Solvent	1	1	1					
Red Lead Primer or Red Lead /Red Oxide Primer	2							
Zinc Chromate Primer				1				
Calcium Plumbate Primer		1						
Primer for Wood					1			

Oil-Based or water thinned undercoat	1	1	1	2	1			
Alkyd gloss or other finishing coat	1	1	1	2	1			
Varnish exterior Grade -full gloss							4	
Acrylic emulsion								1
Acrylic emulsion								2

7.18. Flooring

7.19. Step Irons

Step irons shall be either of galvanised iron to an approved Standard or of stainless steel as detailed. Unless otherwise detailed stainless steel step irons shall be fabricated from 25 mm diameter solid bar twice bent to form a 'U' shaped rung with 375mm tread width and two legs 350 mm long, the ends of the bar shall be ragged and built 175mm into the concrete wall. The tread of the rung shall be stamped or ribbed to provide a non-slip surface.

7.20. Wooden Structures

The design and construction of wooden structures made of structural timber and boards, shall be in accordance with HRN U.C9.200 and amendments HRN U.C9.200/1.

The design and construction of wooden scaffolding and formwork shall be in accordance with HRN U.C9.400.

The protection of wood in structures shall be in accordance with HRN U.C9.500.

7.21. Parquet Flooring

The materials used must comply with the quality provisions of:

- HRN.D.D5.020, parquet, parquet planks, massive
- HRN H.K1.065, adhesive for parquet
- HRN U.F2.016, technical conditions

Testing of the material will be performed in accordance with:

- HRN.D.A1.041, wood testing, measuring
- HRN.D.A1.043, wood testing, wood moisture content

7.22. Roller Shutters and Curtains

The materials used must comply with the quality provisions of:

- HRN U.F2.022, technical conditions for installing roller shutters and curtains
- HRN G.E5.050, plastic plates

7.23. Masonry Works

The materials used shall comply with the quality provisions of:

- HRN B.B3.200, natural stone slabs
- HRN B.C1.010, 011, 015, cement
- HRN B.C1.020, lime
- HRN U.N1.201, prefabricated stairs
- HRN U.N9.051, prefabricated window sills

Testing of the material shall be performed in accordance with:

- HRN.B.B8.001, testing resistance to freezing
- HRN B.B8.010, testing water absorption
- HRN B.B8.012, testing pressure strength
- HRN B.B8.013, testing resistance to atmospheric agents
- HRN B.B8.015, testing wearing resistance
- HRN B.B8.017, testing flexural strength

7.24. Metal Works

The materials used shall comply with the quality provisions of:

- HRN C.B3.021, hot rolled round bars
- HRN C.B3.024, hot rolled rectangular bars
- HRN C.B3.025, hot rolled flat bars
- HRN C.B3.101, hot rolled straight-side angle sections
- HRN C.B3.111, hot rolled different-side angle sections
- HRN C.B3.141, hot rolled U holders
- HRN C.B4.112, thin steel sheets
- HRN C.B5.021, construction seamless circular pipes, technical conditions
- HRN C.T3.001-100, welding
- HRN C.T7.100-113; 300-430, corrosion protection
- HRN M.B1.011-656, screws
- HRN M.B2.011-120; 135-143, washers
- HRN M.K3.010-324, hardware
- HRN U.N9.060-062, letter boxes
- HRN U.N9.300, shoe scrapers

Testing of the material will be performed in accordance with:

- HRN D.E8.193, permeability of water vapour and air
- HRN U.J6.041, measuring sound insulation

7.25. Wood Work

All measures for joinery are to be checked on the spot. All internal joinery, that is, doors are anticipated for placing with, that is, without blind door jambs. All windows are to be placed without blind window jambs. All external joinery must be made of high-quality PVC profiles with interrupted heat bridges and put in insulating IZO glass window-panes. Pay attention to cleanness of placing - repeated painting is not planned. The price includes supply and placing based on a piece, that is, on m2 of all woodwork items, all necessary fixings, 4+16+4 mm IZO glass window panes and all final skirting. All the rest according to technical conditions for woodwork.

Placing includes supply of items to the construction site, joinery placing, joinery connecting when placing complex items with all necessary auxiliary material and equipment (roofing battens, fixing foam, "Bitrax" strip (or equivalent) and other).

7.26. Fire Extinguishers

Fire extinguishers shall comply with the requirements of Croatian standards HRN Z.C.1.650 and HRN Z.C1.020

Part 9 –General - Electrical and Telecommunications Installation

9.1 General information

Equipment for transformer stations 10(20)/0.4 kV shall be built in standard concrete housing, in which the following equipment shall be built:

- one switching power transformer with the nominal transferring proportion of 10(20)/0.4 kV and nominal power of 1000 kVA
- medium-voltage distribution switching block of type "Ring Main Unit" (RMU) with 4 fields (1 transformer field and 3 line fields);
- switching block of low-voltage resolution with one supply field and 12 outlets.

Transformer stations shall be connected to the electric-power network of 10(20) kV by cables laid in the earthing ditch to the entrance of transformer stations. Entrance of the medium-voltage and low-voltage cables to the transformer stations shall be done through the cable installations, which are to be built-in in the concrete bases of transformer stations.

Housing of the transformer stations is to be made of standard concrete elements, which are transported to the site and can be quickly assembled on the building-site itself.

The housing of the transformer stations consist of the space planned for transformer chamber, under which, there shall be an oil pit, and the switching space. In the switching space, low-voltage and medium-voltage, switching blocks are to be located.

Transformer stations are to be equipped with one double-door and one single-door with blinds and an anti-insect net, and on the lateral wall of the transformer chamber, ventilation openings are to be built-in with blinds and anti-insect net, which enables ventilation of the transformer stations by natural air circulation. The door with blinds are to be made of electrically oxidized aluminium, and shall be built-in on the same side of the transformer stations housing, which simplifies the realization of access to transformer stations.

Under transformers, there shall be an oil-tight and watertight bath of capacity big enough to accept total quantity of oil possibly leaked from the power transformer.

The noise level that the transformer stations emits to the surrounding area shall be within the limits determined by the Law on Noise Prevention (NN no.17/90 and 26/93) and the standard HEP N.012.01/92.

9.2 Connecting power cables

System of street lighting is connected to public distribution system with cables, started with cabinet- place where measuring equipment is installed.

9.3 Trenches for power cables and telecommunication conduits

Before the start of construction work, it is necessary to set out the cable route in the presence of all utility companies' representatives. The Contractor must have a copy of cadastral plan of the underground service installations if it exists.

Depth of the trench excavation shall be 0.8m where there is no road traffic and which is brought to the final level, and in places where there is road traffic it is 1.2 m.

Cables are to be laid on the bottom of the trench on a layer of sand, 10 cm thick, and after laying the same material shall be provided up to a total thickness of approximately 30cm. The cable trench route in the vehicular and pedestrian traffic must only be excavated after the road or footway sub-base has been completed.

9.4 Mechanical cable protection

Above the cable, it is necessary to place cable protection warnings (synthetic guards or brick). Additional mechanical protection is put above the first layer of the cable cover.

At road crossings cables will be laid in ducts with internal diameter 200mm and wall thickness of 5mm. For connection of ducts original joints will be used. In the places where reserve ducts are installed, they must be closed with a purpose made cap while the active ones are closed with bituminous jute. Tubes are to be surrounded with concrete on all sides.

9.5 Clamp connections

Cable connections shall be made with suitable cable clamps, depending on the construction and insulation of the cable. Kind and type of clamp are determined by: nominal voltage, construction and kind of insulation and the position of clamp in the network.

Clamps must be installed to protect permanently the connection from moisture penetration and possible mechanical damage. Marking on the clamp must contain: mark or name of producer, type mark of clamp and mark of standard according to which the clamp was produced. All marks must be permanent.

For middle-voltage cable with PE-X insulation, the warm-contracting cable clamps, clamps in pulling technique and clamps based on electric insulation strips are used.

With transitive clamps it is recommended to use warm-contracting technology or technology of electric insulation strips. While making cable clamps, the continuity of metal covers for electric cable protection must be done with adequate connection tools. The position of the completed clamp must be marked on the earth surface with a marking according to the enclosure.

9.6 Earthing rope

Earthing rope is to be laid along the whole cable route and so that the two earthing transformer stations systems are connected:

- If the cable clamp has a metal housing, it is connected to the earth rope.
- Metal cable cover, as well as all metal parts of the cable ending, that are not under voltage in normal operation must be earthed
- According to the requirements of HT, at intersections iron pipe is necessary to be earthed on both sides to a length of 20m
- According to the requirements of water companies, at intersections the iron pipe must be earthed on both sides for a length of 20 m.
- As earth along the whole cable route, Cu rope 50 mm² is to be laid.

9.7 Safety distances of 10(20) kV cables from other underground installations

Along the cable route, there is frequent intersection of power cables with other underground installations. For this reason, it is necessary to respect the applicable regulations:

- Laying power cables under and above water or sewage pipes, except where crossing at intersections is not allowed.

- Minimal horizontal distance for parallel laying of power cables and water supply system is 0.5m or 1.5m for the main water supply system (this distance can be lowered by 30% if special mechanical protection is provided)
- At intersections, the cable can be laid above or under the water or sewerage pipes. Vertical distance between the cable and the main pipeline must be 0.5m, and for intersections with water connection at least 0.3m.
- Distance of the power cable to 20kV from the closest telecommunication cable at parallel closing is at least 0.5m, and for cables above 20kV is at least 1.0m.
- Intersections of power cables with TT underground cables must be done at an angle of 90°, and not less than 45° with vertical distance of 0.3m for power cables of 1kV, and 0.5m for power cables up to 35kV.
- If a vertical distance of 0.5 m cannot be achieved at intersections, the cables are separated with materials resistant to thermal impact; for example by laying into the protective tubes, under the condition that light distance is not less than 0.3 m. The length of protective tubes, semi-tubes or protectors must not be less than 1m on both sides from the place of intersection. Protective tubes for power cables must be made of conductive materials, and for TT cables of nonconductive material (concrete or plastic)
- Passage of the cable under roads can be done in several ways: by direct excavation of the trench in the road, by drilling or by tunnelling.
- Crossing of the cable is done at an angle of 90° i.e. vertically to the road axis and only exceptionally, a variation of 30° is allowed.
- As a rule, power cables are laid outside the road surface, and not in the roadway. If they are laid in the roadway, the cable depth must be increased in relation to standards.
- For storm drains under the road, it is necessary to build a concrete block with four pipes of diameter of 200 mm. Dimensions of the concrete block are: length 10m, width 1.15m, height 45cm, MB 10. Upper edge of the concrete block must be minimally 80 cm under the flood canal.

9.8 Cable laying

9.8.1 General remarks

- Cables are to be transported on drums. Shorter pieces can be delivered in coiled hoops, respecting the minimal allowed radius of cable bending. Cable ends must be watertight and protected with adequate caps.
- When conditions allow, the cables must be stored undercover, secured from direct impact of sunlight, atmospheric agents, rotting and unknown objects.
- Each cable hoop or cable drum must have signing plate with stamped information on the cable: type of cable, number and cross section, nominal voltage, weight and length, year of production and number of cable hoops.

9.8.2 Way of laying the cable

- For the case of laying the cable at low temperatures, cable must be pre-heated. The lowest temperature of the cable with outer PVC cover at laying is + 5, and with PE cover – 5 ° C.
- For uncoiling the cable, it is necessary to lift the barrel from the floor to the firm stand, to enable the free turning of the barrel. The cable is uncoiled by light and steady pulling from the upper side of the barrel, so that the uncoiling direction is opposite to the direction of the arrow on the barrel.
- Laying the cable in the ditch can be done manually or with machines. Manual cable laying should be used for short sections of 300m and sections with sharp turnings. Workers carry the uncoiled cable in boxes. The minimum allowed radii of cable bending must be respected, and the cable must not be pulled along the ground.

- Laying the cable by machines, i.e. laying the cable by a winch, is allowed on the route where there are no obstacles and big bends. The cable is pulled over the self-rotating rollers that are put to the bottom of the ditch at the distance of 4 – 6 m.
- For the case of laying the cable round bends, angle rollers must be used.
- Before cable laying by machines, it is necessary to calculate the cable pulling force and to control it with a dynamometer during laying.
- By applying the pulling strength, the allowed pulling force is:

$$F_d = 5 \times D^2 \text{ (N) for cables PP OO and XHE 49-A}$$

$$F_d = 9 \times D^2 \text{ (N) for cables PP41}$$

Where D = outer cable diameter in mm

- Where cables are laid in parallel, it is necessary to keep a constant distance along the common route.
- At laying and transportation of the cable, minimally allowed cable bending radius must be taken into consideration and it is:

	Voltage	PVC	PE - X
Single-core	1 – 35 kV	-	15 x D
Multi-core	1 kV	12 x D	10 x D

After laying and covering up the cable with the first layer of sand, it is necessary to:

- Test the laid cable
- Survey the exact cable route, mark the intersections with other underground installations, mark the connection spots and determine the exact total cable length.

9.9 Cables and Flexible Cords

(a) General:

Only cables and flexible cords permitted by Croatian standards may be installed. Where the appropriate National Standard is not yet available, cables and flexible cords complying with the latest British, VDE or CENELEC standard shall be installed.

(b) PVC Cables:

These shall be high conductivity stranded copper conductors with 450/750volt grade insulation.

The rating of these cables shall not exceed the rating in the Croatian standards.

Colour coding of cables shall be as follows unless otherwise agreed with the Supervisor before cables are installed.

Earth	- Green/Yellow
Neutral	- Blue
1st phase	- Brown
Other phases	- Red or Yellow
Switchwire	- Brown
Strappers	- White

Unless indicated otherwise the minimum sized cables below shall be used in final sub circuits.

Lighting	-	2.5 sq.mm PVC
Socket outlets	-	2.5 sq.mm PVC
Cooker (Domestic type) circuit	-	16.0 sq.mm PVC
Water heater circuit (3 kW)	-	2.5 sq.mm PVC
Water boiler circuit (5 kW)	-	10.0 sq.mm PVC
Boilerhouse final circuit (3 kW)	-	2.5 sq.mm PVC

Grouped cables shall be derated per the appropriate National Regulations.

9.10 Building Services Installation

9.10.1 The Contractor shall supply and install the complete building services installation, all as indicated on the drawings, and as specified herein. The installation shall be in accordance with all relevant Health and Safety Regulations, and with the rules for electrical installations in buildings.

9.10.2 The following shall be included:-

- (i) Lighting - internal, external, emergency and inspection
- (ii) General services and "small power".
- (iii) Electrical services for heating, ventilation, and plumbing systems.

9.10.3 The individual systems are described in detail below.

6.88 9.11 Lighting

9.11.1 The complete internal, emergency and inspection lighting installation shall be carried out as detailed on the drawings, and as specified below. Steel conduit, trunking and wiring systems shall be as specified above. All lighting fittings shall comply with VDE Standards.

9.11.2 All final circuit lighting wiring shall use minimum conductors cross-sectional area of 2.5 sq. mm stranded copper with P.V.C. insulation, 475/750 volt grade.

Colour coding shall be as follows:-

First Phase	-	Brown
Strappers	-	White
Neutral	-	Brown
Earth	-	Green/Yellow

Second and third phases: any colour except black, blue, green or green/yellow.

9.11.3 Lighting fittings shall be as scheduled on the drawings. Each panel shall be provided with an emergency lighting central test unit. Each unit shall be housed on a compartment of each switchboard.

9.11.4 The minimum average illumination level in all areas shall be 200 lux with full normal lighting in use. The emergency lighting shall illuminate escape access ways, power distribution room and office, as shown on the drawings.

9.1.5 Inspection lighting outlets shall include 220/25V, 50 Hz safety transformers, 5 ampere, totally enclosed socket outlet, plug and portable hand lamp fitted with 10m of 1.5 sq. mm, 3 core PVC/PVC circular flexible cable. The complete assembly shall be fully interlocked and intrinsically safe (i.e. sparkles). Inspection lighting outlets shall be suitable for operation in hazardous areas, they shall be fully weatherproof where fitted externally and be certified EXd or EXe to IEC 79.

9.25.6 All wiring in or adjacent to light fittings shall be protected by high temperature oversleeving.

9.11.7 All fittings shall be supplied complete with lamps/tubes. The Contractor shall be responsible for replacing any faulty or damaged lamps/tubes required prior to handover of the installation to the Contracting Authority.

9.11.8 Fluorescent lamps shall be "white", low energy type. Diffusers and lamps shall not be fitted until the building has been cleaned and painted.

9.11.9 Conduit outlet boxes shall be fitted with white blank covers or plaster rings with cable outlet grommets where the fitting does not cover the box fully.

9.11.10 Lighting switches and circuits shall be grid type, rated at 20 amperes, 220 volts with stainless steel cover plates.

9.11.11 Flexible earth leads shall be fitted on all fittings and switches.

9.11.12 The Contractor shall supply and install a complete system of external lighting as detailed on the drawings. The external lighting shall be wired in cabling sized as indicated. Where external lighting columns are used the cut-outs shall be mounted in the bases of the columns.

9.12 Street Lighting

9.12.1 Light-technical and geometrical parameters

Lamp posts on the road are 12 m high in double-sided arrangement on average 40 m apart, with small variations conditioned by the situation on the mounting spot.

To the lamp posts, lamps as type Gamalux LVC-16 400 W NaV or equivalent are mounted. On the crossroads, lamp posts are doubled, i.e. two lamps are mounted to the lamp post, on the console.

According to the international recommendations CIE 115/95, lighting falls into class of street lighting M1 with following requirements:

- The distance from the lamp post to the edge of the footway/road is 100cm.

Class of road lighting	M1
Level of medium illumination of the road surface	Lm= 2.0 cd/m ²
General equality of illumination of the road surface	jLm= 40%
Longitudinal equality of illumination of the road surface	jLu= 70%

9.12.2 Power supply to the street lighting

Street lighting will be powered from the distribution cabinet +KRO-JR next to the substations. From the sub-station to +KRO-JR, cable PP00-A4x150 mm² + Cu 50 mm² is to be laid. From the cabinet +KRO-JR to the individual lamp posts, cables PP00-A4x25 mm² + Cu 50 mm², are to be laid.

The street lighting controlling is to be by a light relay and built-in clock on the low-voltage switchboard in the substation. Signal cable is PP004x6 mm². Protection from too high voltage by touch is planned by TN"-S system.

Local equalizing of potential in switch-boards is required, as is lightning protection;

- galvanized lamp posts
- Cu earth rope 50 mm².

Lamp posts are connected through the earth screw to the earth rope in the ground that is laid with cables.

9.12.3 Cable trenches

Excavation depth of trenches is min. 1m and 1.2 to 1.5m under roads.

9.12.4 Laying and the way of covering

Cables are to be laid on the bottom of the trench on a layer of sand, 10cm thick, and after laying, the same material is spread over in the thickness of 30 cm.

At a level of approximately 70cm below finished ground level, the earth Cu rope is to be laid. At a level of 50cm, the PVC warning tape with sign "ATTENTION-POWER CABLE" in Croatian is to be laid.

Cables must be covered, at the latest, the next day after lying.

Road crossing of the cable shall be in ducts laid in MB-20 concrete bedding and surround, whose size depends on the number of ducts. Several ducts of 200mm are planned dia will be needed, as the route is used for low voltage and high voltage resolution.

9.12.5. Mechanical cable protection

Around the cable, it is necessary to put mechanical warning cable protection (HDPE or PVC guards, grid or brick). Additional mechanical protection is put above the first layer of the cable cover.

On the road crossings, for mechanical protection, cables will be laid in HDPE or PVC ducts with internal diameter ϕ 200mm and wall thickness of 5mm. For connection of tubes, original joints will be used in accordance with the Drawings.

9.12.6 Clamped connections

Connection of cables shall be made with suitable cable clamps, depending on the construction and insulation of cable. Kind and type of clamp are determined by: nominal voltage, construction and kind of insulation and the position of clamp in the network.

Clamps must be done to protect permanently the connection from moisture penetration and of possible mechanical damage. Marking on the clamp must contain: mark or name of producer, type mark of clamp and mark of standard according to which the clamp was produced. All marks must be permanently stable.

All joint locations must be marked with concrete marker blocks with brass studs buried above the clamps at ground level.

9.13 Protection from electric shock

9.13.1 TN system protection

To obtain safe TN system protection from indirect electric shock, it is necessary to take the following measures in the low voltage network:

- the end of each electric circuit (outlet) must be earthed
 - zero-conductor must be connected at every place where there is earth, lightning rod installations or protective earth of the construction
 - at places where conditions allow, connecting the zero-conductors of the neighbouring zero-wave networks if the cross-sections are the same or they differ in one standard cross-section,
 - obligatory potential equalization and application of the current protection switch (FI switch) must be installed.
1. Basic condition for application of the TN protection system is that the failure current (I_k) that appears at total short circuit of the phase conductor with zero-conductor or a part of a device, or installation that is not protected by zero, is greater or at least the same as the switch-off current (I_i) of the corresponding installation fuse, automatic fuse or protection switch, that is $I_k \geq I_i$
 2. Total resistance of earth of the zero conductor, beside fulfilling conditions for zeroing in the low voltage network, must have such value which will disable the appearing or maintaining the prescribed voltages that could be the consequence of insulation breakthrough of the high-voltage part of transformer stations to the low-voltage part.

$$R_{uk} = \underline{U}_d$$

$$k \times I_{kl}$$

where:

Ruk (Ω)	total resistance of earth measured in the transformer stations as earth of its earthing, together with earth of all other earthings connected to the zero-conductor in transformer stations and low voltage network
Ud (V)	Allowed touch voltage in transformer stations, depending on time of switching off line because of the one-pole short circuit.
K	correction voltage
Ikl(A)	Current of the one-pole short circuit or the earth connection in the corresponding network of 10 kV, earthed by low resistance.

9.14 Earthing System

9.14.1 General

The Contractor shall provide and install a suitable main earthing protection system.

The earthing system shall be carried out as combined one, which includes: operating earthing of HV and LV switchgears, protective earthing and lightning protection earthing.

The earthing system shall be composed of: earthing conductors, the main earthing busbars, branch and clamps.

The main earthing grid electrode shall be carried out by hot-galvanized steel strip, of cross section 25 x 4mm minimum, buried in the ground, at depth of 0.8m and laid in foundation of the building of wastewater treatment plant.

The earthing electrode of an outdoor metal fence, shall be separated from main earthing. Earthing conductor shall be hot-galvanized steel strip, 25 x 4mm minimum, buried in the ground at depth of 0.7m, and 1.0m distance from outside of fence.

The concrete ducts with covers will be foreseen on corresponding places for measuring.

All metal parts of equipment and devices need to be connected to earthing system, by individual conductor, made of hot-galvanized 20 x 3mm minimum, which are connected to common branch earthing conductor. The termination of earthing conductor will be connected to metal parts of equipment by galvanized screws.

Interconnecting of hot-galvanized strip of earthing, will be carried out by hot- galvanized cross earthing clamps with screws.

On the connecting place of copper parts and hot galvanized metal part, it is necessary to put inter-layer of lead strip, of 2.0mm thickness.

Drilling of the earthing conductor for joints shall not be permitted.

The earth continuity between the main panel and any outlet in the installation shall comply with the regulations.

The earth connections to the motors shall be made by a bolted disconnecting link to facilitate removal of the motor. Links shall be located to facilitate inspection.

The use of gas, water or other service pipes as an earth conductor shall not be permitted under any circumstances. The Contractor shall ensure that adequate clearances are

maintained between the electrical installation and other pipework as required by the regulations. All service pipework shall be bonded to the earthing system to ensure continuity.

The complete conduit, trunking and wiring enclosure systems shall be electrically continuous and shall be connected securely to all outlet boxes etc., forming part of the installation. The continuity shall be such that the resistance to the main earth of any part of the conduit or trunking systems shall be less than 0.5ohms.

The Contractor shall measure of soil resistivity according to IEEE Standards.

Test certificates in respect of the electrical installation shall include figures for "insulation" and "effectiveness of earth".

A main earthing busbar/test link shall be provided in the Power Distribution Room for connection of all earth continuity conductors. Secondary pits for checking and measuring of earthing impedance are pointed in the drawing.

The resistance of earthing system shall be 1.0 Ohm maximum.

9.14.2 Standards

Earthing system shall be carried out according to:

- IEEE 80/1986 Guide for safety in substation grounding
- IEEE 81/1983 Instruction for measuring of soil resistivity, grounding impedance etc.
- VDE 0141/7.76 Regulations for switchgear earthing of rated voltage above 1 kV
Book of Technical norms for electrical power switchgear for rated voltage above 1000V

9.14.3 Earthing Conductors

The main earthing conductor shall be hot-galvanized steel (Fe-Zn) strip, with cross-section area of 100 sq mm (25 x 4mm).

Interconnecting all metal parts of equipment shall be carried out by Fe-Zn strip, with cross section area 60sq mm (20 x 3mm).

9.14.4 Testing

After carrying out of earthing system before energizing of the wastewater treatment plant, the Contractor shall measure impedance of earthing system, according to IEEE standard and to prepare test reports.

9.15 Lightning Protection System

9.15.1 General

Lightning protection of building shall be carried out in grid form of hot-galvanized steel strip (Fe - Zn), 20 x 3mm, installed on the roof of the wastewater treatment plant building. The grid shall have "meshes" with size 20 x 20m maximum.

The Fe-Zn strip shall be installed on supports with concrete base, made of Fe-Zn steel, placed on the roof. Supports shall be installed in each 1.5m maximum.

All exposed metal parts on the roof, gutters, drain pipes, lead flashings, etc. shall be connected to lightning protection conductors.

On the highest installed Fe-Zn strip on the roof, 4 pointed air rod 600mm long, shall be provided (minimum).

Lightning protection grid on the roof shall be connected to the earthing grid over six Fe-Zn, 20x3mm, down conductors.

On each down conductors, disconnecting place shall be provided, necessary for checking and measuring. Down conductor shall be installed on the wall by supports.

Each down conductors shall be protected by metal angle steel, 1.5 m height from ground surface.

Interconnecting of Fe-Zn strip shall be carried out by cross connecting clamps, hot-galvanized.

9.16 Spare Parts

Spare parts will be brand new and manufactured according to standards and requirements as for basic equipment.

Spare parts will be packed in such way to be stored as long as possible and protected from all damages under normal storage conditions.

Test certificates and accompanying technical documents will be supplied with spare parts.

The spare parts supplied shall be sufficient for one year's service of equipment.

9.17 Taking over the equipment

Upon delivery of the transformer stations, attestations of quality of the delivered equipment will be submitted, i.e. attestations and testing reports of particular testing to prove that the equipment was made and tested in accordance with the valid standards.

Particular parts or elements of the transformer stations have certificates of quality in accordance with the following regulations and standards:

9.17.1 Power transformer

HRN N.H1.011/85 - Power transformers.
General technical conditions.

HRN N.H1.019/87 – Power transformers.
Marking the clamps and outlets.

HRN N.H1.005/90 – Power transformers. Three-phase oil distribution transformers with nominal powers of 50 to 2,500 kVA.
Nominal values and equipment.

HRN N.H1.050/74 – Power transformers. Gas relay.

HRN N.H1.551/90 – Power transformers. Determining the level of noise of the transformer and mufflers.

IEC 60076-1/93 – Power transformers. Part 1: General

IEC 6035/91 Loading guide for oil-immersed power transformers

9.17.2 Medium-voltage switching block

HRN BO.030/78 – Coordination of insulation in high-voltage (HV) plants.

HRN A5.012/63 – Dielectric strength of strong insulation materials according to the voltage of industrial frequency.
Procedures of testing.

IEC 60529/01 – Degrees of protection provided by enclosures (IP code)

IEC 60255 – Electrical relays

IEC 60044 - Current transformers

IEC 60298/98 - A.C.metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.

IEC 60694/02 – Common clauses for high voltage switchgear and controlgear standards.

IEC 60071 – Insulation co-ordination

IEC 60071-1/93- Part 1: Definitions, principles and rules

IEC 60071-2/96- Part 2: Application guide

VDE 0670 – Part 6: Switchgear.

Internal interference arcs.

- Part 3: High voltage and load break switches.

- Part 2: Earthing switches.

9.17.3 Low-voltage switching block

HRN N.K.5.503/88 – Low-voltage switching blocks.
Requirements for type-tested and partially tested switching blocks.

HRN IEC 60364-1 – Electric installations of buildings part I
Application area, subject and basic principles
Protection from electric stroke.

IEC 60439-1/99 – Low-voltage switchgear and control gear assemblies.
Part 1: Type-tested and partially type-tested assemblies.

9.17.4 Medium-voltage separation switch and disconnectors

IEC 60427/00 – Synthetic testing of high-voltage alternating current circuit-breakers

IEC 60265-1/98 – High voltage switches

Part 1: High-voltage switches for rated voltages above 1 kV and less than 52 kV.

IEC 62271-102/01 – High voltage switchgear and control gear
Part 102: Alternating current disconnectors and earthing switches

VDE 0670 – Part 6: Switchgear.
Internal interference arcs
- Part 3: High voltage and low break switches.
- Part 2: Earthing switches.

9.17.5 Low voltage isolator switch

HRN N.K5,012/82 – Low-voltage switches, isolators, isolation switches and combinations with fuses. General technical conditions and testing.

IEC 60947-3/01 - Low voltage switchgear and control gear
Part 3: Switches, disconnectors, switch disconnectors, and fuse-combination units

9.17.6 Cables

HRN HD 603 S1:01 – Distribution cables with nominal voltage of 0.6/1kV

HRN HD 620 S1:01 – Distribution cables with squirted insulation for nominal voltages of 3.6/6(7.2)kV to 20.8/36(42)kV

HRN HD 361 S3:01 – Way of marking cables

HRN HD 324 S1:01 – Recognizing insulated and bare conductors by colours

HRN HD 383 S2:01 – Conductors of insulated cables
Instruction for dimensional limits of round conductors

HRN EN 60811 Material for insulations and covers of electric cables

HRN EN 50265-1 2-1,2-2 General methods of cable testing under the impact of fire

HRN HD 48-S1 Testing cables and accessories by impulse voltage

HRN HD 405-3S1 Testing on cables under the impact of fire

HRN HD 605-S1 Additional testing on cables

HRN IEC 60183 Conductor for high-voltage cable selection

HRN IEC 60229 Tests on cable covers that have protective function and are applied by extrusion

HRN IEC 60502 Cables insulated by extruded insulation for nominal voltages of 1-30kV

9.17.7 Transformer stations housing

HRN EN 1992-1:2004.051/87 Concrete. Control of production in concrete factories for

concrete of category B II.

HRN U.J6.201/89	Acoustics in construction industry. Technical conditions for planning and building of constructions.
DIN 1048	Book of Regulations on technical standards for concrete and reinforced concrete.

Beside this, for each transformer stations, following documents are to be issued:

1. Result of concrete testing
2. Certificate on reinforcement quality
3. Proof of quality of material of Al metalwork
4. Attestation of roof coat
5. Declaration of quality of reinforced-concrete elements
6. Report on oil-impermeability and water-impermeability of a part of oil tub under the transformer
7. Declaration of galvanic connection of metal masses of the transformer stations housing
8. Certificate of the skill of welders

9.18 Commissioning

After building the construction, and before putting it into operation, it is necessary to undertake and to issue a report:

- a) Report on functional testing of the protection of power transformer, according to the Book of Regulations on technical standards for electric power plants with nominal voltage above 1,000 V (Sl. list no.4/74 ad 13/78).
- b) Report on measuring resistance of operation and protection earthing of TS, according to the Book of Regulations on technical standards for electric power plants with nominal voltage above 1,000 V, articles 147 and 158.
- c) Minutes of testing of medium-voltage cable for connection: power transformer – medium-voltage transformer field.
- d) Testing the cover of medium-voltage cable for connection: power transformer – transformer field (according
- e) Report on testing the dielectric strength of transformer oil and coil insulation.
- f) Survey of outside ground around the construction of the transformer stations.

Part 10 – Water Supply and Sewerage Installation

10.1 General

10.1.1 General

Prior to commencing installation works, 2 copies of the design must be submitted for approval to the public enterprise for water supply and sewage. One approved copy serves to the contractor as permission for execution and must be held on site at the building site.

The Contractor shall follow completely the approved design. Prior to commencing of works he shall compare the installation design with the existing situation at the building site and clarify any differences with the Supervisor.

10.1.2 Standards HS

- Steel pipes for water supply system C.B5.225
- PVC pipes and pieces for watersupply system C.C6.505,506
- Cast iron pipes and shaped pieces for water supply C.J1.021-092
- PE-Xc water supply pipes DIN 4726
- Wall tap M.C5.250-251
- Standing tab M.C5.290
- Exhaust valve with inclined spindle M.C5.271
- Straight exhaust valve M.C5.260
- Outlet valve M.C5.280
- Corner exhaust valve M.C5.251
- PlovniFloat valve for water tank M.C5.820
- Bolts M.C5.600
- Cast iron pipes and shaped pieces for sewerage C.J.421-482
- PVC pipes and shaped pieces for sewerage G.C6.511-521
- Sanitary ceramics U.N5.100
- Wash-basin U.N5.110
- Toilet conch U.N5.120-122 i 170
- Bidet U.N5.130,131
- Urinals U.N5.140,150
- Bathtubs, semi bathtubs and shower-bathtubs U.N5.210,220 i 230
- Standing battery with movable exhaust M.C5.805
- Siphon for wash-basin M.C5.810
- Siphon for urinal M.C5.811
- Outgoing knee with lid M.C5.812
- Spillover knee M.C5.813
- Lids for manholes M.J6.210
- SML cast iron pipes for sewerage DIN 1952
- Portland cement B.C1.010
- concrete steel C.K6.020
- canal lids M.J6.210

10.1.3 Installation

The Contractor shall check all levels in the design and compare them with the existing levels at the building site. When constructing the sewage network, the connection to the sewer in the street must be formed before the network on site to the bottoms of the stack pipes.

All horizontal lines of the water main installations shall slope towards the lowest point. Changing directions of water main pipes must not be executed in hot and cold state.

Pipes through walls must be laid vertically to the wall surfaces.

Laying pipelines in the ground

The pipeline that is to be laid into the ground shall be bedded and surrounded with at least 5cm thickness of sand. Pipes shall not be laid in trenches until the Supervisor has approved the trench line and level. Backfilling shall not commence until the pipeline has been approved by the Supervisor..

Laying pipeline in buildings

Pipelines shall not be built rigidly into the walls and other structures. Holes for passing pipes through structures must be sufficiently large and the space between the pipes and structures must be filled with plastic material to prevent damage to the pipes. When passing through walls, water main pipes must be protected with a protection pipe whose diameter is 40mm bigger than the outer diameter of a water main pipe. Interspaces should be filled with tar-treated oakum or permanently elastic putty.

Sewage pipes must not be built rigidly through walls. Interspaces between the wall and pipe should be filled with oakum and asphalt or other permanently elastic putty.

Protection of pipes

Water pipes shall not pass through the chimney and ventilation duct walls, through channel ditches, under the toilet bowl or urinal and where they may be subject to pollution, freezing, heating and corrosion.

At crossing points, the pipes must often be protected. When crossing sewage pipes the water pipe must be higher and the interspaces filled with clay at least 20cm thick. If the distance is less the water pipe will be laid through a protection pipe conduit as when the pipe is passing through a wall.

At the places where the pipes are subject to freezing they are to be insulated. The insulation should be carefully executed and lines must not be closed until the Supervisor has approved them.

Joints

Jointing of pipes, and of pipes and valves must be performed so that the inside diameter of the pipe must not be narrowed with ends, valve parts, oakum, tin or in any other way, or deformed by bending the pipe.

Sealing of socketted cast-iron water and sewage pipe joints shall be performed by ramming with tar oakum and melted lead, or with rubber ring joints.

Galvanized water pipes shall be connected with threaded joints and the connection sealed with oakum.

Lead outlet pipes shall be jointed by soldering. PVC plastic sewage pipes shall have spigot and socket joints incorporating rubber rings.

Pipe joints in the walls, ceilings and other structures should be avoided.

Fixing pipes

Pipes on walls and ceilings shall be supported by clips at distances depending on the profile and type of the pipe. Lead and PVC pipes in warm premises should be fixed along the whole length on to a firm surface.

10.1.4 Fittings

Fixtures must be installed precisely, taking care of easy handling and aesthetic looks. The fixtures shall be fixed in the way to be easy for handling.

10.1.5 Sanitary Devices and Fittings

Installation of sanitary devices and fittings must be performed precisely and neatly, taking care of aesthetic looks and ease of usage.

Sanitary devices are to be fixed onto the walls by plastic or metal plugs and should bear the force of 100 kp at the most in appropriate place.

Heights for placing sanitary devices, unless otherwise prescribed on the Drawings, are measured from the finished floor and are as follows:

- Washbasin	80 cm
- Shelf	125 cm
- Mirror, to the centre	155 cm
- Towel rail (holder)	75 cm
- Wall tap	110 cm
- Sink	85-90 cm
- Toilet cistern (mounted high), the bottom	200 cm
- Low mounted cistern, connection to water	90 cm
- Toilet roll holder	80 cm
- Wall urinal, front edge	65 cm

10.1.6 Testing Installations

Finished, but not yet insulated and backfilled networks must be tested for impermeability and good functioning, before being taking over.

Water supply network, unless otherwise determined, shall be pressure tested to at least twice the working pressure and to 12 bars minimum for a period of 30 minutes. There shall be no leakage.

The sewage network shall be tested as indicated in Section 4.2 of this Specification.

Testing of the installations shall be executed in the presence of the Contractor and the Supervisor. Immediately after successfully testing, thermal insulation can be fixed, openings in structures can be sealed and trenches backfilled.