



Port Network Plan and Improvement
Programme:
Renovation of the Ferry Terminals of Baku
and Turkmenbashi

Tender Documents (Draft)
Ferry Terminal, Turkmenbashi
September 1997

Volume III.ii, The Works, Specifications

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ГОСТ

1. INTRODUCTION

The Tender Documents for the civil and building works for renovation of the Ferry Terminal in Turkmenbashi comprise the following documents:

- VOL. I The Tender
- VOL. II The Contract
- VOL. III.i The Works, Bill of Quantities
- VOL. III.ii The Works, Specifications
- VOL. III.iii The Works, Drawings

The present volume III.ii of the Tender Documents, being subject of the Works' Specifications, comprises a general description of the site of the project and the works to be executed as well as the technical specifications for the execution of the works.

The present document is available both in English and in Russian

The English shall be the contract language.

In case of any discrepancy between the English version and the Russian version, the English version prevails.

2. GENERAL DESCRIPTION

2.0 General

In this section the design criteria for the works, the local site conditions, the works to be executed and the corresponding general planning and time schedule are presented.

The design criteria given in section 2.1 have formed the basis for the elaboration of the contract drawings and specifications included in these tender documents. The verification of the project and the preparation of the execution project (calculations, drawings and specifications) which, according to VOL. II - sub-clause 6.5 of Part 2, Particular Conditions, shall be done by the Contractor when he takes over the responsibility of the whole project shall also comprise a verification of these criteria.

The local conditions of the site chosen for the location of the present project are treated in the section 2.2 by describing in brief aspects like the geographical location and topographical conditions, the meteorological conditions, the soil conditions, the hydraulic conditions, the local building material resources and the local conditions concerning supply of water and electricity.

The information given hereafter is given in good faith but without any responsibility of the Employer. The Bidder shall satisfy himself regarding local resources of construction materials, supply of power and water, resources of labour and all other conditions that may influence on his bid and no claims from the Contractor due to any error in the site information supplied by the Employer will be accepted.

The works and items to be supplied under this Contract are in brief the following:

- Terminal land works, comprising
 - demolition of buildings and structural works
 - filling and levelling of land part of terminal area
 - execution of outside utilities networks for heating, power and water supply, sewerage, drainage, etc.
 - execution of internal roads and parking areas, including fencing and outdoor lighting
 - repair of the connection to the existing access road to Ferry Terminal
- Marine works, comprising
 - dredging for embankment/reclamation area
 - filling and levelling of reclaimed terminal area
 - coastal protection/embankment works
 - partly demolition and reconstruction of the finger piers, central pier and lifting tower foundation
 - demolition and reconstruction of access bridge to central pier
- Ferry ramp works, comprising
 - dismantling of ferry ramp structures (link spans) and lifting towers, including counterweights and machinery

- cleaning, inspection and verification of dismantled structures and machinery
 - repair works on ramp structures with replacement of rails and deck and partly of structural parts due to deterioration
 - renewal of complete surface protection of all steel structures
 - disassembling and testing of ferry ramp structures and lifting towers, including new counterweights and machinery
 - new lifting tower building structures
 - new control system for operation of ramps, including electronic installations.
- Railway works, comprising
- provision and installation of new P-65 rails on the ferry ramps
 - repair of the existing road/rail crossing at the access road and construction of new crossing at container road
 - execution of inspection walkway alongside rail yard track
- Land building/structural works comprising
- New Ticketing Building, including shed
 - New Border Control Building, including sheds
 - New Public Service Building
 - Modification/extension to Sea Station
 - New Substation
 - New Passenger Bridge/Sky Walk between the Passenger Terminal and the central pier.

A general description of the content of each of these works is presented in section 2.3 which shall be read in connection with the project drawings being subject of VOL.III.iii. The detailed descriptions, concerning the execution of the works, are presented in section 3, Technical specifications, of this volume.

The general and overall time schedule, which the Contractor has to obey, is shown in section 2.4. This time schedule, including contractual completion dates according to the Administrative Conditions, shall be further detailed by the Contractor.

2.1 Design Criteria

2.1.1 Standards and Codes of Practice

Constructed during the period of the former Soviet Union, the existing terminal infrastructure in both Baku and Turkmenbashi ports have been designed and built according to Soviet standards and codes of practice

After the break-up of the Soviet Union, the same norms and standards are still used. Despite their wide application these standards and codes are not readily available from ordinary sources in Azerbaijan and Turkmenistan but have to be procured through relevant design institutions and/or from Russia (Moscow). Also they are not available in English translation.

The designs/verifications shall be carried out applying what is considered the most appropriate under the present circumstances. This means that with the exception of the marine works, the designs of other works shall be carried out applying Soviet standards and codes of practice. The marine works may be designed according to relevant international norms, like Eurocodes, etc.

The following criteria have been applied for preparation of tender project and shall be used as a basis for further detailing/verification of the project.

2.1.2 Design Basis

2.1.2.1 Vessels

The project is based on the assumption of continued use of existing ferries of the 'Dag-estan' type. The main features of this vessel type are:

- Dead weight, DWT : 3950 tons
- Length o.a. : 154.30 m
- Breadth, max : 18.30 m
- Draught, max : 4.50 m

- Capacity main deck : Railway lane-meters (lnm) = 416m ~ 28 rail wagons (14.4 m length)
or alternatively : Truck lnm = 592m ~ 32 trucks (semitrailer type)
or ~ 41 semitrailers
or ~ 80 containers (TEU)
- Capacity hold deck : 50 cars
- Passengers : 202

2.1.2.2 Lifetime

The general design lifetime of the new terminal infrastructure is 50 years as regards corrosion, fatigue of materials, statistics, etc. This do not apply to mobile equipment and similar, with normal economic lifetime much shorter.

2.1.3 Design Loads

2.1.3.1 Dead Weight

- Reinforced concrete : 25 kN/m³
- Construction steel : 78.5 kN/m³
- Bricks, sawed from loamy stone : 20.0 kN/m³
- Clay bricks : 18 kN/m³
- Masonry in hollow conc. Blocks : 14 kN/m³
- Sea water : 10.25 kN/m³

2.1.3.2 Live Standardised Loads

- Buildings: office : 2.0 kN/m²
hall : 4.0 kN/m²
- Traffic areas road traffic : max axle load 120 kN
- Pier and access bridge : 10 kN/m²
- Passenger bridge : 4.0 kN/m²
- Ramp : 80 kN/m track or 40 kN/m rail

2.1.3.3 Berthing Loads

- Fender energy and forces : 540 kN/m
berthing speed 0.3 m/s
- Bollard forces : 750 kN

2.1.4 Natural Design Conditions

2.1.4.1 Temperature, Humidity, Precipitation

- Extreme air temperatures : Max. 44°C
: Min. -18°C
- Extreme water temperatures : Max. 35°C
: Min. ~0°C
- Average relative humidity : 65%
- Average yearly precipitation : 116 mm
- Design rainfall for surface drainage : 60 l/sec/ha.

2.1.4.2 Wind loads

- Wind pressure : 0.60 kN/m²

2.1.4.3 Snow loads

- Snow pressure : 0.50 kN/m²

2.1.4.4 Ice loads

Considered of minor importance

2.1.4.5 Seismic loads

The coastal region of Turkmenbashi (project area) is, according to СНП II.7-81, belonging to seismic activity area of 9 degrees (corresponding to Modified Mercalli Scale).

2.1.4.6 Water levels

For the final stage of reconstruction works a design water level variation between -25 m and -30 m below Baltic Sea Level (BSL) has been selected.

At present time (June, 1997) the water level is reported to be around -27 and it has been decided in the first (present) phase of the project to maintain the existing level for land areas that will not be touched by new/renovation works (e. g. land base of ramps).

2.1.4.7 Waves

Due to protected location of the Turkmenbashi port, the wave heights are very limited. The fetch is a few kilometers for the East winds and 20 km for the South winds. It is seldom to observe waves with heights of more than 0,5 m in the bay

2.1.4.8 Soil Conditions

See section 2.2.2.5.

2.1.5 Materials

2.1.5.1 Concrete

- Building works
 - Class B7.5 concrete; design compression strength: 4.5 MN/m². Blinding layer for foundations and floors.
 - Class B15 concrete; design compression strength: 8.5 MN/m²
Building works, foundations, lintels, monolithic parts of floors, seismic belt.
 - Class B20 concrete; design compression strength: 11.5 MN/m².
Building works, frame (columns and girders) of the public service building and columns of the passenger bridge.
 - Class B25 concrete; design compressive strength: 14.5 MN/m²
Roofing works, frames (columns and girders, monolithic floors) of the passenger terminal
- Marine works
 - Class A concrete; Characteristic compression strength: 35 MN/m².

- Class B concrete; Characteristic compression strength: 15 MN/m²
Blinding layer.

2.1.5.2 Reinforcement and Structural Steel

- Land works
 - Reinforcement steel.
 - .Class AI, mild steel; yield strength : 225 MN/m².
 - .Class AIII, high tension steel; yield strength : 365 MN/m².
 - Structural steel.
 - .BCT3KП, yield strength : 225 MN/m².
- Marine works
 - Reinforcement steel.
 - .Type R, mild steel; yield strength : 220 MN/m².
 - .Type Y, high tension steel; yield strength : 550 MN/m².
 - Structural steel.
 - .St. 36, yield strength : 235 MN/m².
 - .St. 52, yield strength : 355 MN/m².

Other materials will be normally available standard materials.

2.2 General Description of Site

2.2.1 Location of Terminal

The sea port of Turkmenbashi is the only major port in Turkmenistan located on the eastern shore of the Caspian Sea at a distance of approximately 550 km from the country's capital Ashgabat. The town has 70,000 inhabitants. The port is linked to the capital by road and railway. From Ashgabat similarly there are road and railway connections to the neighbouring countries of Iran, Uzbekistan and Kazakhstan. On the sea side of Turkmenbashi there are maritime connections to Azerbaijan, Iran and Russia. Through the Volga-Don-system, maritime transport can reach large parts of Western Russia and Eastern Europe.

The port was built as a result of construction of the Central Asian railway at the end of the 19th century. Physically the port is located in a sheltered bay, some 14 nautical miles from the open sea at 40(00' North and 53(01' East. The location of the port can be seen from Dwg. T.01.00.

The waterway entry to the port is through 22 km long dredged channel.

The ferry terminal is located at the eastern end and about 4 km from the main port area.

2.2.2 Natural Conditions

2.2.2.1 Topography

The ferry terminal is located partly on reclaimed land with a surface level of -25.4 m.

A topographic survey has been carried out as part of the present project.

2.2.2.2 Bathymetry

As bathymetric surveys are not carried out on a regular basis, there is no exact knowledge about the water depths in channels and at quays. Detailed data are available from 1975, but because of the high degree of siltation in the area, these are not reliable. In 1993 a Ukrainian company carried out some bathymetric surveys in connection with construction of a terminal for agricultural products just east of the ferry terminal. However, these data are not available in the port of Turkmenbashi.

2.2.2.3 Meteorological Conditions

2.2.2.3.1 Temperature and Precipitation

The climate of the Turkmenbashi area is characterized by hot, dry and sunny weather in the long summer period and by frost and small quantities of precipitation in the winter period. The region is the most dry in the former Soviet Union with a yearly average precipitation of 116 mm. The average relative humidity is 65%.

The annual air temperature is +15.9°C. The absolute maximum was +44.1°C and the absolute minimum -17.9°C. The average number of frost days is 18 and average number of days with snow is 3.

2.2.2.3.2 Wind

Wind roses are available, giving probability for wind direction and wind speed interval. The roses show that northerly winds are predominant. Wind rose for Turkmenbashi is attached in Appendix 5. Too strong winds makes navigation at quays and in the channels difficult, and therefore a maximum wind speed of 17 m/s has been set out by the port authority as the limit for navigation. According to the Harbour Master, maritime traffic is interrupted during an average of 5 days per months due to too strong winds.

2.2.2.3.3 Visibility

Only ten days with fog are observed per year. In addition to this, haze and dusty storms can occur.

2.2.2.4 Hydraulic Conditions

2.2.2.4.1 Waves

Due to the sheltered location of the port of Turkmenbashi, wave heights are very limited. The fetch is a few km for northern winds and 20 km for western winds. It is very unusual to observe wave heights of more than 0.5 m in the bay.

2.2.2.4.2 Currents

Currents in the Bay of Krasnovodsk are characterized by the eastern drift. In general, the direction of the current is equal to the direction of the wind. Maximum speed of current is not more than 0.5 m/s according to natural measurements.

At the entrance to the northern channel in the opening in the Krasnovodsk spit, the current can be very strong.

2.2.2.4.3 Tide

Tides in the Caspian Sea are negligible.

2.2.2.4.4 Salinity

The average annual salinity in the Caspian Sea is 1.27 %. The maximum salinity is 1.45 % and the minimum is 1.11 %.

2.2.2.4.5 Ice

Ice can occur in strong winters. The average duration of ice periods in strong winters is 24 days and the average thickness of the ice is 3-10 cm.

2.2.2.5 Soil Conditions

The region of Turkmenbashi Ferry Terminal is formed by clastic sediments of sand, big rock fragments, silt and loamy soils underlayered by clay. The area of the Ferry Terminal has been created by reclamation of sand brought in from the Krasnovodsk Spit.

In 1961 a geological/geotechnical study was performed to investigate the bearing capacity of the sand and silt within the reclaimed territory.

According to grading, the reclamation sand is fine. Investigation of recovered samples of the sand showed that its mean porosity coefficient is 0,63 in average. In correspondence with СНиП II-15-74 (СНиП 2.02.01-83) the reclaimed sand is of mean density.

Reclaimed sand from the Krasnovodsk Spit is expected to cover the Terminal area in a thickness of 0 - 12 m. The upper boundary of the lower clay layer is generally expected at level -30 to -40.

The old geological/geotechnical survey insufficiently characterise the foundation conditions for each building and structure. Therefore, a new survey covering each building and structure shall be carried out by the Contractor.

2.2.2.6 Seismic Conditions

Turkmenbashi is situated in a seismically active area. According to the Soviet Standards, the seismic force in Turkmenbashi is 9 (correspondingly to the Modified Mercalli Scale).

2.2.3 Navigational Aspects/Approach to Turkmenbashi

2.2.3.1 General

There are two access routes from the open sea to the port of Turkmenbashi. A northern route (length 22 km) going through the opening in the Cheliken peninsula and a southern route (length 35 km) going south of the peninsula. The northern route is normally used by vessels heading for or arriving from Baku or Russia, while traffic to and from Iran uses the southern route. For the ferry link to Baku, the northern route is 24 nautical miles shorter than the southern route.

In the beginning of the 1970's the northern route was dredged to 7 meters water depth. The width of the channel is 140 m.

Naval charts from 1979 and 1980 are available, showing the navigational approach to Turkmenbashi.

Use of pilot is compulsory in the port and access channels of Turkmenbashi. However, the ferries servicing the Baku-Turkmenbashi line are often exempted from the use of pilot.

2.2.3.2 Sedimentation and Dredging

According to records of the Caspmorput, who has been carrying out the dredging works in Turkmenbashi, important siltation that takes place in the approaches to Turkmenbashi port.

The dredging records also confirm that dredging works carried out in the approaches to Turkmenbashi port since the break-up of the Soviet Union have been "urgency" measures at a level much lower than what should be done in order to maintain the depths of the approaches properly. The result is that today the water depth is much smaller than 7 m.

A particular problem has been mentioned concerning the northern ferry berth which should be suffering from inflow of sediments and materials from the reclamation just north of the terminal.

2.2.4 Railway Facilities and Access

The railway terminal is situated not far from the railway yard of Turkmenbashi main station. The terminal itself consists of a shunting yard, access tracks and ferry connection tracks, and it is connected to the railway system via two connection tracks as shown on the Turkmenbashi Terminal layout dwg. T.01.00 and T.01.04.

Removal of the main goods station of Turkmenbashi to the present site of the ferry terminal is planned and works have started but remain non completed for some years.

The terminal is connected via one track to the track area of the port and via another track to the station yard.

Presently the shunting yard consists of 6 parallel tracks with a switch area in each end. The connection to the ferry access tracks is established from one of the parallel tracks

(track 5). Track 1 to 4 have the length of about 500 m. Track 6 of 215 m has a blind end. The lay out of the yard is not very well suited for the sorting of wagons for the ferry as it gives several crossing shunting movements and has a considerably reduced capacity. The already constructed part of the removed shunting yard is also used as a supplement of the ferry terminal yard.

The access tracks are used for parking of wagons waiting for shunting on board the ferry and for temporary parking of wagons from the ferry.

The access tracks are grouped with 4 tracks for each of the two ferry berths. Two of these four tracks are used for wagons to the ferry and the other two for wagons from the ferry. The length of the tracks is about 225 m to 228 m giving a capacity of 15 - 18 wagons corresponding to the capacity of 2 ferry tracks.

Light signals are installed for control of train movements to and from the access tracks. All switches are manually operated and train movements are controlled by radio equipment.

2.2.5 Road Access

A 2-3 km long asphalt road leads to the ferry terminal from east from the main road between Ashgabat and Turkmenbashi. The access road is generally in a good condition, except for some holes that need repair close to the ferry terminal. The access road is crossing both the port railway and the main railway line. The width of the road is 6 to 8 meters. In connection with the railway crossings, there are sharp bends. Most of the access road is located in level - 25 m, which means only about 2 metres above the current sea level.

2.2.6 Auxiliary Facilities and Utilities

2.2.6.1 Heating Supply, Heating and Ventilation

The existing source for heating for the ferry terminal is the local boiler house located at the territory of the ferry terminal. The boiler house is presently being moved to another location next to the sea station. Future capacity will be sufficient for the consumers located inside the ferry terminal area.

Heating systems and ventilation in the existing passenger building/sea station and customs building are in working condition. All heating is by means of hot water radiators. Heating pipelines are temporarily located overground between the boiler house and the passenger and customs buildings.

2.2.6.2 Electrical Installations

The main source of power supply in the ferry terminal is the 35/6/0.4 kV substation named "Paromnaya". The high voltage side of the substation is supplied from the city network which passes at a distance of 150 m from the substation.

The consumer supply side is 380/220 V and the frequency is 50 Hz.

The condition of the substation is bad and a new substation is under construction next to the sea station.

The outside lighting in the ferry terminal is in a poor condition. The internal telephone communication between divisions of the ferry terminal is good. The outside telephone lines are in a poor condition and therefore communication inside Turkmenistan and internationally is almost impossible.

2.2.6.3 Water Supply

In the existing facilities, there is a water supply system of steel water pipelines with diameters of 50 mm and 100 mm. However, the system is not in a working condition and water is currently brought by tank trucks.

The water supply system shall be renewed.

2.2.6.4 Sewerage

No proper sewerage system is existing in the ferry terminal. The newly repaired passenger and administration building is equipped with sewerage installations connected to a septic tank/or wells.

Sewerage and garbage is removed by trucks.

2.3 General Description of Works

2.3.1 Terminal Land Area Arrangement

2.3.1.1 Layout, Arrangement

The chosen layout of the renovated terminal is shown on Dwg. no. T.01.03/04. According to this layout the terminal will comprise the following new/renovated areas:

- Arrival and Ticketing area
- Holding area for dangerous cargo
- Border control area (customs, police)
- Marshalling area
- Interface traffic area in front of ferry berths
- Vehicle disembarkation area

All these areas will be paved by asphalt on a gravel bed and supplied with drainage system and flood lighting. Traffic lanes will be separated by painted lines and low movable fences where found necessary. The customs area will be fenced off.

Access by road and rail will be through the existing infrastructure, but the existing internal road between the ferry terminal and the main port shall be upgraded (through separate project) and a dedicated container/administration additional road link will be constructed.

The following new buildings/structures will be present on the terminal area:

- Vehicle Ticketing Building (new)
- Border Control Building (new)
- Public Service Building (new)
- Passenger and Administration Building (existing)
- Passenger Bridge/Sky Walk (new)
- Railway Control Post (existing)

These buildings are further described in the following sections.

2.3.1.2 Demolition and Filling Works

To accommodate the layout of the renovated Terminal various existing building works and structures not fitting into the new layout shall be demolished and the demolished material shall be removed from the site.

The demolition works will have to be planned in accordance with the construction of the replacement building works and structures foreseen e. g. the substation.

Following the demolition works the level of the area shall partly be raised to levels as shown in dwgs (average approximately -23.5). Fill material for levelling may be taken either from approved quarry (approx. 11 km from Turkmenbashi) or from the sea side.

2.3.1.3 Road and Parkings

All new traffic areas and roads are proposed to be constructed in the same way consisting of a three layer base (sand, gravel, crushed stone) on top of which a two layer asphalt wearing course is placed. Where new paved areas are constructed in connection with old ones (e. g. access road), a new asphalt wearing course shall be applied to the old road providing a uniform and levelled surface of the completed road.

Roads and parkings shall be provided with kerbstones, sidewalks, drainage, fencing and lighting. Further, traffic lane markings and road signs shall be provided.

2.3.1.4 Lighting, Power Supply and Electric Installations

Floodlighting masts, 18 m high each, with glow lamps in the floodlights, shall light the terminal area. Lighting of lanes, footpaths shall be arranged by fittings with ДРЛ type mercury vapour lamps, installed with a help of bracket on steel supports. Outside lighting and power supply net of the buildings and structures is executed from cable conduits 0.7 m under ground. Telephone and radio net is also made of cables.

2.3.1.5 Drainage, Water and Sewerage

There shall be a drainage system to drain rain waters from the terminal area. The system shall be provided with oil separator before the water is let through outlets into the sea.

On the terminal area, water supply pipelines shall be constructed to provide the buildings and the structures with drinking water. There is also a water pipeline, designed for provision with watering of plantation and washing of pavements. The designed water pipeline is to be connected to the existing water supply pipeline in the terminal.

The water supply pipelines shall be made from steel and they shall be laid at a depth of 1.0-1.2 m under ground.

The area will be provided with fire hydrants.

From the planned buildings the sewage flows to the sewage collecting tank through pipes made from asbestos-cement. From the collecting tank the sewage shall be taken by road tanker to the city sewage system.

2.3.1.6 Heating Installations

The heat source is hot water, coming from the new local boiler house, located next to the sea station.

The heating net is laid from the boiler house under ground. The pipelines are laid in covered RC ducts.

The pipelines shall be welded steel pipes and shall be heat insulated.

2.3.2 Marine Works

2.3.2.1 Layout, Arrangement

Drawing T.02.01 is showing the layout of marine structures. Project components are summarised as follows:

- . Land base for ferry ramps
- . Access bridge
- . Lifting towers (first row from land side)
- . Lifting towers (second row from land side)
- . Lifting towers (third row from land side) and stop fenders
- . Lifting towers (third row from land side) and base of central pier
- . Finger piers
- . Central pier
- . Head of central pier
- . Coastal embankment/land reclamation

2.3.2.2 Land Base for Ferry Ramps

To serve future needs of ramp motion with water levels varying between level -25 m and level - 30 m, the land base must be raised; but to reduce costs and taking into consideration the present water level it is decided to maintain existing ramp deck level at land base in the first phase. This entails rehabilitation of bearings and buffers. Minor concrete repair works shall also be executed.

2.3.2.3 Access Bridge

Existing substructure consist of reinforced concrete piles 350 x 350 mm in lengths of 12 - 14 m. Existing superstructure is a reinforced concrete slab, 6300 mm wide.

Existing access bridge shall be completely demolished.

A new steel access bridge shall be constructed. The bridge consists of 3 equal spans of 26 m U-shaped sections. Bridge supports are established as follows:

- Land base with steel sheet piles, concrete piles and a reinforced concrete super-structure
- 2 support reinforced concrete beams between bases of lifting towers
- Demolishing and concreting for a support in the rear side of pier base

Deck level varies from pier level in - 23.07 m to the existing level in -25.39 m. The result will be an inclination in the first span of about 0.082, which is considered acceptable.

Free height will be limited to 3.5 m by the existing control building on pier base exactly as it is limited today.

The passenger access bridge/sky walk is envisaged executed as a steel bridge at a higher level above access bridge using the same supports and with the same free spans. When crossing existing control building at the pier base it is planned to demolish parts of the top of this building to let the passenger bridge pass. For this purpose no installations should be placed in the mid section of existing control building.

2.3.2.4 Lifting Towers

A rectangular box (10.6 m x 5.6 m) of steel sheet piles forms the substructure in the first and second row. The concrete front towards ramp side is drawn back from steel pile front, and steel piles are cut at low level to allow ramp movements.

An irregular but almost rectangular box (14.5 m x 11.85 - 15.50 m) of steel sheet piles forms the substructure at the base of finger piers. At the same time the structure forms the first part of the finger pier.

An irregular box (15.4 m x 13.0 - 18.0 m) of steel sheet piles forms the substructure at the base of the central pier. At the same time the structure forms the first part of the central pier. Besides the building for the electrical system and control system is situated on the structure.

The inside of tower foundations are filled up with mass concrete, which is formed to create support for the steel structures, stop fenders, guiding fenders and pits for counterweights. The steel superstructures are towers for carrying the lifting mechanism and the counterweights.

To serve future needs of ramp motion with water levels varying between level -25 m and level - 30 m, lifting towers must be raised. Ramp deck levels at land base, lifting points and ramp end will vary as follows:

	Highest position level	Lowest position level
Land base	- 23.88 m (-23.88 m)	- 23.88 m (-23.88 m)
First row of towers	- 22.83 m (-22.64 m)	- 24.91 m (-25.12 m)
Second row of towers	-21.78 m (-21.40 m)	-25.94 m (-26.36 m)
Third row of towers	-20.67 m (-20.08 m)	-27.03 m (-27.67 m)
Ramp end	-20.50 m (-19.88 m)	-27.20 m (-27.88 m)

Design levels are laid out for the maximum inclination of 0.046 giving levels in () in the table.

Steel structures in existing towers shall be rehabilitated and reused. Tower foundations are raised by concreting as shown in table below:

	Existing level	Future level
First row of towers	-25.39 m	-23.00 m
Second row of towers	-25.39 m	-22.00 m
Third row of towers	-24.19 m	-21.00 m

Pits are designed to give the necessary space for motion of counterweights. The pits shall be rehabilitated and made watertight as follows:

- Existing counterweights are taken up
- Pits are pumped dry, cleaned and sandblasted
- A steel tank lining are installed to secure watertightness
- The volume between existing pit surface and lining are concreted
- Raising of substructures by concreting to level shown i table

New circular counterweights are constructed, eventually reusing some of the heavy steel from existing counterweights. Lay out design of counterweights include a well (manhole) for maintenance access to pits. Existing steel sheet piles are protected by sacrificial anodes

2.3.2.5 Finger Piers

Existing substructure consist of reinforced concrete piles 350 x 350 mm with toe levels varying from - 15.0 to - 16.3 m. Existing superstructure is a reinforced concrete slab 6200 mm wide and about 28 m's in length. A front wall of precast concrete units supports the guiding fenders. On top of the slab sand is filled in to top level of the pier. The finger pier is equipped with wooden guiding fenders supported by driven wooden piles. On the pier a lighting tower is placed.

Existing finger piers shall be totally demolished from pier end to base at lifting towers.

New shorter fingerpiers are established consisting of:

- Steel pipe piles foundation protected by sacrificial anodes
- A reinforced concrete superstructure anchored to existing tower support substructure
- Fenders

2.3.2.6 Central Pier

Existing substructure consist of reinforced concrete piles 400 x 400 mm with toe levels varying from - 16.5 to - 17.5 m. Existing superstructure is a reinforced concrete slab 12 m wide and 139.1 m's in length including pier head. A front wall of precast concrete units

supports the guiding fenders. On top of the slab sand is filled in to top level of the pier. The pier is equipped with wooden guiding fenders supported by driven wooden piles. On the pier a lighting tower is placed close to the pier head.

2.3.2.7 Demolition

Existing structures to be demolished are:

- All existing fenders and pile supports for fenders
- Front walls of precast concrete units
- Pavement
- All structures above concrete slab
- Taking up scrap material, broken piles etc. from the bottom

Existing slab and concrete piles support shall be a part of the rehabilitated structure to serve as relieving platform.

2.3.2.8 New Structures

The new pier structure is carried out as follows:

- Driving of a new steel sheet pile wall. The wall must be slightly inclined to avoid interference with existing concrete piles.
- Mutual anchoring of the walls on both sides the pier by anchors in every double pile.
- Sand are filled in between the walls up to slab level. It might be necessary to make interim holes in the slab to completely fill up the volume below the slab.
- Concreting of bollards- and fender supports.
- Filling in sand on top of slab.
- Installing of water outlets, water pipes, cables etc.
- Pavement

2.3.2.9 Quay Equipment

Fenders are designed to cover all levels of fender list belting of the ships ranging from the highest ship deck level at waterlevel - 25 m to lowest ship deck level at waterlevel - 30 m. New fenders are the pivot type to avoid fender panels to tilt into ships hull. Fenders are constructed with a closed box design for the panel minimizing the exposed surface area to be protected from corrosion. Corrosion protection will be a combination of painted surface and sacrificial anodes. Steel panel facing is designed to be a 60 mm UHMWPE (ultrahigh molecular weight polyethylene) plate covering the total front from level -20.00 m to -27.50 m.

Pivot support is a driven steel pipe pile and top fastening and energy absorption is created by two rubber fender elements of types as "Trellex MV". Rubber fender elements can be installed in three different positions depending of actual waterlevel.

Additional equipment to be installed are:

- Bollards per 30 m
- Sacrificial anodes on sheet piles
- Safety ladders

- Light
- Water supply
- Water outlets

2.3.2.10 Head of Central Pier, Dolphin

A rectangular box (7 x 12 m) of steel sheet piles filled with sand forms the existing sub-structure. A reinforced concrete quay wall is constructed on top of the sheet piles.

This existing pierhead shall be totally demolished. The new dolphin forming the pierhead is positioned about 20 m far out than the original to create better berthing and mooring conditions for the ferries which are longer than existing pier.

A TT-shaped prestressed reinforced concrete beam makes the access to the dolphin.

The dolphin consists of:

- A circular substructure of driven straight-web steel sheet piles filled up by sand
- A reinforced concrete superstructure as a sand filled box
- Fender supports
- Bollards
- Fenders

2.3.2.11 Coastal Embankment/Land Reclamation

To create additional land areas for the renovated ferry terminal the sea area west to the existing ferry terminal shall be reclaimed to reach an upper surface level of approximately -23,70 m.

The works shall comprise

- Removal of existing coastal protection and debris in the area
- Dredging of layer of soft soil deposits, if actual
- Filling, levelling and compaction of fill

The horizontal dimension of the reclaimed area will be approx. 0,6 ha.

The reclamation shall be done using proper sand fill (possibly from sea), properly compacted to allow direct foundation of buildings works and roads.

The reclaimed area shall be protected from the sea side by a properly designed and constructed coastal protection. The crest level of the embankment shall be -23.00 in BSL and it shall be extended also to cover the existing embankment protecting the existing reclamation. The embankment shall be made from core of gravel with cover layers of armour stones.

2.3.3 Ramp Structures

It is the objective of the project to reuse as much as possible of the original structure of the access ramps and the operating machinery, which for many years of service have proven records of reliable operation. Changes may be necessitated by deterioration, damages and accommodation to the future requirements for the operation of the terminals. Therefore the works start with the dismantling of the whole ramp structure incl. lifting tower for a detailed inspection on land, which may reveal weak points in the structures.

2.3.3.1 Elevating of Ferry Access Ramps

The existing ferry access ramps shall be relocated to adjust to the future water level variations.

The machinery shall be modified so as to allow for all three spans of the ramp to be positioned with a slope of maximum 4.6 % in upward as well as downward direction.

In the foreseeable future a maximum slope of 3.8% in both directions should be sufficient for the ferry terminal operation rendering a maximum allowable difference in ships position of 6.6 meters.

2.3.3.2 Structures of Ferry Access Ramps

The Wooden deck of the ramp spans shall be replaced with a deck of Ekki or Azobé timber.

The strength of the Azobe wood is such that the span between the supports of the timber may be maintained as it is on the existing structures, and yet the deck will be able to resist the design load from vehicles.

The steel structures of the ramp spans shall not be changed unless proven unable to resist the design loads agreed upon or unless they have been damaged or deteriorated decision shall be taken in agreement with Employer following the detailed inspection, testing and verification by the Contractor.

Since the rail switches on the seaward span of the ramps are not used (as the ferries have only two connecting rail tracks) the switches shall be omitted and only two straight tracks be provided. The existing rail, type P43, shall be replaced by rail type P65.

2.3.3.3 Machinery for the Ferry Access Ramps

2.3.3.3.1 Existing Machinery

In principle the existing machinery may be used with the following modifications:

- The lifting towers are raised to an elevation corresponding to the new elevation of the ferry ramps.
- The spindles and the counterweight wires for machinery in rows 1 and 2 are replaced with longer ones allowing for the increased slope of the spans.

- Wires for the lifting machinery and counterweights at row 3 are replaced with longer ones for the added travel length of the span.
- Counterweight mass shall be increased in accordance with the increased mass of the wooden decks.

Other modifications are not foreseen unless the towers or machinery are proven unable to resist the design loads as agreed upon or unless they have been damaged or deteriorated.

2.3.3.3.2 Alternative: Hydraulic Machinery

It is possible to remove the lifting towers at rows 1 and 2 and replace the towers with steel columns for suspension of oil hydraulic cylinders for operation of the ramp spans no. 1 and 2.

Using hydraulic cylinders for the operation will make the use of counterweights unnecessary, and the counterweight pits may be filled with concrete.

In order to carry the live load, the spans shall be equipped with hydraulically operated sliding bolts or similar locking devices.

The machinery at row 3, however, can not in a simple way be operated by hydraulic machinery as the counterweights are necessary to reduce the weight of the third span at the ferry support and as the stroke length of the cylinders would be too long.

2.3.3.4 Electrical Installations

2.3.3.4.1 General

The electrical installations on the ferry ramps and piers are of old construction and worn-out.

Generally, all the electrical installations (cable trays, cables, limit switches, motors, switchboards, control boards, lighting fixtures, etc.) shall be changed. The following chapters describe in outline the work to be done in the different areas.

It shall be emphasised that during the whole construction period shall the Contractor organise the electrical work in a way making it possible to operate the left ramp system when right ramp system is renovated and vice versa.

2.3.3.4.2 Power Supply to the Ramp System

For the time being, the whole ramp system is supplied from 3 (3x150 + 1x70 Cu cables. These cables shall be used in the future for supply of the new installations.

2.3.3.4.3 The Ramp Control Building

From this building the ferry ramps are controlled.

All the electrical installations in this building shall be changed. The Contractor shall organise the work in the building in a way making it possible to operate one ramp side during the renovation.

After renovation, electrical heating in the managing centre shall be delivered and installed

2.3.3.4.4 Lifting Tower Buildings

All the existing electrical installations in these 6 buildings shall be totally replaced. After the building and the machinery has been repaired and renovated, the new electrical equipment can be installed.

2.3.3.4.5 Outdoor Lighting Installation

The outdoor installations on the piers and the buildings shall be total new installations.

New masts (3 nos.) shall be furnished, each 25 m high.

2.3.3.5 Ramp Control System

The existing way to move the ramps with electrical motors, gears and counterweights shall be retained but the total electrical installations and materials (motors, limit switches, control boards, cables, breaks, etc.) shall be changed to new materials and new technology. Further, the motor control shall be changed from slip ring AC motors to frequency controlled AC motors.

The existing control system is based on relay systems. The new control system shall be based on a PLC system and relay system.

The control system shall not be based on a 2 wire loop system but hard wired from the lifting towers to the PLC placed in the main switchboard.

The emergency operation system (electrically) in each lifting tower shall be designed independently of the PLC system. These systems shall be hard wired and it shall be possible to run the systems locally with the PLC out of order, but in a safe way.

In each lifting tower and in each of the control panels emergency stop systems shall be installed.

2.3.4 Railway Works

No major railway works are to be carried out in the first phase of the project. Inside the railway yard itself, only a walkway alongside the inspection track shall be constructed. The inspection walkway, 1.0 m wide, shall be paved with asphalt as a footpath. Otherwise, only minor changes in connection with replacement of rails on ferry ramps and repair of road/rail crossing at the access road and installation of new crossing at the container road shall be executed.

2.3.5 Border Control Building

2.3.5.1 Architectural Layout.

Border Control Building is shown on dwg. T.06.01. It is one-storey building which should be shared by the custom-house, water police and frontier-guards. The building dimensions are 12,4m x 27,4, the height is 3 m from the floor level up to the ceiling.

External doors are plastic coated aluminium. There are veneered wood doors in the office rooms.

The floor of the office rooms is parquet. The floor of toilets is covered with ceramic tiles. The floors in halls, corridors, rooms for customs examination are covered with marble plates.

The ceilings are suspended.

The walls in the office rooms are oil painted, walls of sanitary rooms are faced with tiles.

The facades are plastered with high-quality decorative plaster and painted.

2.3.5.2 Structural Design

The walls are made of blocks with the thickness of 40cm. The walls are plastered and painted from inside. The overhead covers are pre-fabricated RC hollow panels with the length of 5,86 m, supported by the longitudinal walls 1, 2, 3. The roof water insulation is 3 layer fibreglass felt for heat insulation, blinding, etc.

Direct foundation is utilised constructed as strip monolithic beams of RC on strip slabs. Moisture preventive actions are prescribed. The floors of the ducts are pre-fabricated RC plates.

The sheds covering the traffic lanes have dimensions 22.3x18 m, height 5.5 m.

Direct foundation with strip monolithic beams of RC on strip slabs.

The bearing steel columns are steel pipes.

The roof structure is a pre-fabricated steel structure, covered with galvanised steel plates.

2.3.5.3 Electric Installation

Lighting of the building consists of fluorescent lamps, built-in the suspended ceiling.

Telephone and radio network and fire alarm system are installed in all rooms.

Fluorescent lamps, telephone and radio network is installed in the cabins in the sheds areas.

If installed, traffic lane barriers shall be electrically operated from cabins.

At the underside of the shed covers high durable fluorescent lighting fixtures are mounted.

The islands between the traffic lanes under sheds shall have identification lights to provide safe driving for vehicles.

2.3.5.4 Water, Sewerage

Water-supply network is made of galvanised steel pipes.

Sewage network is made of cast iron pipes.

Sewage network is placed under the floor in ducts. Pipe works above floors are visible.

2.3.5.5 Heating and Ventilation

There shall be a two pipe water heating system with lower separation. The pipelines shall be laid in the floor ducts canal.

Ventilation is mechanical. Air conditioning is installed. "ROOFTOP Heat Pump" type conditioner is to be installed on the roof.

2.3.6 Public Service Building

2.3.6.1 Architectural Layout

Public Service Building is shown on dwg. T.08.01. The public service building is one-storey building, with dimensions 10x12.4 m and with a height of 3.0 m. The building is located at the marshalling area for vehicles. The structure is divided in two parts:

- kiosks, telephones, buffet
- toilets for men and ladies

The buffet floors are of marble, in the toilets they are made from ceramic tiles.

Walls in the buffet shall be painted with oil paint, in the toilets walls are to be covered with ceramic tiles.

The inside walls are wooden, covered with veneer.

Outside facades of the building are plastered with high-quality decorative plaster and painted.

2.3.6.2 Structural Design

Direct foundation is utilised constructed as strip monolithic beams of RC on strip slabs. Moisture preventive actions are prescribed. The floors of the ducts are pre-fabricated RC plates.

Outside walls shall be from blocks with a thickness of 40 cm.

The roof decks are RC, pre-fabricated hollow slabs. The length is 5.86 m and 7.06 m.

2.3.6.3 Electric Installations

Indoor lighting consists of fluorescent lamps in the kiosk and in the cafeteria, and by glow lamps in the toilets.

Telephone and radio network and fire alarm are installed in all rooms except toilets.

2.3.6.4 Water, Sewerage

Water-supply network is made of galvanised steel pipes with $d=15-50$ mm.

Sewage network is made of cast iron pipes.

Sewage network is placed under the floor in ducts. Pipe works above floors are visible.

2.3.6.5 Heating and Ventilation

There shall be a two pipe water heating system with low distribution pipe¹. The pipes are laid on the surface, along the wall.

Mechanical ventilation in toilet and wash basin (kitchen) areas.

Air conditioner is to be installed in the hall.

2.3.7 Modification of Sea Station in Turkmenbashi

2.3.7.1 Architectural Layout

The following description refers to dwg. T.05.01. The existing Sea Station Building in Turkmenbashi has recently undergone total repair. However, to arrange the necessary facilities for customs and police check of passengers after the new passenger bridge has been introduced, a modification and extension of the building is proposed.

The existing yard is proposed to be covered with glass elements. On the ground floor of the covered yard, the following additional facilities will be constructed:

- ticketing office
- customs and police check area
- hall for arriving passengers
- offices for police and customs

On the first floor there will be connection to the new passenger bridge.

For a convenient operation of the existing Sea Station, staircases and balconies, connected with a passenger bridge, shall be added.

¹ The low distribution system means that main distribution is located at the bottom or in a basement of buildings, for the upper distribution system the pipeline must pass through roof.

Window frames and doors of aluminium. Floors in halls and checking area will be of marble. In the offices, the floor will be parquet. Inside walls and columns in the halls will be covered by fire-proof materials and in the offices, walls will be covered by paint and wallpaper.

2.3.7.2 Structural Design

Staircase elements are pre-fabricated RC steps and steel substructure.

The balconies are made of U-profile steel beams and a light floor.

2.3.8 Ticketing Terminal Building

2.3.8.1 Architectural Layout

The following description refers to drawing T.07.01.

The dimensions are 6.4x10.0 m. The building is one-storey with rooms for work, rest, kitchen and toilet. The rooms have a height of 2.70 m.

Floors in the rooms and in the corridors are parquet. In the toilets they are covered with ceramic tiles and with linoleum in the kitchen.

Ceilings are painted with water-emulsion paint.

Outside windows and doors are of PIMAPEN type, the inside doors are wooden and veneered.

Walls shall be painted with oil paint. In the toilets walls are to be covered with ceramic tiles.

Facades are plastered with high-quality decorative plaster and painted.

2.3.8.2 Structural Design

Direct foundation is utilised constructed as strip monolithic beams of RC on strip slabs. Moisture preventive actions are prescribed.

Outside walls shall be from blocks with a thickness of 40 cm.

The roof decks are RC, pre-fabricated hollow slabs. The length is 5.86 m, supported by longitudinal walls. Water insulation of the roof has to be performed from 3 layers of fibre glass felt on heat insulation, blinding, etc.

The shed above the traffic lanes has dimensions 22.5 x 12 m, h = 5.5 m.

Direct foundation is utilised constructed as strip monolithic beams of RC on strip slabs.

Carrying steel columns are made from steel pipes.

The shed roof is a pre-fabricated steel structure, welded and covered with steel galvanised plates.

2.3.8.3 Electric Installations

All lighting of rooms consist of fluorescent lamps except by glow lamps in the rest rooms. Lighting under the shed is performed with high durable fluorescent lighting fittings, installed in the pre-fabricated steel structure of the shed roof.

Lighting of the ticketing cabins shall be executed by fluorescent fixtures.

If installed, traffic lane barriers shall be electrically operated from the cabins.

The islands between the traffic lanes under the shed shall have identification lights to provide safe driving for vehicles.

Telephone and radio nets are installed in all of the cabins and offices. The fire alarm net is included.

2.3.8.4 Water, Sewerage

Water-supply network is made of galvanised steel pipes.

Sewage system for the sanitary devices, wash basins and w. c. pans is made of cast iron pipes.

Sewage network is placed under the floor in ducts. Pipe works above floor are visible.

2.3.8.5 Heating and Ventilation

A two pipe water heating system with low distribution system is prescribed. The pipelines shall be mounted visible on the floors, along the wall. Double control cock is installed on the supply pipe.

Natural ventilation in toilet.

Air conditioners to be installed in offices.

2.3.9 Passenger Bridge/Sky Walk

2.3.9.1 Structural Design

The basic carrying structures are steel space frames and RC columns.

Roof of the bridge is galvanised steel plates.

Floor of the bridge is steel plates covered with asphalt.

Direct foundations on in situ cast slabs is utilized.

Sides of the structure are made of steel nets with small mesh.

2.3.9.2 Lighting, Electric Installations

The lighting is carried out by lighting fittings with glow lamps, installed on the ceiling each 10 m along the whole passenger bridge.

2.4 Planning of Works

The General Time Schedule for the execution of the works under this contract is shown hereafter in Figure 2.4-1. According to clause 14 of VOL.II, Part 1. Contract Conditions, of this contract, this Time Schedule shall be detailed by the Contractor shortly after the award of contract.

The detailed execution time schedule prepared by the Contractor shall respect the completion dates indicated in the General Time Schedule and allow the identification of all major operations of significance for the execution of the works under this contract (execution documents, ordering, provisioning, preparation, execution, testing, approbation, completion, etc.). The approbations by the Engineer as required by the contract shall be clearly marked and sufficient time shall be provided during the execution period.

The Contractor shall allow a reasonable margin of time for contingencies. He shall also state his intentions regarding shift works.

In the detailed time schedule the Contractor shall make due allowances for all requirements specified in other clauses of this specification and he shall take into account the seasonal change of weather conditions.

In the present project it is of particular importance that the planning presented takes into account that the ferry terminal shall be kept operational during the whole of the construction period. This shall be obtained by phasing the works, renovating only one berth and ramp at the time. The critical paths of this planning, assumed to be the finishing of substitution works for works to be demolished and the completion of the renovation of the first ramp before the work on the second one can be started, shall be clearly indicated including reasonable margin of security. Also the road and rail traffic through the construction site and border control operations during the period of construction shall be planned in detail and necessary traffic regulation measures be taken by the Contractor before the different phases of the construction works can begin.

Once approved by the Engineer the detailed time schedule shall be strictly adhered to unless any alterations are to be found to be necessary during the construction of the works and are confirmed in writing by the Engineer.

Renovation of Ferry Terminal - Turkmenbashi
 Planning of Works

ACTIVITY	M O N T H S																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
O1 Contract of works																						
i2 Mobilization																						
i3 Land works																						
- Demolition																						
- Reclamation																						
- Filling, levelling																						
- Road works																						
O4 Marine works:																						
- Central pier																						
- Finger pier 1																						
- Finger pier 2																						
- Ramp support 1																						
- Ramp support 2																						
- Access bridge																						
- Fenders 1																						
- Fenders 2																						
- Coastal protection																						
O5 Ramp works:																						
- Part 1																						
- Part 2																						
- Control systems																						
O6 Railway works:																						
- Part 1																						
- Part 2																						
O7 Building works																						
- Passenger terminal modification																						
- Other buildings																						
- Passenger bridge																						
O8 Completion (commissioning)																						

3. TECHNICAL SPECIFICATIONS

3.0 General Aspects

3.0.1 Documents

These Technical Specifications shall be read in conjunction with the Contract Drawings and the General Description in section 2, regarding the works to be executed and the technical manner of their execution.

If not specified otherwise the land works shall be executed in accordance with the relevant Soviet Standards (СНП) and Codes of Practice like ГОСТ and the marine works shall be executed with relevant international norms like EUROCODES, etc.

A copy of all documents governing these works (codes and standards included) shall at all times be available in the Contractor's site office.

If in this specification the practice is adopted of specifying a particular item as "similar" to that listed in a particular firm's catalogue, it is to be clearly understood that this is to indicate the type and quality of the equipment required. No attempt is being made to give preference to the equipment supplied by the firm, whose catalogue is quoted.

Wherever reference is made in the contract to specific standards and codes to be met by the materials, plant and other supplies to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards which ensure substantially equal or higher performance than the standards and codes specified will be accepted subject to the Engineer's prior review and written approval.

Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure substantially equal performance, the Contractor shall comply with the standards specified in the documents.

3.0.2 Materials

All materials, equipment and accessories are to be new and of the highest quality; uniformity of type and manufacture of equipment or accessories is to be preserved as far as practicable throughout the whole work.

The Contractor shall, if required by the Engineer, submit samples of materials to the Engineer for approval before placing an order.

All equipment and materials supplied shall be suitable for continuous use in Azerbaijan/Turkmenistan and the particular climatic conditions specified elsewhere in the Tender Documents.

3.0.3 Workmanship

The work shall be carried out corresponding to the best international standards by competent workmen under skilled and experienced supervision. The Engineer shall have the authority to have any part of the work taken down or changed, which is executed in a manner unsatisfactory to the Employer.

The Contractor will be entirely responsible for all materials, apparatus, equipment etc. furnished by him in connection with his work, and shall take all special care to protect all parts of finished work from damage until handing over has taken place.

3.0.4 Mobilisation and Demobilisation

Mobilisation of the site shall include all the Contractor's general obligations according to the Administrative Conditions, hereunder:

1. Transport, provision and installation of general plant and equipment including supply of water, power etc. throughout the contract period as required for the execution of the temporary and permanent works.
2. Construction and maintenance of all necessary access roads to and within the port area and the borrow pits etc.
3. Establishment of basic set out lines. The Contractor shall also undertake all detailed setting out.
4. Provision of housing and welfare facilities for the Contractor's employees including supply of water, power and all necessary arrangements for the proper discharge of sewage and drainage.
5. Survey Assistance as required from time to time by the Engineer including a full time topograph.
6. Site laboratory for testing of concrete, aggregates, sand, bitumen etc., with the necessary moulds, press, sieves, instruments etc.
7. Provision of Engineer's office at the working site close to the Contractor's site office, contained in a good quality building of around 100 m² divided into 3 offices, meeting room with capacity for 15 persons, copying room, store and archive, tea room and bathroom with flushing toilet, shower and handwash basin.

Furnishing of the above mentioned office completely with furniture and equipment, international telephone installation, ventilation, electricity, lighting and air-conditioning as required.

Furniture and equipment shall include, but not be limited to:

- 5 no. office desks.
- 1 no. drawing desk with drawing machine.

- 8 no. office chairs.
- 1 no. meeting table with 15 chairs.
- 2 no. steel filing cabinets each of about 0.5 m³ volume.
- 1 no. steel filing cabinet for drawings.
- 1 no. plain paper copying machine (A4 and A3 size).
- 1 no. drawing printing machine.
- appropriate shelving.
- 1 no. refrigerator.
- 2 no. telephones.
- 2 no. PCs including laser printer.
- 1 no. telefax machine.

The Contractor shall maintain all the above mentioned facilities in good and workable condition and provide supply of water, electricity, paper, discharge of sewage etc. during the whole period of the works

8. Provision of the necessary survey equipment for the use of the Engineer: 1 Theodolite with tripod, 2 levelling instruments with tripods and staffs, 2 steel measuring tapes of 50 m, surveying poles as needed.
9. Provision, maintenance, operational costs (all risk insurance, immatriculation etc.) and fuel supply of two new four wheel drive diesel machines, min. 2.5 l engine (like TOYOTA LAND CRUISER) and one driver through the whole construction period for the use of the Engineer. Vehicles shall be air-conditioned.

In case vehicles are out of service (accidents, maintenance etc.) they shall be temporarily replaced by the Contractor.

10. Provision of marine transport as required from time to time by the Engineer.

All arrangements and details in connection with the above items shall be subject to the approval of the Engineer.

Items in 6, 7, 8 and 9 above are to be handed over to the Employer upon completion of the works.

Demobilisation shall include removal of all construction plant, temporary works, surplus materials, debris, wastes etc., and clean-up of the site in a satisfactory manner as specified in the Administrative Conditions.

3.1 Geotechnical Investigations

3.1.1 Extent of Works

For description of existing information on soil conditions, reference is made to Section 2.2.2.5.

The geological/geotechnical investigation shall comprise

- a desk study of the geology in the Terminal area

- 3 nos. geotechnical borings located at the Ferry pier of which 2 nos. has to be performed through the existing pier, preliminary depth to level -50
- 4 nos. geotechnical borings located at the new coastal protection north of the Ferry Pier, preliminary depth min. 5 m into the lower clay layer
- 2 nos. geotechnical borings located at the Passenger Bridge, preliminary depth min. 5 m into the lower clay layer
- 1 no. geotechnical boring located at the Passenger Terminal, preliminary depth min. 5 m into the lower clay layer
- 1 no. geotechnical boring located at the New Public Service Building, preliminary depth min. 5 m into the lower clay layer
- 3 nos. geotechnical borings located at the New Border Control Shed for leaving traffic, preliminary depth min. 5 m into the lower clay layer
- 2 nos. geotechnical borings located at the New Border Control Shed for in-coming traffic, preliminary depth min. 5 m into the lower clay layer
- 2 nos. geotechnical borings located at the New Border Control Building, preliminary depth min. 5 m into the lower clay layer
- 1 no. geotechnical boring located at the New Ticketing Building, preliminary depth min. 5 m into the lower clay layer

A preliminary number of 18 geotechnical borings are to be expected, of which 5 nos. are located off-shore, 2 nos. on the existing pier and 11 nos. on-shore.

Location of all borings shall be surveyed with respect to coordinates, and the ground/sea bed level shall be established by levelling/sounding at each boring location.

In all borings representative samples shall be taken each meter, at least one sample of each layer. A representative number of these samples shall be undisturbed samples for advanced laboratory testing.

In-situ tests for estimation of strength and/or deformation properties of the soils shall be carried out, i.e. SPT-tests, CPT-tests, vane tests or similar internationally acknowledged test methods.

Stand pipes shall be installed in all on-shore borings for measuring of the phreatic surface.

Laboratory investigation of the extracted samples shall comprise

Classification tests

- a geological description of each sample incl. geological age and deposit
- moisture content of selected, representative samples
- bulk density of selected, representative samples

- Atterberg limits of selected, representative samples
- grain size distribution by sieve or hydrometer analysis of selected, representative samples

Advanced laboratory tests

- oedometer tests
- unconfined compression tests
- consolidated undrained triaxial tests

All laboratory investigations shall be performed according to internationally acknowledged procedures and specifications.

A geotechnical report shall be issued based on the geological desk study, field and laboratory investigation comprising

Text part

- description of the equipment and methods used in the investigation
- description of the general geology of the area
- description of the ground water levels in the area
- evaluation of soil conditions for each building and structure, including strength and deformation properties. Recommended designed criterias for stability analysis, sheet piling, driven piles, shallow and/or deep foundation shall be given.
- if special requirements are needed during construction, such as ground water lowering, temporary sheet piling or similar, advise on this shall be given

Enclosures

- Site plan showing boring location
- detailed boring logs
- tables and figures showing all relevant laboratory results

3.1.2 Documents

The preliminary location of the boreholes are shown on drawing no. T.01.08

Reports on previous geotechnical investigations are available for review at Ramboll office, Baku:

- Kasporniiproekt: "The Sea Port in Krasnovodsk. Technical-Working Project of Reconstruction of The Ferry Terminal. Technical Report about engineering investigations. Part III Engineering and geological conditions, 1979"

3.1.3 Equipment

All borings shall be performed using shell and auger, percussion or rotary wash technique in minimum 6" casing.

Off-shore borings shall be performed from floating barge or jack-up platform.

The Contractor shall not later than one month after contract submit a description of equipment and procedures for boring operations and laboratory investigations, incl. time schedule for the complete survey, to the engineers approval.

3.1.4 Execution of Works

All key personnel (team-leader, drill-master, geologist/geotechnician) shall be experienced in performing on- and off-shore geotechnical survey to ensure excellent workmanship in all operations.

3.2 Demolition Works

3.2.1 Extent of Works

3.2.1.1 Marine Works

The Contractor shall remove existing structures in compliance with the specifications and as shown on the drawings.

The works comprise:

- access bridge (reinforced concrete slab on concrete piles)
- pavement on central pier
- removal of fill in existing superstructure of central pier
- existing fender system including bearing piles
- quay walls in central pier
- pier head including concrete superstructure, fill behind sheet pile walls and sheet piles
- the total demolition of existing finger piers including concrete superstructure, fenders and concrete bearing piles
- cleaning of bottom in the berths for waste and debris and pile ends rising over bottom level
- existing railing on lifting tower substructures

In general existing concrete surfaces shall be cleaned and sandblasted where new concrete are to be poured against the surface.

3.2.1.2 Land Works

The Contractor shall remove existing structures in compliance with the specifications and as shown on the drawings.

The works comprise demolition of pavements, buildings, walls, fences, etc. and also a full cleaning and removal of equipment and debris (rubbish) in the boundaries of specified territories and on the whole site, if it is required for the work execution, and in general the works shall be performed by the Contractor as prescribed by the Engineer.

3.2.2 Execution of Works

3.2.2.1 General

Execution methods shall be approved by the Engineer and must in no way cause any damage or risks to persons or property on or off the site. Utmost care shall be taken, when demolition or excavation takes place close to electricity distribution cables, telephone cables, sewerage, oil pipes, water supply pipes, etc. The execution methods and the execution including the necessary safe precaution remain the sole responsibility of the Contractor and any damage to property not to be demolished or persons shall be fully repaired by him and on his account.

Unless otherwise stated all demolished structures shall belong to the Contractor and shall be removed from the site on his expense. No dropping of demolished structures into the water is allowed. Removal can be done to a quarry approximately 11 km from Turkmenbashi. Selection of dumping site, work arrangements and approvals required for disposal of waste materials remain the sole responsibility of the Contractor and all costs in this connection shall be carried by him.

Planning of the demolition works shall ensure that proper substitution building works and facilities are completed and made operational before demolition of works to be substituted are executed.

3.2.2.2 Marine Works

3.2.2.2.1 Access Bridge

All structures shall be removed to at least existing bottom level.

3.2.2.2.2 Pavement on Central Pier

Concrete pavement shall be totally removed.

3.2.2.2.3 Removal of Fill in Existing Superstructure of Central Pier

For the execution of rehabilitation works on central pier all fill materials must be removed. Suitable sand materials can be stocked on land for reuse in rehabilitated structure.

3.2.2.2.4 Existing Fender System Including Bearing Piles

Some parts of the fender system have already been removed. The Contractor must by inspection on Site estimate the extent of the works. The whole fender system including timber, rubber, steel, piles and cast in items shall be totally removed.

3.2.2.2.5 Quay Walls in Central Pier

Quay walls and parts of the slab shall be demolished according to drawings. For good connection to new concrete reinforcement shall be left sticking out of fracture surface, which shall be sandblasted. No spill to sea bottom will be allowed.

3.2.2.2.6 Pier Head

Existing pier head is constructed as a rectangular strong point as a backfilled sheet pile structure. All sheet piles shall be pulled up without leaving any part left in the sea bottom. All concrete superstructure, fill behind sheet pile walls and sheet piles shall be removed.

3.2.2.2.7 Finger Piers

Both finger piers starting at sheet pile substructure for lifting towers at the base shall be totally demolished. Concrete piles shall be cut down to design bottom level in - 36.00 m. All concrete superstructure, fill and concrete piles shall be removed.

3.2.2.2.8 Cleaning of Bottom in the Berths

Sea bottom around central pier and its base, finger piers and base shall be cleaned for waste and debris and pile ends rising over bottom level. According to divers inspection a lot of scrap and building materials can be seen at the bottom. Remains from former wooden and steel piles are rising over the bottom.

3.2.2.3 Land Works

No plantation is to be removed or damaged without prior approval from the Engineer.

The Contractor shall demolish or remove all concrete and other materials in superstructure, foundations, etc. at least to a level of 0,80 m below ground level and to a level without interference with new structures and installations or existing structures and installations to be maintained.

Pavements shall be demolished to the extent necessary for the execution of foundations, floors, pipes, etc. and for the renewal and remodelling of pavements.

List of Buildings and Structures to Be Demolished at the Ferry Terminal in Turkmenbashi, see also dwg. no. T.01.01

Building No.	Name of buildings and structures	Floors	Dimensions, in m	Description	
				walls	roof
1	Cafe "Volna"	1	40×6	wooden	asbestos cement
2	Workshop	2	15×6	masonry	asbestos cement
3	Transformer substation	1	10×6	masonry	bitumenous felt
4	Carwash	1	20×10	masonry	bitumenous felt

In some cases, the demolition shall be executed as a dismantling of the structures allowing for re-utilisation of the whole or part of the structures and/or installations. Example is the substation equipment (3). Final decision on which works to be demolished and/or to be dismantled in phases shall be taken on site by the Engineer.

3.3 Earthworks, Dredging

3.3.1 Extent of Works

3.3.1.1 Marine Works

The works covered in this chapter are all earth- and dredging works required for this project in connection with

- Bathymetric survey in berth areas
- Necessary dredging around the ferry berths if actual
- Dredging of soft soil deposits in reclamation area if actual
- Disposal of dredged materials if actual
- Depth soundings of dredged areas with a steel profile or similar lowered to guaranteed bottom level. The soundings must cover the total dredged bottom and the steel profile must not meet any hindrance.
- Bathymetric survey after finalization of the works.
- Sand filling behind sheet pile structures
- Sand filling in pier superstructure
- Sand in land reclamations

3.3.1.2 Land Works

The works covered in this chapter are all earthworks required for this project in connection with

- Topographic survey of land area of terminal before start of works.
- Excavation for foundations, installations and others.
- Sand filling and levelling for yards, road areas and building grounds.
- Back filling after completion of structural and installation works.

- Topographic survey after completion of works.

3.3.2 Documents

Marine Works:

British Standard BS 6031: Code of practice for earthworks.

British Standard BS 1377: Methods of test for soils for civil engineering purposes.

Land Works:

СНиП 3.02.01-87 "Earth structures. Rules for execution of works" and СНиП 3.02.01-83* "Foundation base. Rules for execution of works".

3.3.3 Materials

The following general definitions of earthworks materials shall apply to this and other Clauses of the Specification, in which reference is made to the defined materials.

1. "Top Soil" shall mean the top layer of soil that can support vegetations.
2. "Suitable material" shall comprise all that which is acceptable in accordance with the Contract for use in the Works, and which is capable of being compacted in the manner specified to form a stable fill.

"Suitable material" for filling in reclaimed areas shall at least fulfil the following specifications:

Ignition loss < 1%
No content of lumps of silt or clay
Max. 10% of particles with diameter < 0,075 mm.
Max. 50% of particles with diameter < 0,2 mm.
The coefficient of uniformity shall be
 $U = d_{60}/d_{10} > 1,75$

Outside construction and road areas "suitable material" shall be a cohesionless, compactable material with max. 20% of particles with diameter < 0,075 mm.

"Suitable material" for filling in behind sheet piles, pier superstructure and where sand is specified in drawings only clean sand can be allowed.

If there exists a divergence between the Engineer's and the Contractor's opinion of "Suitable Material", the Engineer takes the final decision which shall be respected by the Contractor.

3. "Unsuitable material" shall mean other than suitable material and shall include:
 - Material from swamps, marshes or bogs.
 - Peat, logs, stumps, and perishable material.

- Material susceptible to spontaneous combustion.
- Clay of liquid limit exceeding 50 and/or plasticity index exceeding 20.
- Materials having a moisture content greater than the maximum permitted for such materials in the Contract, unless otherwise permitted by the Engineer.

Dredging Equipment

The works shall be performed by one or more of the following types of equipment:

- Bucket dredger.
- Cutter suction dredger.
- Hydraulic excavator mounted on a pontoon, barge or ship.
- Crane with grab mounted on a pontoon, barge or ship.
- Barges for transportation of dredged material.

The Contractor shall at any time use the equipment most suitable for the execution of the works taking into account soil conditions as well as other working conditions.

3.3.4 Execution of Works

3.3.4.1 Earth Works

3.3.4.1.1 Setting Out and Measurement

Before starting up any site works, the Contractor must prepare a new topographic/bathymetric survey of the site in the presence of the Engineer and to be approved by the Engineer as basis for payment of works.

The Contractor shall establish all setting out for these works. The setting out shall be approved by the Engineer but the Contractor remains the only responsible for the correctness.

At the completion of the different phases of the earth works the Contractor shall carry out necessary site surveys to document the completion, before payments can be effectuated.

3.3.4.1.2 Site Clearance

The Contractor shall clear all areas of the site for grass, bushes, rubbish, top soil if any, etc., where works shall be executed and where required by the Engineer.

He shall remove all debris to approved dumping sites and no debris shall be deposited except on such sites.

3.3.4.1.3 Excavation

The Contractor shall prior to the commencement of excavations provide a plan for the execution of the work for the approval of the Engineer.

Utmost care shall be taken when excavation is close to permanent structures like oil pipes, sewage systems etc. Precautions taken, in order to safeguard all permanent structures and all repair of damages on these, shall be the sole responsibility of the Contractor and hence be on his account.

Excavation of the soil in trenches may be carried out mechanically except for the last 10% of the volume which shall be carried out manually.

When the earthworks are to be carried out below ground water level, special measures for water collection and pumping shall be carried out throughout the construction period.

It is necessary to follow the safe operation terms according to СНиП III-4-80* when the earthworks are being carried out.

The safety of the excavation is the sole responsibility of the Contractor and the Contractor shall assure himself of the adequacy of temporary supports.

Where the excavation reveals a combination of suitable and unsuitable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the suitable materials are excavated separately for use in the works without contamination by the unsuitable materials.

All suitable material from cuttings shall be used as far as possible as fill in backfillings.

The Contractor shall not borrow or waste material without the approval of the Engineer.

Disposal of excess fill and unsuitable fill shall be out of the Port area as directed by the authorities and approved by the Engineer.

Any pockets of soft material or loose rock shall be removed and the resulting cavities and any large fissures filled according to the specific instructions of the Engineer.

Any excess excavation shall be made good by backfilling with suitable material compacted in accordance with the specifications for overlaying layer. All excavations shall be inspected and approved by the Engineer prior to commencement of any permanent work.

3.3.4.1.4 Backfilling/Filling

Prior to any backfilling the Engineer shall be informed in due time for inspection of the area meant for the backfilling.

Dredged materials used for land reclamation must be clean sand without contents of clay or other not suitable materials. In general the Contractor shall have the permission to use dredged materials in backfilling by the Engineer.

For sand filling behind sheet piles only clean sand are allowed. If suitable the sand can be delivered from the sea bottom.

All earthwork material placed in cuttings or elsewhere shall be deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction plant used.

Normally, backfilling in layers of 20 cm (compacted) will be acceptable.

Special methods of compaction are to be utilized over areas inaccessible to rollers or other heavy compaction plant.

If the material deposited as fill subsequently reaches a condition such that it cannot be compacted in accordance with the requirements of the Contract, the Contractor shall either:

- a. Make good by removing the material until it is in a suitable physical condition for reuse, and replacing it with suitable material.
- b. Make good the material by mechanical or chemical means to improve its stability.
- c. Cease work on the material, until its physical conditions is again such that it can be compacted as described.

The Contractor is to take particular care in placing and compacting filling around pipes, cables, structures, and the like, and is to take such steps as may be necessary to prevent damages to these.

3.3.4.1.5 Borrow Pits, Land and Seawards

The Contractor shall be solely responsible for the selection of borrow pits and all arrangements, approvals and costs involved in their exploitations. The Contractor shall obtain the Engineer's approval for the site of borrow pits. The Contractor shall leave all borrow pits in a tidy and regular state, and he shall ensure that they are self-draining at all times and do not constitute a danger to health or safety.

The Contractor shall notify the Engineer sufficiently in advance of the opening of the borrow pit so that elevations and measurements may be taken of the surface of the borrow material after stripping, and so that any testing may be carried out.

3.3.4.1.6 Compaction

Fills of soils shall be compacted at a moisture content within +/- 2% of optimum moisture to the following density values corresponding to those obtained by the Standard Proctor test:

Fills in constructional and pavement areas: 100%

Fills in other areas: 95%

The Contractor shall, before start of the forming of fills, on trial sections constructed of typical soils, determine the number of passes required by his compaction plant to obtain the above specified densities at optimum moisture content and at intended layer thickness.

The compaction of fills shall hereafter proceed by subjection each layer to the number of passes determined as above in a systematic and orderly manner to ensure appropriate and uniform compaction throughout the fill.

Each layer shall, before compaction, have been uniformly moistened to the appropriate moisture content. Seawater may be used for watering.

Compaction of land reclamation and sand filling behind sheet piles shall start 0.5 m above actual water level. Below the existing concrete slab in the main pier no compaction can be performed, but total filling to slab bottom shall be obtained.

3.3.4.1.7 Tolerance

The surface of fills and cuttings forming the subgrade for pavements and foundations shall be shaped to the lines and grades shown on the drawings +/- 20 mm.

All other surfaces, except as indicated otherwise on the drawings or as directed by the Engineer, shall be shaped to the lines and grades shown on the drawings +/- 50 mm.

Deviations must not be to one side over all.

3.3.4.2 Dredging

Before starting up dredging works the Contractor must make new soundings in the presence of the Engineer for making a basis for payment.

Dredging shall be executed to create a guaranteed bottom level in berthing areas, which means that soundings performed with a steel profile or similar lowered to guaranteed bottom level is nowhere allowed to meet any hindrance.

Dredging of soft soils in reclamation area shall be executed to levels as defined after geotechnical surveys to secure that no soft soils, which can create significant settlements, are left.

When dredging close to structures at the wharf, precautions shall be taken to avoid damages to piles and superstructures.

Fastening of mooring wires etc. to existing structures and bollards must only take place on approval of the Engineer. The Contractor will have the full responsibility of damages that might occur to existing structures because of fastening of wires or other damages that can be referred to the execution of the dredging works.

All rocks with a diameter of more than 0.5 metres must be taken ashore, and delivered in a place indicated by the Engineer.

Disposal of dredged materials shall take place in dumping areas according to requirements set up by the authorities.

The Contractor shall be solely responsible for the selection of the dumping area as well as for all arrangements, approvals and costs involved in the dredging and dumping operation.

3.3.5 Testing

3.3.5.1 Compaction

Compaction of fills shall be tested as required by the Engineer. Normally one (1) density test shall be carried out for each layer per each 1000 m² corresponding approximately each 200 m³. One density test comprises 5 test samples.

Criteria, defining compaction quality of the soil is 1.6 g/cm³. The allowable deviation from the design density is 0.06 g/cm³ from 20% of the samples, selected from different spots.

3.3.5.2 Testing and Payment of Dredging Works

When dredging works have been executed the Contractor shall make soundings with a steel profile or similar lowered to guaranteed bottom level. The soundings must cover the total dredged area 100%. The Engineer must be informed in due time before the soundings are performed and he shall be given the possibility to attend the work.

A bathymetric survey shall be carried out in order to obtain a precise picture of the water depths in the dredged area. The soundings shall at least be performed in lines parallel to the wharf with a line distance of maximum 5 m and with registration of depths at least each 5 m. The method of bathymetric survey shall be agreed upon with the Engineer.

Payment will be based on the theoretical quantity of dredged material calculated on basis of the soundings made before dredging and the guaranteed bottom levels. No payment will be made for extra depth which might be created to obtain the guaranteed water depth.

3.4 Stone and Rubble Works

3.4.1 Extent of Works

The stone and rubble works include all supplies and works concerning:

- Geotextile in slope revetments
- All cover layers, secondary layers and core materials in slope revetments

3.4.1.1 General

4 calendar weeks before start of works, the Contractor shall submit to the Engineer for approval a plan on the method of slope revetment construction including:

- a program about the organization of the revetment construction

- equipment and labor to be used for the entire operation, material supply, spare parts, etc.
- exploitation program of quarry, and/or collection of rock
- stock plan and classification of rock
- estimated rate and intended sequence and schedule of transport and dumping

The Engineer's approval shall not in any way relieve the Contractor of his full responsibility for the safety thereof.

If explosives are to be used, the Contractor shall follow the authorities rules and guidelines for the use of these products.

All facilities, man power, materials and measuring equipment necessary for the proper control of each layer in the stone revetments shall be present on site.

3.4.2 Documents

British Standard BS 6349: Part 7
Guide to the design and construction of breakwaters

3.4.3 Materials

3.4.3.1 Stones

The materials for stone works must be clean, durable, without laminations, without fissures and not friable. The materials must be of such a composition that it does not disintegrate in air, water or during transport and placement.

All stones must have a specific weight greater than 2.5 t/m³.

The materials delivered by the Contractor to be used in stone works are the following:

Gravel: 8 (D (120 mm

The size distribution of the stones shall vary uniformly with
25% between 8 mm $\leq d < 16$ mm and
25% between 16 mm $\leq d < 32$ mm.
25% between 32mm $\leq d < 64$ mm and
25% between 64mm $\leq d < 120$ mm.
with a variation of +/- 10 % in each fraction.

Secondary stones 100 (D (500 mm stones:

The size distribution of the stones shall vary uniformly with
50% between 100mm $\leq d < 250$ mm and

50% between 250mm $\leq d < 500$ mm.
with a variation of +/- 15 % in each fraction.

300 kg stones in cover layers:

The size distribution of the stones shall vary uniformly within the limits of
0.75 x W to 1.25 x W for each weight class.

3.4.3.2 Geotextile

The filter cloth shall be a Class 3 polypropylene non woven fabric resistant to air, sun, water and chemical and bacteriological attacks. The fabric shall be manufactured with and preserve the following properties:

INTERNATIONAL CLASS (CBR test)	CLASS 3
CBR-test (DIN 54307) (x)	> 1500 N
Weight Kg/m ²	> 0.200

3.4.4 Execution of Works

3.4.4.1 General

All surfaces to be covered by stones shall be approved by the Engineer before placing of the stone material.

For each stone layer the Contractor must - under the supervision of the Engineer - make cross-sectional surveys for each 5 m along slope revetments. Tolerances of ± 0.1 m on levels and ± 0.2 m on positions have to be met.

The filter cloth must be placed with an overlap of minimum 1 m. Position shall be secured by steel bars or other means. Special care shall be taken at free ends and overlaps.

Stones must be placed on the filter cloth without damaging it.

Armour stones must be placed in a way which results in uniform distribution of sizes.

3.4.4.2 Testing

The Contractor must document the suitability of all materials considering the relevant demands.

The materials must be approved by the Engineer as to their shape and their geotechnical characteristics. This must be done in good time before the material in question is to be used.

On demand of the Engineer the Contractor must carry out weighing of stones and perform sieve analyses.

At least 3 m³ of stone materials are spread out on a hard surface prepared by the Contractor. The Engineer points out the 10 greatest and the 20 smallest which all will be weighed individually. The remaining stones are counted and weighed as a total. The average weight is calculated.

3.4.4.3 Tolerances

Thickness of layers	± 20 % of nominal thickness average thickness shall be minimum as in drawings.
Levels	-0.1 m / + 0.2 m
Slopes	-0.1 m / + 0.3 m
Horizontal distances	-0.1 m / + 0.3 m

3.5 Pile Works

3.5.1 Extent of Works

The works comprises:

driving of steel sheet piles in:

- Pier head
- Central pier

driving of steel pipe piles in:

- Finger piers
- Fender structures

driving of pre-cast RC piles in:

- Passenger bridge foundation

delivery and driving of piles in interim supports if necessary.

3.5.2 Documents

British Standard BS 8004: Code of practice for foundations.

Danish Code of Practice for Foundation Engineering, 3. edition February 1984, DS 415 published in English December 1984.

3.5.3 Materials

3.5.3.1 Steel Sheet Piles

Steel sheet piles shall be made of steel complying with EN 10025 grade S355JR with a minimum yield point of 360 N/mm².

The design profiles of the sheet pile wall are shown in drawings. The Contractor may use other steel profiles of equal strength and properties subject to the approval of the Engineer.

The piles shall be straight, sound, true and, unless otherwise directed, in one length. Manufacturer's delivery conditions and tolerances must be approved by the Engineer prior to ordering.

A manufacturer's test certificate shall be supplied with all steel sheet piles delivered to Site.

3.5.3.2 Steel Pipe Piles

Steel pipe piles shall be made of steel complying with EN 10025 grade S355J2G3 with a minimum yield point of 240 N/mm².

The piles shall be straight, sound, true and, unless otherwise directed, in one length. Manufacturer's delivery conditions and tolerances must be approved by the Engineer prior to ordering.

A manufacturer's test certificate shall be supplied with all steel pipe piles delivered to Site.

3.5.3.3 RC Piles

RC piles with a size of 300x300 cm and length 8-10 m shall be executed from concrete A25 having a design resistance and in accordance with ГОСТ 13015-75 and СНиП 3.03.01.87.

3.5.4 Execution of Works

3.5.4.1 General

3.5.4.1.1 Working Methods

The Contractor is free to choose the method of driving piles provided that the construction tolerances are satisfied and the piles are not subjected to damage or unacceptable stress conditions. The method of driving piles and the construction of temporary installations shall be submitted to the Engineer for approval at least 6 calendar weeks before the works are due to commence, stating and including:

- all equipment to be used for the entire operation including reserve equipment but excepting tools,

- estimated rate and intended sequence and schedule of driving and extraction of piles and
- drawings showing temporary facilities and work employed.

The Engineer's approval shall not in any way relieve the Contractor of his full responsibility for the safety thereof.

Storage and handling shall be carried out carefully so that no plastic (permanent) distortion or other deficiencies occur, which in the Engineer's opinion make the piles unsuitable for installation.

Before driving all piles shall be marked pr. m in the whole length with clear indication of the numbers from toe to top.

All piles shall be driven truly vertical or accurately to the required rake, and any pile not so driven or not in the correct line, level or position shall, if required by the Engineer, be withdrawn and replaced at the Contractor's expense. No racking or straining of piles into the correct position will be allowed. Piles shall be driven using approved piling plant. Suitable driving caps shall be used during driving to prevent damage to pile heads. Piles shall be shored temporarily in case they are too slender to sustain random lateral forces, which may occur before the completion of the superstructure.

For the alignment of steel sheet piles, the Contractor shall install a beam guide (wale). The Contractor is responsible for the stability of provisional structures.

3.5.4.1.2 Inspection and Approval

All piles shall be subject to approval by the Engineer before and after the piles have been driven. Piles may be rejected by the Engineer, if they appear to have been damaged, cracked, located out of line or tolerance, incorrectly fabricated, marked, stored or handled, or they have been lengthened in a way that is not approved. Rejected piles shall be substituted by other piles as directed by the Engineer, and rejected piles, not left embedded in the soil, shall be promptly removed from the site.

Where, in the opinion of the Engineer, incorrectly placed, inaccurately driven or damaged piles can result in the necessity for driving additional piles or altering the capping arrangement, all such additional material, labour, driving etc. as may be required, shall be provided by the Contractor at his own expense.

3.5.4.1.3 Pile Driver and Hammer

For the purpose of preparation of Offers by Contractors, the piledriver and hammer required to drive the various piles shall be selected on the basis of the so-called "Danish Pile Driving Formula", which is stated in the Danish Code of Practice for Foundation Engineering. As further guidance the following limits should be observed for individual piles, in the notation used in the Danish Code of Practice for Foundation Engineering:

1. Guidelines for the determination of the weight of the hammer:

$$W_r \geq \eta \times 1.5 \times W_p \quad \text{for steel piles}$$

where W_p is the weight of pile excluding buoyancy.

In case of hard soil, it will be necessary to increase the weight of the hammer.

2. The drop of the hammer should satisfy:

$$H \leq \frac{1}{\eta} \times 2.0 \quad \text{for steel sheet piles}$$

where h is the coefficient of efficiency of the hammer, H is in metres.

3. The energy actually induced in the pile by one blow of the hammer should satisfy:

$$E_a = \eta \times H \times W_r \geq \frac{Q^2 \times L_p}{1.4 \times A \times E}$$

where Q is the actual pile resistance required
 L_p is the length of the pile (m),
 A is the cross-sectional area of the pile (m²),
 E is the elastic modulus of the pile material (kN/m²).

It is recommended that the values of E_a are considered to represent the absolute minimum energies and it is noted that shorter driving times would be achieved for the same drop, but using a larger hammer in each case.

If not determined by tests, Danish Code of Practice for Foundation Engineering proposes the following values of the efficiency factor for vertical piles:

$\eta = 1.0$ if the hammer is released.

$\eta = 0.7$ for falling hammers which are connected to the drum.

$\eta = 0.4$ for diesel hammers where H should be the maximum height of fall.

The efficiency factors are used for batter piles and when followers are used.

3.5.4.2 Steel Pipe Piles

3.5.4.2.1 Lengths of Piles, Profiles

The lengths of the piles shown in the drawings may be changed by the Engineer on the basis of data obtained from new geotechnical surveys or from driving of test and other piles on the site, or of other information available.

Toe levels and pile profiles shown in the tender drawings are indicative only and are not to be used for construction.

Where piles are to be lengthened the extension pieces shall be butt-welded to the main piles with full penetration welds in accordance with the standards specified in the relevant chapter herein.

The design profiles of piles are indicated in the drawings. The Contractor may propose to use other steel pile sections subject to the approval of the Engineer and provided that the same steel grades are used and that the requirements to section moduli are satisfied.

The piles shall be straight, sound, true and, unless otherwise directed, in one length.

3.5.4.2.2 Piledriving, Driving Depths

When no set is specified, piles of the lengths shown in the drawings or directed by the Engineer shall be driven to the lines and levels and in the positions shown in the drawings. If, during the course of driving, the Engineer decides that greater penetration is necessary, he may order the piles to be driven further, the piles being lengthened accordingly.

When piles are to be driven to a set and penetration is found to be insufficient after the acceptable set has been achieved, the Engineer may order the piles to be driven until sufficient penetration has been achieved. Should the acceptable set not be obtained when the piles have been driven to the levels shown in the drawings, the Engineer may order further driving to proceed, until the acceptable set is obtained, the piles being lengthened either before or after such further driving.

The penetration or sets for bearing piles will be such as the Engineer may consider necessary to achieve the bearing capacity with sufficient penetration to give the required resistance to withdrawal.

The final set for each pile shall be determined through the average number of blows used to drive the pile the last three series of 20 cm. The number of blows in each case shall be calculated by the Contractor from the prescribed pile driving formula and from the required pile driving resistance, which will be decided by the Engineer on the basis of parameters used in 5.4.2.1.

In the event that the minimum number of blows required is attained at a higher toe level than considered acceptable by the Engineer for other reasons - e.g. if a pile appears to have struck an obstruction - the driving resistance shall be reduced by water jetting. If this attempt fails, the Engineer shall be notified for assessment and for directions of remedial action. It is emphasised that the piles shall not be subjected to excessive impacting that may cause damage to them and cause them to be rejected.

3.5.4.2.3 Records

The Contractor shall record the number of blows made for each 20 cm of driving for the last 2 m of driving or as otherwise directed by the Engineer.

The level of each pile shall be related directly to a bench mark and shall not at any time be measured from the ground level.

For every 5 piles records shall be made for the full length of driving, as number of blows for each 20 cm.

One copy of the driving records shall be made available to the Engineer without delay. In addition to blow counts the records shall include information on pile driving equipment, type and profile of pile, seabed or ground level before and after the driving, toe level, water jetting, if any, and the name of the foreman or supervisor in charge.

3.5.4.2.4 Tolerance

Unless otherwise noted, the tolerance on the location of a pile - at the level of the underside of the beam or slab supported - shall be - 100 mm in the direction perpendicular to the beam and +/- 200 mm in the direction parallel with the beam. Plumb piles shall not deviate more than 1 : 50 from the vertical and raked piles shall not deviate more than 1 : 20 from the inclination specified nor more than 1 : 50 from vertical in the transverse direction.

3.5.4.2.5 Water Jetting

Water jetting of steel piles can be permitted provided that

- * at all times it is applied symmetrically about the pile axis
- * water jetting shall in each separate case be approved by the Engineer
- * a minimum series of 50 blows shall be made at the completion of the driving of each pile without any jetting being used.

3.5.4.2.6 Head of Piles

Where the tops of piles require special treatment to fit in with adjacent work or are to remain exposed on completion of the work, the Contractor shall make his own allowance in length, when ordering, for cutting off the heads of piles to the levels shown in the drawings. Exposed heads shall be cut off to present a neat appearance when finished.

The surface of steel piles against which concrete is to be cast shall be cleaned and free from all rust, grease, paint, millscale or other injurious materials.

3.5.4.3 Steel Sheet Piles

Only slinging holes f50mm about 250mm from the top must be burned or bored in the sheet piles. Fixations to piles should be made as welded connections.

Holes for bolts and anchors may either be made by drilling full-size holes or by burning an under-size hole and reaming it to final size. Burning of full-size holes will not be permitted.

Unless otherwise directed by the Engineer the piles shall be installed to the lines and levels and in the positions shown on the Drawings.

If, during the course of installation, the Engineer decides that greater penetration is necessary he may order the piles to be installed at lower level and the piles being lengthened accordingly.

Records for the pile driving works as described shall be kept by the Contractor and one copy hereof shall be submitted to the Engineer at the end of each day of driving.

The Contractor shall record the number of blows made for each 20 cm of driving for the last 2 m of driving or as otherwise directed by the Engineer.

The level of each pile shall be related directly to a bench mark and shall not at any time be measured from the ground level.

The top of the completed permanent sheet piles shall be brought to specified levels by burning-off of excess lengths. Damaged pile tops shall be removed by burning-off, as required by the Engineer.

One copy of the driving records shall be made available to the Engineer without delay. In addition to blow counts the records shall include information on pile driving equipment, type and profile of pile, seabed or ground level before and after the driving, toe level, water jetting, if any, and the name of the foreman or supervisor in charge.

Horizontal tolerance on sheet pile top shall be ± 50 mm referring to theoretical line.

3.5.4.4 Surface Treatment

3.5.4.4.1 Steel Pipe Piles

Steel pipe piles shall have a surface treatment from a level of 0.5 m below present water level to 50 mm into concrete superstructure as specified below.

Cleaning according to Section 8.

Paint application shall be at least 3 layers of a two component tar epoxy resin to a total dry thickness of at least 360 microns.

3.5.4.4.2 Steel Sheet Piles

No surface treatment shall be applied.

Protection from corrosion below water level by sacrificial anodes according to Section 15.

3.5.4.5 Test Piles

When ordered by the Engineer, the Contractor shall drive test piles vertically in the positions and to the levels indicated by the Engineer.

Additionally, test piles may be required to be lengthened or further test piles may be required and shall be driven in permanent positions selected by the Engineer.

Records of the driving shall be maintained generally and the number of blows observed for each 20 cm. of driving as directed by the Engineer.

Detailed records of the driving shall be supplied by the Contractor to the Engineer immediately after driving.

The method of handling, pitching and driving test piles shall be in accordance with the provisions and requirement of the relevant clauses herein.

If, required, facilities shall be provided for making observations at the toe of the pile and at one other point above the toe of the pile, by securely welding 37 mm bore piping to the pile, sealed at the bottom to receive a 20 mm mild steel bar after driving. The tops and bottoms of the piping and measuring bars shall have machined ends as directed.

3.6 Concrete Works

3.6.1 Extent of Works

For all concrete structures in accordance with descriptions of work, the specifications contained in this section and as shown on the drawings, the Contractor shall:

- Furnish all materials, and equipment required, manufacture, transport, place, finish, protect, cure and test the concrete.
- Furnish documentation that all concrete and concrete making materials (cement, cement replacements, sand, gravel, water and admixtures, reinforcement) are of suitable quality for their intended use and will produce a durable concrete fit for its intended purpose.
- Construct, erect and dismantle forms.
- Furnish and place materials for all joints and cast in items.

3.6.2 Documents

3.6.2.1 Marine Works

The works shall be executed in accordance with the relevant European Standards.

National standards, norms and codes and codes of the former Soviet Union, may be used as an alternative if applicable and so agreed with the Employer.

Basis for this Contract shall be British Standard BS:

BS 6349: Code of practice for Maritime structures.

BS 8110: Structural use of concrete:

- Part 1: Code of practice for design and construction
- Part 2: Code of practice for special circumstances
- Part 3: Design charts for singly reinforced beams, doubly reinforced beams and rectangular columns

Cement : BS 12
Aggregates : BS 882

Water	:	BS 5328
Admixtures	:	BS 5075
Steel reinforcement	:	BS 4449, BS 4482 and BS 4483. For deformed high yield steel bars also the following Danish Standards: DS 411 and DS 13080.
Compressive strength	:	BS 1881
Cutting and bending of reinforcement	:	BS 4466.

Appendices, guidance and recommendation clauses shall be valid to the extent they are applicable.

3.6.2.2 Land Works

The concrete mixes, their manufacture, transportation, placement and curing shall comply with requirements of ГOCT 7473-85.

The materials for preparation of the concrete shall comply with relevant norms and standards.

Cement	:	Portland-cement ГOCT 10178-85
Acceptance	:	ГOCT 22236-85
Transportation and storage	:	ГOCT 22237-85
Sand	:	ГOCT 8736-85
Rubble	:	ГOCT 8267-82
Gravel	:	ГOCT 10260-82
Chemical admixtures	:	ГOCT 24211-80
Water	:	ГOCT 23732-79
Reinforcement	:	ГOCT 5781-82* and ГOCT 7566-81

3.6.3 Materials

3.6.3.1 Marine Works

3.6.3.1.1 Cement

Rapid hardening or early strength cement shall not be used unless specifically approved by the Engineer.

All cements shall be certified by the manufacturers as complying with the requirements of the appropriate specification. Before orders are placed, the Contractor shall submit information on the proposed methods of transport, storage and certification so that the Engineer may satisfy himself that the quantity and quality required can be supplied and maintained throughout the construction period. Where necessary, the Engineer may require further representative samples of the proposed cement to be taken and forwarded to a laboratory approved by him for analysis and testing, before the source is approved.

In addition to the routine test certificates, which are to be supplied by the manufacturer to show the results of sample tests made on batches of cement produced for the Works, each consignment despatched to the Site is to be sampled and tested by the manufac-

turer, and the results of the standard 3- day and 28- day tests are to be submitted promptly to the Engineer. The date of manufacture of the consignment is to be stated on the test certificate.

The Engineer may also make any further tests, which he may consider necessary or advisable to satisfy himself that the cement on site complies with the specification and has not suffered deterioration in any manner during transport or storage.

The cement delivered to the Site must be protected from the weather by effective coverings. Immediately after delivery at the Works the cement is to be placed in these covers and it shall be used in the order, in which it has been delivered.

All cement shall be used within two months of the date of manufacture.

3.6.3.1.2 Aggregates (Fine and Coarse)

The sand shall be from approved sources and a sand which in the opinion of the Engineer is not clean shall be washed clear with fresh water before use.

Crushed sand may be added to natural sand in order to achieve the required grading. Crushed sand alone may only be used with the approval of the Engineer.

Coarse aggregate may be either natural gravel or stone broken to the desired size and shall be obtained from quarries, pits, or other sources approved by the Engineer.

Gravel and ballast shall be approved by the Engineer. Any sand that may be amongst it shall, unless otherwise directed, be removed by screening and kept apart. Should the sand thus obtained be suitable for use in concrete, it may be used for that purpose provided that it complies with the conditions specified for the sand.

The source of broken stone shall be approved by the Engineer and notwithstanding this, the stone as delivered to the Works will be subject to rejection on the Works, if for any reason the Engineer considers it unsatisfactory. The stone must be broken in a stone crusher of approved type to the sizes hereinafter specified, and any dust or fine material below 5 mm in size made in the stone crusher is to be removed by screening or washing if so required by the Engineer.

The grading of aggregate by analysis shall be within the limits given below. Should an analysis of the grain size of the material show a deficiency in any particular size such as to affect the density of the concrete, the Engineer may require the Contractor to add such quantity of aggregate of any particular size that he may deem advisable. In every case the material shall produce a well graded mixture from the largest to the smallest size specified to ensure that concrete of high density is produced.

The fine and coarse aggregate shall when composed and delivered to the mixer be well graded within the following limits.

Sieve Size mm	Percentage Weight Passing max. 32	Max. 19
32	100-100	
25	85-95	
19	73-85	100-100
9.5	55-65	68-88
4.75	42-51	55-65
2.36	32-41	40-52
1.18	27-37	34-45
0.6	18-28	27-37
0.3	5-15	15-25
0.15	1-4	1-5

Further, the fineness modulus of at least 9 out of 10 samples of aggregate shall not vary more than 0.20 from the average fineness modulus of all samples taken during the preceding 30 days period.

The aggregate shall be free of organic and chemical impurities and the content of chloride salt in the aggregate, expressed as the equivalent anhydrous calcium chloride percentage by weight of the cement to be used in the concrete shall not exceed 0.4 per cent. No chloride will be allowed in aggregates to be used in concrete for Marine Works.

For the purpose of calculation, the anhydrous calcium chloride content may be taken as equal to the sodium chloride content or to 1.6 times the chloride ion content as appropriate.

The total sulphate content shall not exceed 4.0% by weight of cement including the sulphate present in the cement

The Contractor shall keep records in duplicate of all control tests. These records shall be available to the Engineer for inspection at all times and they shall become the property of the Employer.

3.6.3.1.3 Water

Clean fresh water is to be used for the mixing of all concrete and mortar. Water shall be tested by approved laboratory if requested by the Engineer.

3.6.3.1.4 Admixtures

The use of chloride free additives or admixtures in concrete may be ordered or approved by the Engineer in accordance with BS 5075. Such approval will only be given, when the Contractor has demonstrated to the satisfaction of the Engineer that the resulting concrete is no less strong, dense and durable than that obtainable without the use of additives.

No admixture will be considered for approval that is not being commercially used with satisfactory service records. All requests for approval of admixtures shall be submitted to the Engineer at least 30 days before it is intended to use the admixture. The Contractor shall submit with his request independent test data and adequate samples of the proposed admixture.

Air-entraining admixture shall be added during mixing in proper amount to give the specified air content. The air-entraining admixture shall be subject to approval by the Engineer.

Calcium chloride or admixtures containing chloride shall not be used.

3.6.3.1.5 Reinforcement

Reinforcing bars used are round steel bars and deformed steel bars (dimensions in mm 6,8,10,12,16,20 and 25).

If precast beams are decided to be prestressed elements and other types of reinforcement are wanted, documentation on all relevant properties shall be submitted to the Engineer and the Contractor must obtain approval before such other types can be used.

3.6.3.2 Land Works

3.6.3.2.1 Cement

Bending strength and compression strength of samples prepared in accordance with GOCT 310.4-76* shall be tested after 28 days for ordinary Portland Cement respectively after 3 and 28 days for high-early-strength Portland cement.

Strength of the samples shall be as follows, in MN/m²:

Type	Compression	Bending
200	20	3,5
300	30	4,5
400	40	5,5
500	50	6,0
600	60	6,5

The manufacturer shall define an activity of all cement consignments performing steam curing of the one-day old cement and indicate the activity in a certificate. It is acceptable to inform the consumer about the cement activity revealed by the steam curing not later than after three days of cement dispatch.

Definition of physical-mechanical features of the cements shall be performed in compliance with GOCT 310.1-76 and GOCT 310.4-76.

3.6.3.2.2 Aggregates

Aggregates for concrete shall be graded and clean. Utilisation of a natural mix of sand with gravel without grading is prohibited. When selecting aggregates for concrete, local raw materials are recommended for most structures.

Depending on granulometric (grain) composition, sands are divided into the groups as follows: coarse, middle, fine and very fine.

After the preliminary sieving through a sieve with holes of 5 mm to extract grains of gravel (rubble), the sand fineness modulus and the full remnant on a sieve No. 063 in accordance with ГОСТ 3584-73 for each group of sands shall be as shown in the table.

Sand group	Fineness modulus	Full remnant on sieve No.063, % of weight
coarse	over 2,5	over 45
middle	2,0... 2,5	30... 45
fine	1,5... 2,0	10... 30
very fine	1,0... 1,5	up to 10

Only coarse, middle and fine sands shall be used as aggregates for concrete.

Supply and acceptance of sand are to be carried out in consignments. The consignment is a sand quantity in one freight train or in one barge for one consumer. When sand is transported by automobiles, the consignment is a sand quantity discharged for one consumer in a day.

A quality control of sand at place of manufacture (in excavation) consists of grading, definition of fineness modulus, content of dusty, clay and silty particles, including clay in pieces. The control shall be performed daily.

Definition of the volumetric bulk weight for sands of all types is to be carried out once per quarter.

Sand sampling for tests shall be executed in compliance with ГОСТ 8735-85. One test requires three samples.

For control inspection of sand unloaded from railway transport, the samples are to be taken: from each wagon if the consignment consists of up to 3 wagons, from three wagons if the consignment comprises more wagons. Each of the samples shall be taken during discharge of the sand from five spots of the wagon at different depths. The samples taken from various wagons shall not be mixed, and they shall be tested separately. If the test results of the first sample are positive, the rest samples may be non-tested.

If the results of the first sample test are unsatisfactory, the second sample is to be tested. If the results of the second sample test are not acceptable, the consignment of the sand can not be accepted.

If the outcomes of the second sample test are satisfactory, the third sample shall be tested. The test results of the third sample shall be considered as the final ones.

It is permitted to carry out a control test of the sand quality and acceptance recurrently.

For control test of sand unloaded from water transport, one sample is to be taken from every part of consignment of not more than 500 t (350 m³). Sampling shall be taken from conveying strips (conveyors) or from another type of loading-unloading equipment.

For control test of sand unloaded from road transport, one sample shall be taken from each part of the consignment having weight 500 t (350 m³). Each sample is to be taken from not less than 5 automobiles.

Estimation of the sand quality shall be carried out separately for each part of the consignment in accordance with results given by testing of individual samples, selected from these parts. In the case of mixture of sand consignment parts, the estimation shall be executed according to arithmetical mean indices of all sample test results.

Transportation and storage of sand shall be performed avoiding pollution of sand.

Coarse-graded aggregate shall be utilised only after grading. In no way can natural gravel-sand mixture or crushed rubble be utilised without grading. While grading coarse-grained aggregate, the following shall be taken into account:

- The maximum fineness of aggregate grains for concreting shall be 32 mm.
- The maximum size of aggregate grains intended for RC structure shall not exceed 3/4 of the minimum distance between reinforcing bars.
- The grain sizes for concrete mixtures supplied through concrete conveying pipes shall not be over 0,4 of internal diameter of the conveying pipe diameter for gravel and 0,33 for rubble. Number of grains with the largest size and plate-shape and needle shape grains taken separately shall not exceed 15 % of weight.

3.6.3.2.3 Admixtures

To get concrete mixture or concrete with specified features chemical admixtures (plasticizing, air entraining, gas entraining, frost resistant, accelerating concrete hardening and steel corrosion inhibitors) may be added into concrete.

The optimum amount of admixtures shall be a subject to definition by a construction laboratory. Notwithstanding this, quantity of admixtures accelerating hardening shall not be more than the following, in % of cement weight: natrium (sodium) sulphate-2; calcium chloride in concrete of reinforced structures -2 and in concrete of non-reinforced structures -3.

Use of admixtures may be ordered and shall be approved by the Engineer, see section 3.6.3.1.4.

3.6.3.2.4 Water

Water used for hardening of concrete mix shall not contain impurities in amounts hindering the normal setting and hardening of cement, or causing reinforcement corrosion.

Water shall be tested by approved laboratory if requested by the Engineer.

3.6.3.2.5 Reinforcement

The following materials are utilised in construction:

- à) mild steel of class A1 with design strength of 225 MN/m².

- á) high tensile steel of class AIII with design strength of 365 MN/m² (diameter of bars is over 10 mm).

Reinforcement steel and reinforcement bars shall be stored individually in accordance with consignments. Protection against corrosion and pollution shall be performed, and also steel labels of the manufacturer shall be well maintained and accessible.

3.6.4 Execution of Works

3.6.4.1 Marine Works

3.6.4.1.1 General

Concrete shall consist of cement, graded aggregate, water and approved admixtures thoroughly mixed, placed and compacted as specified in the following subsections.

The concrete mixes shall comply with the requirements for the various classes listed in the table below:

Class	Use	Com- pressive Strength MN/m ²	Slump mm	Nominal Ag- gregate Size (max) mm	Maximum Water/- Cement ratio	Air Content %
A	Marine work	35	50	32	.45	4-6
B	Blinding	15		32	.70	

At least 30 days before any concrete is placed in the Works the Contractor shall submit to the Engineer for his approval full details of the mixes he proposes to use for each class of concrete together with their anticipated average strength. These mixes shall be based on the results of trial mixes.

The mixes shall be designed by the Contractor with due regard to the workability necessary to allow the Contractor to place and compact the concrete with the equipment he proposes to use in any particular situation.

Cement mortar shall, unless otherwise specified or ordered, consist of one part of cement to three parts of fine sand by volume mixed and thoroughly incorporated together with just enough water to render it workable.

Cement grout for general purposes shall consist of Portland cement and water mixed in the proportion of one part by volume of cement and one and a half parts by volume of water. The grout shall be used within one hour of mixing.

3.6.4.1.2 Production of Concrete

The concrete shall be produced in a modern and reliable plant for batching and mixing the concrete. The mixer shall be capable of thoroughly mixing the aggregates, cement and

water into a uniform mass within appropriate time and of discharging the mix without segregation.

Before concrete production starts and at least once every month after that, or whenever required by the Engineer, the Contractor shall check and recalibrate each scale and other measuring devices from zero to full capacity of the scale.

The Contractor shall notify the Engineer at least 2 working days in advance of his intention to perform these tests.

Daily, the Contractor shall check the accuracy of each scale at its zero and at least one other suitable point.

The Contractor shall submit within 45 calendar days after award of the Contract information on his proposed plant for batching and mixing concrete.

Those surfaces of measuring, mixing and transporting equipment that will be in contact with concrete shall be clean at the commencement of the mixing operation.

The preparation of the concrete and test specimens is to be carried out under the supervision of a suitably qualified expert foreman, primarily assigned to this work.

The materials shall be so measured out as to give the required mix proportions. Cement and aggregate shall be batched by weight - where aggregate may be weighed cumulatively - and water shall be batched by weight or by volume. Admixtures shall be batched using suitable dispensers. The Contractor shall measure the moisture content of the aggregate in accordance with BS 812 (Part 109) as frequently as required and at least once a day for the coarse aggregate and twice a day for the fine aggregate during times of concrete production, and he shall adjust the quantity of mixing water according to the results of these tests if required. The observation of moisture in the aggregate shall be sufficiently frequent and accurate to keep the mixing water in the batch within the following limits:

Cement, water and aggregates + 5 per cent

Admixtures + 5 per cent

In addition to the proving tests stipulated for aggregates, the Contractor shall at intervals test the graduation of fine and coarse aggregates used in the mix. Once a week he shall test the aggregate for impurities and materials finer than sieve size 0,075 mm.

The concrete shall be mixed in the mixer until the materials are uniformly distributed and shall be discharged completely before the mixer is recharged.

Unless otherwise directed by the Engineer, the duration of the mixing shall be 1 1/2 to 2 minutes after all the ingredients are in the mixer and provided all the mixing water is added within the first half minute. In the case of a drum mixer, some water shall be charged before any solids.

3.6.4.1.3 Testing and Control

Control tests on the concrete shall be carried out using testing equipment conforming to BS and approved by the Engineer and the Contractor shall for the purpose of testing - and at his own account - provide on Site equipment for making and curing test specimens, carrying out compression tests, slump tests, unit weight measurements, sieve analyses and tests for checking air content in the concrete, moisture content of aggregates as well as organic impurities in the aggregates.

The Engineer may, at his discretion, introduce other tests at the Employer's expense although no separate payment will be made for normal assistance provided by the Contractor for obtaining any samples required for such tests.

The compressive strength shall be determined in accordance with BS 1881 under good control conditions at 7 days and 28 days from specimens obtained, prepared and stored in accordance with BS 1881.

From each 40 cubic meters two specimens for the 28th day test and one specimen for the 7th day test shall be prepared unless otherwise directed by the Engineer.

The Contractor shall keep records of all operations of the batching plant and of all tests he performs. These records shall include the daily volume of production, type of concrete produced, mix size and weights of the various ingredients, moisture content of aggregate, temperature of concrete, source of materials with cross references to the applicable cement and aggregate tests and where the concrete is placed. These records shall also include general information about the weather, about the progress in placing the concrete and about any difficulties in producing or placing concrete whether due to breakdown of equipment or any other cause. The Contractor shall furnish to the Engineer one copy of all these records not later than one week after the event took place.

3.6.4.1.4 Concrete Deemed not to Comply with Requirements

Whenever the test results for strength do not comply with the requirements, the Contractor shall immediately take steps to modify his operations to the satisfaction of the Engineer. Any remedial work or demolition and reconstruction of rejected work shall be carried out on the Contractor's own account.

3.6.4.1.5 Placing and Compaction

The Contractor shall give the Engineer adequate notice of his intention to place concrete, and before any placing is started the Contractor shall obtain approval from the Engineer.

No concreting will be allowed to take place in the open during storms, sand drift or heavy rains. In places where such conditions are likely to occur, the Contractor is to arrange for adequate protection of the materials, plant and formwork so that the work may proceed under proper cover. Where strong winds are likely to be experienced additional precautions to ensure protection from driving rain and dust shall also be taken. The Engineer may withhold approval of commencement of concreting, until he is satisfied that full and adequate arrangements have been made.

The concrete shall be placed in the positions and sequences indicated on the drawings, in the Specification, or as directed by the Engineer. Except where otherwise directed, con-

crete shall not be placed unless the Engineer or his representative is present and has previously examined and approved the positioning, fixing and condition of reinforcement and any other items to be embedded and the cleanliness, alignment and suitability of the containing surface of formwork.

The concrete shall be transported from the mixer to the place of final deposit by means which will prevent segregation or loss of materials, not permit the concrete to stiffen and not prevent proper placing of the concrete. Transportation time shall be reduced to a minimum, max. 1 hour between mixing and casting.

Concrete shall be deposited as close as practicable to its final position and in such a manner as to avoid segregation due to rehandling or flowing.

The vertical drops shall be not more than 1.7 metres, except where suitable equipment is provided to prevent segregation and where specifically authorised. The concrete shall be placed in approximately horizontal layers of no more than 50 cm's thickness.

All concrete shall be thoroughly compacted by internal vibrators type during placement and shall be thoroughly worked around the reinforcement and embedded fixtures and into the corners of the forms. The use of external vibrators is not permitted. The number of vibrators in use shall be 3 for a pour of max. 50 m³ and for larger pours one extra vibrator shall be in use for every additional 50 m³ max. of concrete.

At least 2 spare vibrators shall always be available at the Site of casting.

The vibration shall continue until the air bubbles cease to appear on the concrete surface and stop immediately with the appearance of bleeding and not carried out to a degree that may cause segregation of the concrete. The working of the concrete by vibrators to make it flow laterally is not permitted and vibrators shall always be extracted at a slow rate to prevent forming of voids.

Before concrete for reinforced concrete work is cast against the ground, a blinding layer of concrete type C, 50 mm minimum thickness, shall be placed over the ground below the underside level of the reinforced concrete to form a hard even surface on which to construct the latter.

Immediately before depositing concrete on or against a surface of rock, masonry, brickwork, old concrete, or the like, the following preparation shall be done. All loose material shall be removed and the surface washed down, the water being suitably channelled or piped away from the work. On upward facing horizontal or near horizontal surfaces a layer of 2:1 sand/cement mortar is to be spread over the surface of the section to be concreted.

3.6.4.1.6 Hot Weather Requirements

The Contractor shall supply suitable maximum/minimum thermometers and record the temperatures of the ambient shade adjacent to all parts of the works where concrete is being placed.

The requirements and precautionary measures named in the following shall be complied with in order to eliminate the undesirable effects of hot weather and dry winds on fresh or hardening concrete.

In places where the ambient shade temperature exceeds 40°C, the Contractor shall take special measures in the mixing, transporting, placing and curing of concrete.

The temperature of the freshly mixed concrete then placed shall not exceed 30°C. Precautions to be taken to meet this requirement may include

- using chilled water or ice for mixing
- cooling of aggregates by continuous fine spraying with cold potable water (adjusting the amount of mixing water accordingly)
- protection of concrete mixer against exposure to direct sunlight and cooling of concrete mixer and containers for transportation of concrete
- avoiding use of warm cement (temperature of cement must not exceed 40°C when used)

Formwork shall be continuously sprayed with cold water before concreting and excess water shall be removed from the inside of the forms immediately prior to the placement of concrete as directed by the Engineer.

Reinforcement and formwork of metal shall be shielded from direct sunlight.

Exposed faces of concrete shall immediately upon placement be protected against evaporation by covering with an impervious membrane or careful fog spraying with water in order to prevent plastic shrinkage cracking until the initial setting has taken place and moist curing can begin.

Curing compounds can be used as an alternative to the precautions mentioned above on finished concrete surfaces.

Premature stiffening of concrete placed in contact with hot surfaces shall be prevented.

3.6.4.1.7 Curing and Protection

The surfaces of the concrete and the formwork shall be maintained in a moist condition for a period of 7 consecutive days after placement, unless a shorter period is permitted and directed by the Engineer. Excessive evaporation of water from all surfaces or rapid change in temperature shall be prevented and alternate wetting and drying avoided. Water for curing shall be fresh, potable water.

During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses and heavy shock. All finished concrete surfaces shall be protected from damages from equipment, materials, rain or running water, sandstorms etc. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

3.6.4.1.8 Repair of Surface Defects

The patching, plastering or cement washing of defective areas such as honeycombs and cracks shall not be permitted except with the approval of the Engineer. However, such approval is not required for the repair of holes left by the extraction of form ties or cored samples.

A dry pack mixture shall be used for holes having at least one surface dimension which is shorter than the hole depth. By weight the mixture shall consist of 1 part cement to 2 1/2 parts of sand passing a No. 16 screen and be so dry that it will not exude water when pressed in the hand. The area to be patched shall be moistened and where necessary coated with a bonding grout before applying the drypack, which is to be solidly compacted by means of a bar and a hammer.

3.6.4.1.9 Casting in of Anchoring Items

For secure anchorage of bolts, inserts etc. to be embedded in prepared holes or recesses in hardened concrete, an expanding mortar shall be used.

The mortar shall consist of cement, sand and water to which is added an expanding compound of approved manufacture.

Mixing shall be carried out in strict accordance with the manufacturer's instructions and the resulting mix shall be such as to produce an expansion of 3 to 5 mm when measured on a test specimen 50 mm in diameter and 600 mm in length.

Before placing the mortar, the hole or recess in question shall be thoroughly cleaned and the surface of the hardened concrete scarified to produce a rough surface. The surface of the hardened concrete shall then be moistened prior to placing any mortar.

The finished mortar shall be prevented from drying out by suitable covering similar to curing of concrete as specified above.

3.6.4.1.10 Surface Finishes

Unless otherwise specified visible formed surfaces shall have a smooth off-form finish of uniform overall appearance while formed surfaces not generally visible may have a rough off-form finish.

Minor unformed surfaces shall be struck smooth after the concrete is placed and shall be floated to a texture consistent with that of adjacent, formed surfaces.

All other horizontal top surfaces - visible and concealed - shall be screeded off to produce an even surface to the correct levels and falls. Surplus concrete shall be removed immediately after consolidation by striking off with a sawing motion of a straight edge.

Unless otherwise specified, concrete top surfaces that will be visible shall receive a wood floated finish with a uniform texture and free of board marks. This work shall be carried out as soon as some stiffening has taken place in the concrete surface and the moisture film has disappeared.

Visible convex corners shall be chamfered 20 by 20 mm unless otherwise indicated on the drawings.

3.6.4.1.11 Formwork

Formwork shall be constructed to provide the correct shape, lines and dimensions of the concrete and within the tolerances specified hereafter. Due allowance shall be made for any deflection, which will occur during the placing of concrete within the forms. Formwork shall be such that the finished surface of all concrete work shall be sound, solid and free from honeycombing, protuberances and blemishes. No plastering of imperfect concrete faces will be allowed and any concrete that is defective in any way is to be cut out and replaced to such depths and be made good in such manner, as the Engineer may direct, and at the Contractor's expense.

Forms for all permanently visible concrete surfaces shall be such as to ensure that the surface is within the tolerances hereinafter specified.

Rough Shuttering:

To be used for surfaces that will not be exposed in the finished structure.

Wrought Shuttering:

To be used for all surfaces that will be exposed in the finished structure.

Where rough shuttering is specified, the use of tongued and grooved sawn timber boards will be permitted providing the resulting surface presents a neat and even appearance. No surface irregularities greater than 10 mm shall be allowed and, in cases of reinforced concrete, the full cover to steel shall be maintained.

Where wrought shuttering is specified, the forms shall be such as to produce a smooth and even surface free from perceptible irregularities, and tongued and grooved, planed boards or plywood or steel forms shall have their joints flush with the surface. The full cover to reinforcement steel shall be maintained. The Contractor shall make due allowance for the renewal and/or repair of shuttering for which more than one use is intended.

In mass concrete, surface irregularities may be permitted, but in reinforced concrete construction the surface shall be true and the full cover to the reinforcement shall be maintained at all points. The tolerances for the finished concrete dimensions shall not be exceeded.

Before concrete is placed, the form shall be thoroughly cleaned and freed from sawdust, shavings, dust or other debris by hosing with water. Temporary openings shall be provided to assist in removal of the water and rubbish.

After cleaning, the forms shall be coated with an approved shutter oil, which shall not be allowed to run on to reinforcement or other embedded steelwork.

All formwork shall be inspected and approved by the Engineer before concrete is placed within it, and this shall not relieve the Contractor of the full responsibility for the soundness, finish and tolerances of the cast concrete specified elsewhere.

Notwithstanding these Clauses no prop or shuttering shall be removed without the permission of the Engineer, and such permission shall not relieve the Contractor of his responsibilities for the safety of the structure.

3.6.4.1.12 Construction Tolerances

Tolerances for formed surfaces of in-situ and precast reinforced concrete are:

- Location of in-situ structure generally, relative to established setting-out lines, module lines, and levels: + 10 mm
- Longitudinal dimensions less than 30 m of same members: + 10 mm
- Cross-sectional dimensions of beams, slabs, walls, etc.: 0 mm to + 10 mm
- Size and location of penetrations, recesses, etc. + 5 mm
- Holding-down bolts, etc., as group: + 5 mm
but within group by template only
- or as otherwise specified on the drawings

3.6.4.1.13 Joints

Construction joints, the position and arrangement of which shall be as indicated on the drawings or as previously approved by the Engineer, shall be in accordance with BS 8110.

The Contractor is to allow for working beyond the ordinary working hours where necessary in order that each section of concrete between joints may be completed without any lapse while the work is in hand, and at no additional cost to the employer.

Contraction joints, where specified, shall be formed as deliberate planes of discontinuities in the concrete structure. To form such a joint, either the face of the concrete slab or block first formed shall be painted with two coats of approved rubber bitumen paint, before the adjoining slab or block is concreted, or the joint may be sawn in the concrete slab and subsequently filled with a sealing compound.

Expansion joints shall be formed in the same way as contraction joints but, in addition, an approved compressible sheet or filler shall be supplied and placed in the joint to provide freedom for two adjacent concrete slabs or blocks to expand. In certain situations a highly compressible joint filler of foam rubber or other approved material shall be used as directed by the Engineer. The exposed edges of the joints shall be sealed with an approved synthetic rubber or similar resilient sealing compound.

3.6.4.1.14 Reinforcement

Cutting and bending of reinforcement shall be to BS 4466 and DS 411.

The number, size, form and position of all steel reinforcing bars, ties, links, stirrups, and other parts of the reinforcement are to be in exact accordance with the drawings and kept in the correct position in the forms without displacement during the process of vibrating the concrete in place. The Contractor shall provide all necessary spacers and spare bars at his own cost to maintain the reinforcement in the correct position. Any ties, links or stirrups connecting the bars shall be taut so that the bars are properly braced, and the inside of their curved parts shall be in actual contact with the bars around which they are intended to fit. Bars shall be bound together with 16 gauge black annealed mild steel wire. Binding wire shall be twisted tight with proper pliers. The free ends of the binding wire shall be bent inwards, away from the form work.

Before any steel reinforcement is embedded in the concrete, any loose mill scale, loose rust, oil, grease, or other deleterious matter shall be removed. Partially set concrete which may be adhering to the exposed bars during concreting operations shall likewise be removed.

The concrete cover to reinforcement measured to the outside of ties or stirrups shall comply with the following conditions:

	Min. cover
a) Concrete cast against and exposed to earth	75 mm
b) Concrete in marine works	55 mm
c) Concrete exposed to weather	40 mm
d) Concrete in piles	35 mm
e) Concrete not exposed to weather	20 mm

The Contractor shall provide any necessary spacers which shall be made of concrete of same characteristics as the structure in which they are cast in to ensure that this cover is attained. In no case may the use of timber packings be permitted.

Curtailment of bars and location of laps shall be in accordance with the drawings. Any additional laps desired by the Contractor shall be subject to the Engineer's approval and requested before the reinforcement is placed in the form.

Where splices or overlapping in reinforcement are specified or required by the Contractor, the overlap shall be in accordance with BS 8110.

Welding of bars is not permitted unless approved by the Engineer or shown on the drawings.

All reinforcement, when placed and fixed in the forms, shall be inspected and approved by the Engineer before any concrete is placed.

3.6.4.2 Land Works

3.6.4.2.1 General

Composition of concrete mix shall be systematically corrected taking into account activity of cement, moisture and grading of aggregates changed during the works.

3.6.4.2.2 Concrete Mix Classes

Concrete mix shall correspond to specified requirement for the concrete class as specified in table below

At least 30 days before any concrete work, the Contractor shall submit to the Engineer characteristics of concrete mixes used.

This concrete mix shall be based on test results as indicated in ГOCT 7473-85.

Prescriptions for 1 m³ of concrete

Type	Concrete class	Gravel, m ³	Rubble, m ³	Sand m ³	Cement type		Water	Design compression strength, MPa
from gravel	B 7,5	0,77	-	0,54	0,204	-	0,20	4,5
	B 15		-	0,50	-	0,275	0,20	8,5
	B 20		-	0,47	-	0,326	0,205	11,5
	B 25		-	0,43	-	0,382	0,21	14,5
from rubble	B 7,5	-	0,80	0,63	0,214	-	0,21	4,5
	B 15	-		0,53	-	0,286	0,21	8,5
	B 20	-		0,50	-	0,332	0,215	11,5
	B 25	-		0,47	-	0,382	0,22	14,5

3.6.4.2.3 Concrete Mix Preparation

Dosage of materials for mechanical preparation of concrete mix shall be carried out by weight. An exception is permitted for water, admixtures, dosed as fluid and for water solutions of these admixtures. Metrology test of dosers shall be done at least once a year, and control test of doser inaccuracy shall be implemented at least once a month.

Making the dosage control test, on the basis of 10 weighings, inaccuracy shall be as follows: for cement and admixtures, dosed as powder - not more than 2 %; for aggregates - 2,5 %; for water, admixtures, dosed as fluid, and for water solutions of these admixtures - 2 %. Concentration of admixture working solution shall be checked before each filling of consumption tanks but at least once a shift.

When preparing concrete mix the following regulations shall be followed: time of concrete mixing is to be defined by a construction laboratory; permissible reduction or increase of charge of mixer drum (pan) compared to certificate data shall no be more than 10 %.

If concrete mix is to be prepared in mobile concrete mixer loaded with dry mix, the following rules shall be followed: mixture shall start not later than 30 minutes after aggregates have been charged; number of mixer revolutions per batch shall be not less than 70 and not more than 300.

As a rule, concrete mix shall be transported by specialised means of transport, such as: mobile mixers, agitating trucks. It is allowable to transport concrete mix in trucks-dumpers and tanks (buckets) mounted upon trucks. Ways of transportation shall exclude possibility of precipitation intrusion as well as protect the mix against undesirable effects of wind and sunbeams during transportation.

Option of means and modes for transportation of concrete mix, and also definition of allowable time and distance of transportation shall be a subject for determination by the laboratory taking into consideration required quality of concrete mix.

Tanks where concrete mix is to be transported shall be cleaned and washed after every working shift and before long (over 1 hour) breaks in transportation.

The fluidity of concrete mix placed in structures shall be as specified below:

No.	Description of structure	Slump, cm
1	Bedding under foundations and floors, road bases	0-1
2	Pavements, floors of constructions without reinforcement and with minor reinforcement (retention walls, foundations, blocks, structures concreted in horizontal slipform)	1-3
3	Massive reinforced constructions, slabs; beams and columns of a big and middle size (with a side of 0,4-0,8 m)	3-6
4	Thin walls, columns, bins, silos, beams, slabs with a small size up to 12 cm thick and elements of structures with a big amount of reinforcement: - horizontal - vertical	6-8 8-10
5	Constructions concreted in vertical slipform	6-8
6	Constructions with big amount of reinforcement and fixed parts which hinders for placement of plasticised concrete mixes by vibration	20-24

The fluidity of concrete mixes pumped through pipelines shall be determined with due regard to technical characteristics of used concrete pumps and guns but it can not be less than 4 cm.

The fluidity of concrete mix are to be checked at casting place at least twice a shift, and also at a mixing place at least twice a shift if the weather is stable and the moisture of aggregates is constant. If the moisture of aggregates changes rapidly and/or the preparation of a mix with new composition or from new consignment of materials starts, the fluidity shall be tested not less than every 2 hours.

3.6.4.2.4 Concrete Testing

Quality control of concrete shall conform to ГOCT 7473-85.

Fluidity, frost resistance, density, water tightness, deformability, as well as other indices specified by the design shall be defined in accordance with requirements of state standards in force.

Strength check must comprise tests for compression strength. Besides, pavement concrete shall be tested for stretching when bending.

Concrete shall be tested for water tightness and frost resistance by sampling carried out on concrete installations before each batch and then at least once a quarter, and also when composition of concrete or characteristics of materials changes.

Concrete mixes shall be verified by technical control by the manufacturer. Verification of concrete mixes shall be performed by consignments.

Volume of mix in consignment is to be determined by ГOCT 18105-86.

Control of concrete strength shall be performed in accordance with ГOCT 18105-86.

Concrete mixes tested for the highest category shall produce concrete with a strength with a general variation not exceeding 9 %.

It is permissible to determine the concrete strength by means of non-destructive methods in conformity with ГOCT 17624-72, ГOCT 21143-75 and other methods indicated in ГOCT 10180-78. In this case, control and check of concrete strength with due regard to uniformity shall be performed in correspondence with ГOCT 21217-75.

3.6.4.2.5 Formwork

Timber, steel, plastic and other materials for forms shall comply with requirements of ГOCT 23478-79.

Forms in touch with concrete shall be made from coniferous timber. For other elements of form and fasteners it is permissible to use timber of deciduous specimens (aspen, alder). For bearing framework timber with a moisture content of not more than 18 % shall be utilised. A moisture content of not more than 25 % is acceptable for other parts.

Timber boards shall be planed and have a width of not more than 150 mm. Plywood for form manufacture shall be water-resistant.

Tightening bolts and snap ties as well as fastening parts shall be standard, and they shall be fast mounted and dismounted. Ties and snap ties not compliant with standards are allowable when shuttering of individual constructions of a small size is being carried out.

When installing the structures supporting form, the following demands shall be followed:

- Posts shall be installed on bases having a bearing area suitable to prevent undesirable settlements
- Ties, snap ties and other fastening elements shall not hinder concreting
- Fastening of ties and guys to the previously concreted structures shall be done with allowance for strength of concrete at the actual moment load.
- Form base shall be aligned before beginning of installation of the shuttering

Local unevenness of form when checking with 2 meter long plank shall be less than 3 mm.

3.6.4.2.6 Reinforcement

Reinforcement steel (bar, wire shape) and cast-in members shall conform to the design and requirements of relevant standards.

Placing of reinforcement shall be executed complying with the following requisitions:

- Before mounting of reinforcement form shall be checked
- Reinforcement shall be secured with specified cover to reinforcement secured by spacers (dry cement stones).
- Reinforcement shall be fastened against displacement and protected against damages which can occur during concreting of construction

Welding of bars is not permitted unless approved by the Engineer.

Installed reinforcement shall be accepted and registered in a statement for buried work tests before concrete placement starts.

Specified location of reinforcing bars and nets is provided by correct installation of supporting devices, templates, spacers, stands, linings and backing strips. In no way shall linings from curtailments of reinforcing bars, wooden planks or rubble be used.

Concrete cover to reinforcement is 20 mm -0/+5 mm not exposed to weather, and 30 mm -0/+8 mm exposed to weather.

3.6.4.2.7 Concrete Placement and Compaction

Before concreting bases and surfaces of construction joints shall be cleaned for debris, mud, grease, snow and ice, cement coat, etc. The cleaned surfaces shall be flushed with water and treated with air jet immediately before placing of concrete mix.

When cleaning concrete surface for cement coat, damage of concrete is not allowed. Concrete strength shall therefore not be less than:

Cleaning with water or air jet	:	0,3 MN/m ²
Cleaning with mechanised steel brush	:	1,5 MN/m ²
Water-sand blasting or cleaning with mechanised cutter	:	5,0 MN/m ²

Before concrete placement, the following shall be accepted and tested: all structures and elements buried by further works, correctness of installation and fixing of a form and constructions supporting the form. Just before concreting, the form shall be cleaned for rubbish and mud, and reinforcement shall be freed from rust coating.

Surfaces of formwork shall be lubricated in a way that do not deteriorate appearance and durability of structure.

Inplacing of concrete the height of free dumping shall not be over 2 m, and for roofs it shall be not more than 1 m.

If the height is more than specified, concrete mix shall be placed through inclined trays or through vertical tremie pipes.

Concrete shall be placed in horizontal layers of equal thickness without ruptures, with a consequent direction of placement to one side for all layers.

The thickness of placed layer of concrete may be determined based on compaction means.

If heavy suspended vibrators located vertically are to be used, the layer thickness shall be by 5-10 cm thinner than the working part of vibrator. When hand-operated internal vibrators are used, the thickness of placed layer shall not exceed 1,25 of the vibrator working part.

When compacting concrete by surface vibrators in constructions without reinforcement and with single reinforcement, the layer thickness shall not exceed 25 cm and for constructions with double reinforcement it shall not be more than 12 cm.

When concreting special structures (road pavements, hydraulic and other structures) with utilisation of high capacity vibrators, the placed layer of concrete can be increased.

For compaction, the following regulations shall be observed:

- Relocation pitch (distance) of internal vibrators can not be more than one-and-half radius of their operational scope. Relocation pitch of surface vibrators shall provide with 10 cm overlap of the vibrated spot by the surface vibrator platform.
- Depth of internal vibrator submersion into concrete mix shall provide its penetration into layer applied previously by 5-10 cm.
- Bearing of operated vibrators by reinforcement and cast-in members of concreted structures as well as by snap ties and other fasteners shall not be allowed.

Period of vibration at each spot is to be defined by experiment, at the same time it shall provide sufficient compaction of concrete which is shown by the following: settlement of concrete is finished, bleeding is appeared on surface, extraction of air bubbles is stopped.

The following general rules shall be maintained for placing concrete in columns and walls:

- Height of columns and walls cast continuously shall not exceed: 5 m for columns, 3 m for walls and partitions, 2 m for columns with size less than 0,4 m and columns of any size with crossed stirrups. If parts of columns and walls are cast without construction joints breaks shall be made to settle concrete mix.
- Duration of the breaks for settlement of placed concrete shall be not less than 40 minutes, and not over 2 hours.
- Frame structures shall be cast with a break between concreting of columns and girders of frames.

Beams and floor slabs shall be cast simultaneously. Walls to be casted to columns and walls shall be cast 1-2 hours after casting of these columns and walls. If the cross-section height of the beams is more than 0,8 m it is allowable to cast them separately from slabs.

In plane non-reinforced structures (platforms, blinding under floors) concrete shall be applied in a way of strips of 3-4 m width. Concrete shall be placed in every other strip, and the intermediate strips are to be filled after concrete in adjacent strips has stiffened.

Casting on top is permissible after the under-laying concrete has reached strength not less than 1.5 MN/m².

Face of construction joints, made when concrete is placed with breaks, shall be perpendicular to axis of concreted columns and beams, surface of slabs and walls.

Subject to the Engineer's approval construction joints can be installed in the following way:

- Columns - at the level of a foundation top, the bottom of purlins, beams
- Beams with big dimensions, casted to slabs - by 20-30 mm below the level of slab bottom
- Plane slabs - at any spot parallel with a smallest slab side
- Ribbed slabs - in a direction parallel with beams around the quarter point of the slab spans.

3.6.4.2.8 Concrete Curing

Placed concrete shall be protected against precipitation intrusions or moisture losses for a period of 7 consecutive days after placement. During further periods an ambient temperature and moisture shall secure strength increase of concrete and preserve concrete against blows and shocks.

Dismantling of formwork for concrete and RC structures can be accepted as follows:

- Dismantling of formwork side units which do not carry weight of constructions, can take place when concrete has reached a strength securing surface and corner edges when form is being removed
- Removal of formwork for bearing RC structures can take place after concrete has reached a strength of 70-100 % (depending on load) of specified strength.

3.6.4.2.9 Construction Tolerances

Condition of installed formwork shall be observed continuously in progress of concreting. If deformations or displacements of formworks influencing dimensions or quality of concreted structures, are revealed, actions shall be taken to remove these problems or the concrete works are to be stopped temporarily.

Tolerances for formed surfaces of in-situ and precast reinforced concrete are:

- Location of in-situ structure generally, relative to established setting-out lines, module lines, and levels: + 10 mm
- Longitudinal dimensions less than 30 m of same members: + 10 mm
- Cross-sectional dimensions of beams, slabs, walls, etc.: 0 mm to + 10 mm
- Size and location of penetrations, recesses, etc. + 5 mm
- Holding-down bolts, etc., as group: + 5 mm
but within group by template only
- or as otherwise specified on the drawings

3.6.4.2.10 Concrete Works in Hot Dry Weather

Carrying out concrete works in hot and dry weather, the following shall be taken into account:

- Increase in water requirements of concrete mix when its temperature is risen
- Fast loss of concrete mix fluidity during transportation or curing before placement;
- Intensive dehydration of placed concrete
- Considerable setting (initial) shrinkage of hardening concrete
- Difficulties for regulation of content of entrained air in concrete mixes having different temperatures
- Forming of non-equivalent temperature field in constructions under influence of sun radiation

Cements used for concrete in hot and dry weather shall have a setting start not earlier than 1,5 hours from beginning of hardening. Concrete shall be prepared by utilisation of surface active plasticising admixtures and plasticising-air entraining admixtures.

If it is impossible to use the admixtures when selecting concrete composition, increase of water consumption is allowable (to get necessary initial fluidity of concrete mix) in limits of 5 % while temperature of concrete mix equals 25°C and up to 10 % while temperature of concrete mix is 35°C, maintaining a required water-cement ratio. The fluidity shall never be regenerated by adding of water at the spot of placement. Maximum total period of transportation and placing of concrete mix without admixtures can not exceed 60 minutes while the temperature of concrete mix is 20°C and 20 minutes when the temperature of prepared mix equals 33°C.

Exposed faces of concrete shall immediately upon placement be protected against evaporation by covering with an impervious membrane or careful fog spraying with water in order to prevent plastic shrinkage cracking until the initial setting has taken place and moist

curing can begin. Duration of the initial curing shall correspond to the time required for procurement of initial strength of not less than 0,5 MPa.

Further concrete curing may be by means of installation of a water holding coat. The coat shall be systematically wetted; exposed horizontal surfaces of concrete shall be maintained under water layer; fine-graded water spray shall be continuously provided by means of various watering devices.

Further concrete curing shall be carried until concrete reaches 70 % of the design strength.

During the curing period watering wooden formwork shall be carried out regularly in order to retain concrete surface in a constantly moist condition.

3.6.4.2.11 Concrete Works in Wintertime

Heated water, thawed or heated aggregates are to be used in wintertime. When dry aggregates do not have ice on their grains, they can be added into mixer without being heated if the heat balance of concrete mix allows this.

By the beginning of curing or heating, temperature of concrete placed in shuttering shall be not less than 5°C when using concrete with frost-resisting admixtures and 2°C when making a heat treatment of concrete.

Concrete placement shall be continuous and if breaks can not be avoided concrete surface shall be covered and heated.

When ambient temperature is less than 10°C concreting of highly reinforced structures having reinforcing bars with a diameter of more than 24 mm, or reinforcement of rail steel profiles or with big steel cast-in parts, shall be carried out with a preliminary heating of steel up to positive temperatures or with a preliminary spot vibration at reinforcement and formwork zones with an exception of cases when concrete mixes have been pre-heated (when temperature of concrete is over 45°C). The vibration period for concrete shall be prolonged not less than by 25% in comparison with summer conditions.

Protruding bars of concreted structures shall be covered or heat insulated to the height (to the length) of not less than 0,5 m.

When shuttering is to be removed in winter time, constructions shall be covered if difference between concrete temperature and ambient one exceeds 25°C.

3.6.4.2.12 Precautions to be Taken During Concrete Works

Condition of tare, formwork and paving tools shall be inspected every day before concrete placement into formwork starts. Revealed faults shall be removed at once. Before beginning of concrete placement by vibrating tremie, operational order and safety of fastening for all links of vibrating tremie between each other and to emergency rope are needed to be examined.

When compacting concrete by electrical vibrators it is not allowed to relocate vibrator over electric cables during breaks in work; electric vibrators shall be switched off during transition from one spot to another.

Trestles for supply of concrete mix by dumpers shall be equipped with fender beams. There shall be lanes of not less than 0,6 between a fender beam and fence. Fender cross-beams shall be installed at the dead end trestles.

Bins (skips) for concrete mix shall conform to standards. Displacement of charged or empty bin is allowed when cut-off valve is closed.

When placing concrete from skips or a bin, the distance between bottom edge of the skip or the bin and earlier placed concrete or surface to where concrete is to be placed shall not be over 1m if otherwise stated by the design.

Mounting, dismounting and repair of concrete conveying pipes as well as removal of concrete blocked inside (blocking corks) shall be permitted only after the pressure has been reduced up to the ambient one.

In the course of cleaning (testing, blow) of concrete conveying pipes with compressed air, the workers not busy with these procedures shall be removed from the pipe to not less than 10 m distance.

3.7 Masonry Works

3.7.1 Extent of Works

All walls from natural brickwork materials (sawn lime stone), clay bricks and blocks, and concrete blocks shall be executed by the Contractor in accordance with the specifications and as shown on the drawings including furnishing and manufacturing of these materials, mortar plaster, anchors, ties, etc.

Unless otherwise stated all walls are plastered and painted on both sides.

3.7.2 Documents

When erecting brickwork constructions the Contractor shall be guided by the following norms and state standards:

- Stone and reinforced brickworks : СНиП II-22-81
- Clay bricks and blocks : ГОСТ 530-80
- Building mortars : ГОСТ 5802-86
- Sand : ГОСТ 8736-85
- Portland cement : ГОСТ 10178-85

- Water : GOCT 23732-79

3.7.3 Materials

Brickwork materials to be provided for construction shall be accompanied by the manufacturer's certificate containing information regarding their strength limit (mark, class) and frost resistance, and also density for light and heat insulating materials. When there is no certificate, the Contractor shall perform the necessary tests before these materials are used (GOCT 6427-75 and GOCT 8462-85).

3.7.3.1 Natural Sawn Lime Stone

Lime stone is sawn in blocks ("cubic" stones) of 190x190x390 from solid rocks in excavations.

The block mark is to be defined according to compression strength of entire and half blocks, as well as by testing of samples in shape of cube or cylinder.

Samples with specified dimensions have to be used to determine each certain mark of a block, results of the tests of the cubes and the cylinders are to be multiplied by coefficients of correction:

Mark of Blocks	Cube edge, mm	Cylinder height and diameter (h=d) mm	Coefficients of correction	
			Cube	Cylinder
25...100	150	100	1,00	1,02

Sawn lime blocks accepted for walling shall be of mark not less than 55.

Density of lime stone block shall be not more than 20,0 kN/m³.

3.7.3.2 Clay Bricks and Blocks

Bricks and blocks are produced from clay and silica rocks (trepel, diatomite).

Bricks can be both solid and hollow with dimensions of 250x120x65 mm.

Blocks are made hollow having dimensions of 190x190x390 mm (size of two holes is 120x120 mm).

Clay bricks and blocks shall be marked not less than 75..

Clay bricks and blocks are utilised to fill skeletons, in partitions and ventilation duct masonry.

3.7.3.3 Concrete Blocks

Concrete blocks for retention walls are manufactured from heavy concrete of class not less than B7,5.

Dimensions of blocks vary as follows: length -2380; 1180 and 880 mm, width 300; 400; 500; and 600 mm, height 280 and 580 mm.

3.7.3.4 Masonry Mortar

Cement-lime mortar of mark not less than 50 shall be used for masonry.

Cement mortars shall contain inorganic plasticisers (lime, clay) or organic plasticisers (gas entraining, waste material of industrial processing).

Quantity of admixtures and clay added into solution shall be limited depending on moisture conditions to be retained for the whole operational period of the building.

Natural and manufactured sand with a grain fineness up to 5 mm shall be used as aggregates for masonry mortars, and if masonry is from bricks and stones with a regular shape, the fineness shall be up to 2,5 mm.

In its weight sand shall not contain more than as follows: 1% of mica; 2% of sulphuric (sulphate) compounds calculated on SO₃ ; 3% of dusty, clay and silty particles specified by sieving; 20% of grains passing through a sieve with net No. 014.

The following shall be observed in mortar preparation:

- To batch parts of mortar by weight and modify when type, density and activity of binding material are changed; moisture and density of aggregate are changed; type of plasticizing admixture is modified, etc.
- To mix mortar thoroughly
- To control fluidity of mortar in accordance with conditions of operation.
- Mortars with inorganic plasticizers and also cement, lime and clay are prepared in mortar mixing machines - first water shall be poured into machine, then aggregate, binder and plasticizer are consequently charged.

Prescription for 1 m³ of Cement-Lime Mortar, M50

Compounds	Unit	MARK
		50
Cement mark 300	t	-
Cement mark 400	t	0,0178
Lime	t	0,0106
Sand	m ³	0,124
Water	m ³	0,046

3.7.4 Execution of Works

3.7.4.1 General

On delivery materials intended for execution of masonry shall be tested for conformity to requirements of strength, frost-resistance, dimensions, appearance and other indices envisaged by standards and the design.

Quality of materials furnished for erection of masonry constructions shall be controlled by data of relevant documents of the manufacturers-suppliers; as for materials used in executive constructions that utilise the design carrying capacity to 80 % and more, quality shall be additionally controlled by means of test performance with involvement of a construction laboratory.

Mortar for erection of masonry constructions shall be used before setting starts. Mortars segregated in the course of transportation shall be mixed before application into the work. Utilisation of dehydrated mortars is not allowed. Each mortar portion (transport unit) shall be accompanied by a document indicating type, mark and fluidity of the mortar, dates and hours of its manufacture, the types and the marks of cement, the mix moisture.

Thickness of horizontal joints of masonry from bricks and blocks with a regular shape shall be 10-15 mm. Mean thickness of the horizontal joints of the storey height shall be 12 mm. Permissible thickness for vertical joints of masonry from bricks and blocks with a regular shape shall be 8-15 mm; the mean thickness of the joints is 10 mm.

Walls, columns erected with jointing are to be executed in correspondence with a single system of joint bond - common bond or English bond. Header courses in masonry shall be placed from entire bricks. Independently on accepted bond system, placement of header courses must be implemented in the bottom (the first) and the top (the last) rows at a level of wall and column offsets, in cornices, belts, etc.

When erecting masonry constructions, vertical position of edges and corners of masonry from bricks and blocks, horizontality of its rows shall be examined not less than twice in each masonry level (every 0,5 - 0,6 m) with removal of revealed deviations.

Upon completion of masonry for each floor, horizontality and masonry top level shall be checked independently on intermediate examinations of the horizontality of its rows.

As a rule, deviation from design dimensions and position of masonry constructions shall not exceed the below mentioned:

Deviations from:

dimensions (thickness) of construction elements in layout	+/- 15 mm
levels of bearing surfaces	-10 mm
widths of columns	-15 mm
widths of openings in walls	+/- 15 mm
displacement of vertical lines of window openings	+/- 20 mm
displacement of construction lines	+/- 10 mm

Deviations of surfaces and corners of masonry from verticality for:

one floor	+/- 10 mm
whole building	+/- 30 mm
deviations of masonry rows from horizontal for 10 m length of wall	+/- 15 mm
unevenness on vertical surface of masonry revealed by installation of control plank with a length of 2 m	+/- 5 mm

3.7.4.2 Masonry Works in Winter Time

Bricks and blocks shall be cleaned from snow and ice to erect masonry constructions in wintertime conditions. Sand shall not contain ice and icy pieces with a diameter of more than 1 cm.

Lime putty used in masonry mortars shall not be frozen and it shall have a temperature of not less than 0°C.

Masonry of mortars with frost resisting chemical admixtures shall be carried out observing the following requirements:

- Mortars for erection of non-reinforced underground constructions, as well as walls of non-domestic buildings, shall be prepared with admixtures from calcium chloride, natrium (sodium) chloride in a quantity of 4-7% of cement weight
- Mortars for erection of masonry for overground constructions and also walls of dwelling buildings shall be prepared with admixtures from natrium nitrate, potash. In no way shall potash be used in a quantity of more than 10 % for masonry from stones (bricks) with a mark less than 100
- Masonry on mortars containing chemical admixtures can not be allowed when walls are to be erected for buildings with relative ambient moisture exceeding 60 % or if the ambient temperature during operation is over 40°C as well as for constructions located in a zone with fluctuating water level or affected by wetting in the course of operation.

3.7.4.3 Masonry Works in Hot and Dry Weather

When carrying out erection of masonry constructions in a hot and dry weather (when the ambient temperature equals 30°C and more and the relative ambient humidity is less than 50%), the following supplementary requirements shall be maintained:

- Water consumption of mortars prepared on Portland cement shall not be increased
- Water holding capacity of mortar shall be determined at manufacture spot once per shift; this shall be done for each composition of mortar in a way of definition of an index of water holding capacity, the magnitude of the index shall not be less than 75 % of the water holding capacity determined in laboratory conditions
- Segregation capacity of mortar transported by non-specialised traffic to more than 5 km distance shall be tested not less than twice per shift on the building site. Segre-

gation value shall not be more than 25 cm³ for mortars with the fluidity of 10-12 cm and not more than 40 cm³ for mortars having the fluidity of 12-14 cm.

- Before application clay bricks shall be submerged into water for time necessary for optimum wetting or wetted completely
- When there are breaks in the work, the top masonry row shall not be covered with mortar. After that breaks masonry shall be watered before continuation of the work.

3.7.4.4 Erection of Brickwork Constructions in Seismic Regions

When constructing masonry structures in seismic regions like Turkmenbashi, additional demands shall be made on materials:

- Surface of bricks and blocks shall be cleaned from dust before application
- Portland cement shall be used as binder in mortars intended for construction of masonry
- Natural sand shall be used as aggregate in mortar mixes. Fine and dune sands concentrated with sieved wastes from mining with fineness of 1,5-2,5 mm are allowed for utilisation
- Before the masonry works start, the construction laboratory shall specify the optimum ratio between magnitude of preliminary wetting of local walling material and water content of mortar mix
- Used mortars shall have a high water holding capacity (bleeding not more than 2%)
- To apply cement mortars without plasticisers is not allowed
- Ambient temperatures for setting periods of mortars shall be taken into account when selecting cements.

Masonry of bricks and blocks of a regular shape shall be performed in conformity with the following requirements:

- Masonry shall be executed for the whole thickness of construction in each row
- Horizontal, vertical, cross and longitudinal joints of masonry shall be completely filled with mortar with pointing of masonry joints on outdoor masonry sides
- Masonry of columns with a width of 2,5 bricks and less shall be executed from entire bricks with an exception when broken bricks are to be used for bond of masonry
- Temporary breaks in erected masonry shall be ended with inclined joggle only and they shall be located out of the spots of structural reinforcement of walls
- Curved ends of vertical ties of anti-seismic belt shall be directed (for control) to one of the indoor surfaces of erected wall.

While accepting masonry constructions in seismic regions, anti-seismic belts made at each floor, fastening of thin walls and partitions as well as strength of mortar cohesion with walling shall be tested intermediately.

If the results of tests for quality control of cohesion in masonry show that masonry category is reduced in correspondence with seismic effect resistance, the works shall be stopped for identification and elimination of the reason. Masonry of bearing structures that has been already erected shall be reinforced in conformity with the Engineer's approval.

3.7.4.5 Precautions to Be Taken During Masonry Works

After each moving of mason's scaffolds masonry level shall not be less than by 0,7 m higher than stage or floor. If masonry is intended for construction below this level, safety belts or special protective screening.

Never shall masonry be constructed by workers in standing position if outdoor masonry thickness exceeds 0,75 m. If the wall thickness is more than 0,75 m, it is allowed to construct masonry from wall using the safety belts fastened to a special safety device.

Masonry of the subsequent floor without installation of floor bearing constructions, as well as platforms and stairways in staircases is not allowed.

When masonry exceeds 7 m protective sheds shall be applied around circumference of the building; a width of the protective sheds shall not be less than 1,5 m, and they shall be installed with a slope towards wall.

It is permitted to carry out the masonry works without installation of the protecting covers (the sheds) if walls are up to 7 m height. The same concerns walls that are higher than 7 m but stipulating use of the protective screening installed at a masonry level.

3.7.5 Plastering Works

The following works are to be finished before start of plastering: filling of conjugation joints of window, door blocks; installation of window cills, installation of water insulation for floors and lavatory floors; laying of all communications (utilities); mounting of electric, radio and telephone wiring; window glazing.

If ambient temperatures of rooms to be plastered are low, it will be necessary to maintain the temperature of not less than 10°C while humidity is not more than 70 % within 2 days before the finishing work starts. Upon completion of the finishing work, the 10°C temperature in the rooms shall be retained within not less than 12 days. Natural drying of the rooms shall be carried out in a way of regulated ventilation through window and door openings.

Surfaces of brick, block, concrete structures to be plastered shall be thoroughly cleaned from dust, grease and bituminous blemishes as well as from salts appeared on the surface.

In dry weather, when temperature is 23°C and more, the plastered areas of walls from bricks, blocks shall be wetted avoiding water losses from the mortar.

Before plastering, concrete surfaces shall be treated by cutting and scarifying on the surfaces.

The plastering works shall be carried out in a specified sequence according to the following table:

Sequence of the operations	Category of plasters		
	ordinary	improved	high quality
Preparation of the surfaces for plastering	+	+	+
Aligning the surfaces	+	+	+
Installation of furrings ¹	-	-	+
Application of a scratch coat	+	+	+
Aligning the applied base coat	+	+	+
Application of a coat (second layer)	-	-	+
Aligning the applied coat (second layer)	-	-	+
Aligning corners	+	+	+
Aligning ceiling joints	+	+	+
Application of a finish coat	-	+	+
Floating	+	+	+
Finishing of reveals and caps	+	+	+

Thickness of the each layer shall not exceed 7 mm if it is from lime mortars and 5 mm if it is from cement mortars. The total thickness of the plaster shall not exceed 20 mm. Application of the each other plaster layer is acceptable only after setting of the previous layer.

Before hardening of the fresh plaster, it is necessary to keep it away from blows and shocks, wetting and excessive drying.

The plastering works shall comply with the following requirements:

- plaster shall be solidly connected with surface and it shall not scale off the surface;
- plastered surfaces shall be even, smooth, with precisely done corner edges, without traces left by floating tools, runs of mortar, blemishes.

Composition of the plastering mortars and type of the plasters are specified by the design. Quantity of certain mortar components as well as quality testing shall be carried out by a construction laboratory (standard CH 290-74).

Materials, used for preparation of the mortars shall correspond to the following standards of ГООТ:

- . lime - 4.204-79
- . cement - 4.214-80
- . sand - 4.211-80

¹ In order to follow the uniform level, workers shall apply strips of plaster for guidance

Table of prescriptions for 1 m³ of plastering work mortars is indicated below:

Material	Mortars									
	lime			cement				mixed		
	ratio of lime and sand			ratio of cement and sand				ratio of cement, lime and sand		
	1:2	1:2,5	1:3	1:1	1:2,5	1:3	1:6	1:1:6	1:2:3	1:3:15
Lime putty, m ³	0,43	0,38	0,33	-	-	-	-	0,11	0,21	0,33
Cement, kg	-	-	-	991	670	455	241	226	174	90
Sand, m ³	0,91	0,994	1,06	0,77	1,04	1,06	1,06	1,06	1,06	1,06
Water, litre	182	197	212	300	240	190	143	202	202	202

3.8 Steel Works

3.8.1 Extent of Works

3.8.1.1 General

The Contractor's duties under this contract includes all notification and applications to authorities and the procurement of all necessary certificates and permits.

In accordance with the specifications and as indicated on the drawings, the Contractor shall furnish all materials, equipment, tools and labour which are required to manufacture, treat and install all steel structures including all necessary mountings, connectors and fittings. Unless otherwise stated, all steel shall be surface protected by painting.

It shall be observed that the ferry ramps on both sides of passenger access bridge are existing ramps in commercial operation and all work shall be carried out in close co-operation with the ferry terminal authorities.

The Contractor will be required to set up a Quality Assurance Organisation and a Quality Assurance Programme and to keep and maintain such Quality Assurance Records as are necessary to secure that the work is executed and the materials are such as set out in the specifications.

The Quality Assurance Organisation and Programmes shall be submitted to the Employer for consideration one months prior to commencement of manufacture.

3.8.1.2 Marine Works

It is the intent of this contract to provide for:

- a complete new access bridge between two ferry ramps as replacement for existing concrete bridge including surface protection (Design lifetime 50 years).
- new fender structures including surface protection.
- steel sheet piles.

- anchors.
- steel piles.
- bollards including surface protection.
- lining of counterweight pits including surface protection .
- steel in sacrificial anodes protection.
- railings including surface protection.
- other steel equipment according to drawings.

It is required that the Contractor shall include supplementary calculations for elements not specified in specification or on drawings, inherent to engineering practices in order to achieve completely satisfactory structures.

The Contractor shall deliver documentation for inspection results, design drawings and supplementary calculations.

Further more it is required that the Contractor uses a method that minimise the period of time where there are no passenger access bridge.

3.8.1.3 Ramps and Towers

It is the intent of this contract to provide for a complete rehabilitation of the two ferry ramps and 12 support towers to ensure a continuous and trouble free operation in the future (design lifetime 50 years).

In accordance with the specifications and as indicated on the drawings, the Contractor shall furnish all materials, equipment, tools and labour which is necessary to dismantle, disassemble, inspect, rehabilitate and reassemble the two ferry ramps and the 12 support towers including counterweights.

The specifications are not intended to cover all details of the work, as the ramps need to be dismantled and inspected for the Employer and the Contractor to be able to agree upon the extent and the procedure for the rehabilitation.

However, it is required that the Contractor provides all the elements inherent to good engineering practices in order to achieve a completely satisfactory ferry ramp installation.

The specifications for the ramps and towers shall be read in conjunction with all other relevant chapters and paragraphs of this specification.

The Contractor shall, in every respect, be responsible for the complete rehabilitation, testing, commissioning, proper operation and safe functioning of the ramps.

The extent of works to be provided under this contract shall include but not be limited to the following:

- Dismantling of the wooden deck and the rails on the 2 ferry ramps.
- Dismantling of the 2 ferry ramps and the 12 support towers including counterweights.

- Disassembling of the ramps and towers to facilitate cleaning and inspection followed by the said cleaning and inspection.
- Discarding of the following equipment:
All timber, steel cross beams for deck support on spans 3, equaliser beams, rails, railing upon ramps, counterweights (except hoisting counterweights at the seaside span), lateral roller guides at the bridle beams, K-lattice columns under all support towers, masonry work on towers and all structural elements which are rejected following the inspection.
- Delivery of new equipment:
All discarded equipment is to be replaced with new equipment.
- Rehabilitation of all equipment not replaced with new equipment
- Application of complete surface protection upon new as well as rehabilitated equipment.
- Assembling and erection of the rehabilitated ramps and towers.
- Delivery of documentation:
Inspection results, design drawings and calculations.

The intent is for as many parts of the existing ramps and towers as possible to be reused. Only if the inspection reveals parts to be in such poor condition that rehabilitation is impossible or financial unsound, the parts should be replaced by new ones according to the specification or to the original specifications for the existing parts and in agreement with the Employer.

3.8.2 Documents

3.8.2.1 General

In general the work shall comply with the standards, norms and codes in the latest edition listed below.

National standards, norms and codes and standards, norms and codes of the former Soviet Union, may be used as an alternative if applicable and so agreed with the Employer.

Rail track work on the ramps and land works shall comply with national standards.

Basis for the Contract shall be British Standard BS 5400 Steel, concrete and composite bridges:

- Part 1: General statement
- Part 2: Specification for loads
- Part 3: Code of practice for design of steel bridges
- Part 6: Specifications for materials and workmanship, steel
- Part 9: Bridge bearings
- Part 10: Code of practice for fatigue

Appendices, guidance and recommendation clauses shall be valid to the extent they are applicable.

3.8.2.2 Marine Works

Delivery conditions and material specifications for structural steel, etc.

EN 10025	Hot rolled products of non-alloy structural steels- Technical delivery conditions.
EN 10204	Metallic products- Types of inspection documents
EN 10210-1	Hot finished structural hollow sections of non-alloy and fine grain structural steels - Part 1: Technical delivery requirements
EN 10027-1	Designation system for steel- Part 1: Steel names, principal symbols
BS 3410	Metal washers for general engineering purposes
ISO 898-1	Mechanical properties of fasteners- Part 1: Bolts, screws and studs
ISO 898-2	Mechanical properties of fasteners- Part 2: Nuts with specified proof load values- Coarse thread
BS 4395	High-strength friction grip bolts and associated nuts and washers for structural engineering
SEL 072	Ultraschallgeprüftes grobblech technische Lieferbedingungen

Welding and workmanship

Surface Protection

Hot-dip Galvanising

See section 3.8.2.3.

3.8.2.3 Ramps and Towers

3.8.2.3.1 General

The ferry ramp system will not be able to sustain the RU-loading for locomotives as specified in Part 2 of the standard.

Therefore the RU-loading shall be construed as a uniformly distributed load of 80 kN/m of track without the four concentrated loads representing the locomotive.

3.8.2.3.2 Delivery Conditions and Material Specifications for Structural Steel, etc.

BS 4	Structural steel sections
BS 4848	Hot-rolled structural steel sections
BS 4360	Weldable structural steels
BS 1449	Steel plate, sheet and strip
BS 2763	Round steel wire for ropes
BS 3410	Metal washers for general engineering purposes
BS 3692	ISO metric precision hexagon bolts, screws and nuts
BS 4190	ISO metric black hexagon bolts, screws and nuts
BS 4395	High-strength friction grip bolts and associated nuts and washers for structural engineering

- BS 4620 Rivets for general engineering purposes
SEL 072 Ultraschallgeprüftes grobblech technische Lieferbedingungen

3.8.2.3.3 Welding and Workmanship

- BS 5400 Part 6
BS 4870 Approval testing of welding procedures
BS 5135 Metal-arc welding of carbon and carbon manganese steels
EN 22553 Welding symbols
ISO 5817 Arc-welded joints in steel - Guidance on quality levels for imperfections

3.8.2.3.4 Surface Protection

- ISO 8501-1 Preparation of steel substrates before application of paints and related products-Visual assessment of surface cleanliness
ISO 4628 Paints and varnishes-Evaluation of degradation of paint coatings-Designation of quantity and size of common types of defect

BS 5493 Code of practice for protective coating of iron
RUGOTEST No. 2 and 3

3.8.2.3.5 Hot-dip Galvanising

- ISO 1459 Metallic coatings-Protection against corrosion by hot-dip galvanizing-Guiding principles
ISO 1461 Metallic coatings-Hot-dip galvanized coatings on fabricated ferrous products-Requirements

3.8.2.4 Land Works

In general the work shall comply with Soviet standards, СНиП II-23-81* and СНиП 3.03.01.-87.

Other equivalent standards and codes of practice may be used conditionally upon the prior approval of the Engineer.

3.8.3 Materials

3.8.3.1 Marine Works

Steel qualities and certificates shall be as stated in General Notes i.e. for load carrying structures, the properties shall be as for S355J2G3 according to EN 10025.

3.8.3.2 Ramps and Towers

3.8.3.2.1 Steel Qualities and Certificates

Steel qualities and certificates shall be as stated in General Notes i.e. for load carrying structures, the properties shall be as for S355J2G3, whereas other secondary steel structures such as railing etc. may have properties as for S235J0 according to EN 10025.

3.8.3.3 Land Works

3.8.3.3.1 Structural Steel

Except otherwise specifically noted or approved by the Engineer steel shall be type ВСТ3КП2, yield stress in accordance with СНиП II-23-81*.

All steel shall be free from cracks, scratches and bulges, and shall have clean, straight edges, a fine, smooth surface and exact cross section.

A manufacturer's test certificate shall be supplied with all steel delivered on the site.

All steel used for stairs and ladders shall be hot-dip galvanised.

3.8.3.3.2 Bolts and Nuts

All bolts and nuts shall be of steel quality according to ГОСТ 7605-70* with increased accuracy.

Anchor bolts (ГОСТ 2479.1-80) for columns fixing to foundation shall be material of steel types ВСТ3КП2, 09Г26 or 10 Г2С1.

3.8.4 Execution of Works

3.8.4.1 Marine Works / Ramps and Towers

3.8.4.1.1 General Marine Works

The Contractor shall built the new passenger access and all other marine steel structures in accordance with specifications and drawings.

In case the specifications or drawings calls for supplementary design and calculations the Contractor shall provide documentation for Employers acceptance before implementation.

3.8.4.1.2 General Ramps and Towers

The rehabilitation of the ramps and the towers shall be performed according to the original design of the structures except where the specification and drawings calls for a different design.

In case the specifications and drawings calls for different design, other parts of the ramps and towers may be inflicted.

It is the responsibility of the Contractor to perform the necessary redesign of such parts in order to obtain a complete and satisfactory design of the whole structure.

The basis for the drawings are existing drawings located in the offices of the Harbour Authorities and the Ferry Terminal Authorities.

As these drawings may differ from the actual structures "as built ", it is the responsibility of the Contractor to verify all measurements necessary on the actual structures before the work commences.

The replacement of existing rails P43 to new rails P65 shall include all necessary fittings, fishplates and bonds for joining of the new rails.
Special attention shall be paid to the bonds at the suspended joints between the ramp spans to ensure that a differential angle of 2.7 degrees does not jeopardise the joints.

Fixing of rails to the existing structures of span 1 and 2 and the new structures of span 3 shall be made by use of the Gantrail system as shown upon drawings.

It is the responsibility of the Contractor to ensure that the specified fittings are suited for use with the rail type P65 or if another type of Gantrail fitting is better suited.

In case the Contractor as a result of the inspection of the existing structures finds evidence, which gives reason to believe that the original design is inadequate for the required design life of 50 years, he shall redesign the weak components in question.

3.8.4.1.3 Cleaning and Inspection of Ramps and Towers

Following the disassembling all structures are to be mechanical cleaned where necessary to remove compact heaps of dirt, seaweed etc. and washed before sandblasting.

All structures are then to be sandblasted to remove all existing paint to a degree necessary for inspection purposes.

All structures are to be thoroughly inspected for mechanical damage, excessive corrosion, laminations, cracks and deterioration, which are detrimental to the structures.

All findings shall be reported to the Employer as part of the Quality Assurance and decisions as to the effect of the findings shall be made in agreement with the Employer.

Any cracks which might appear to be caused by fatigue shall be cut out from the structures and brought to an experienced metallurgy laboratory for microscopic examination to establish the cause of the cracks.

It is compulsory that the cutting process shall not change the metallurgy of the surrounding material close to the crack.

Therefore the cutting shall be performed at a safe distance from the cut or be performed by use of small water cooled grinding sheaves.

If possible the entire crack should be cut out in order to facilitate the revelation of the cause of the crack.

Searching for cracks should preferably be done by magnetic particle methods, as fatigue cracks will almost always appear at the surface of the structures.

The steel cross beams at span 3 of the ramps have a history of failing due to cracking and are especially suspected of fatigue failure.

Therefore at least one specimen of a crack in these beams shall be analysed in the laboratory.

Special attention shall be paid to the following areas of the structures:

- The flanges of the main girders, where notch effects due to welds might cause initiation of cracks
- Riveted joints of the cantilever beams at the sea side of span 3
- Nose end pin bolt structure at span 3
- Cantilever bearing pad structures at the nose end of span 1 and span 2
- The cantilever ends of the bridle beams and the equaliser beams at all three spans
- Support structures for the longitudinal rail beams of span 1 and span 2.
- The substructures of the support towers, especially the bracing of the K-lattice
- The horizontal beams of the towers supporting the spindle assembly

3.8.4.1.4 Choice of Standard Products and Documentation for Marine Works

In cases where the specification or drawings do not specify the choice of products or where the Contractor wish to choose alternative products than specified, the Contractor shall provide documentation and prospective calculation for Employers acceptance at least 2 months before implementation.

The Contractor shall under this contract choose:

- 3 identical transition sections for compression and dilatation.
- 3 x 4 bridge bearings.

3.8.4.1.5 Design and Documentation for Ramps and Towers

As a rule all damaged structural items which are deemed to have a lifetime less than the required 50 years shall be replaced by new ones.

If the reason for rejection of the item is due to mechanical damage, excessive corrosion, lamination etc. the item shall be replaced according to the original design.

If the reason for failure of the item is judged to be either fatigue or failure due to excessive stresses the Contractor shall redesign the item.

Basis for the design shall be BS5400 as mentioned in chapter 8.1.2.2 with the exception that a reduced RU-load (train load) of 80 kN/m uniformly distributed shall be applied. All other loading shall be as stipulated in Part 2 of the Standard, and loads caused by nature such as wind, snow and earthquake shall be adjusted using national standards applicable for the area in question.

The design documentation shall comprise:

- Drawings detailing all items redesigned by the Contractor
- Design calculations to verify the carrying capacity and lifetime of the redesigned items

The documentation shall be submitted in triplicate to the Employer for consideration one month prior to commencement of manufacture.

Drawings shall be in both English and Russian Language.

3.8.4.1.6 Steel Work

.1 General

The general design shall, as far as practicable, be such as to avoid the formation of pockets where moisture and water can collect. Adequate drainage shall be provided to prevent corrosion where this is not possible.

All welds shall be continuous. All load bearing structural welds shall be correctly terminated and due consideration shall be given to weld design in highly stressed areas to minimise the fatigue effects of stress concentrations due to weld notches.

Intermittent welds shall not be used in the interests of stress concentration and corrosion prevention.

.2 Cutting

Machine flame cutting or shearing of steel equivalent to BS 4360 grade 40D and 50B in tension flanges over 50 mm thick is only acceptable if at least 3 mm of material is removed from the flame cut or sheared edge by machining.

.3 Straightening

All plates, bars and sections shall be flattened and straightened and made free from twist before any other work is done on them.

The method adopted for this work shall be such as not to injure or mark the material.

.4 Notches

The ends of all beams or girders shall be square where required and flanges neatly cut away.

Where stress relief holes are required all holes shall be kept as small as possible and radii shall be applied in the inner corner to reduce the notch effect.

.5 Drainage Holes

Drainage holes shall be provided in members where water could collect during and after erection. However the fender steel structure shall be a completely closed box structure with no possibilities for water to enter.

.6 Holes

Holes shall be in accordance with BS 5950 except that drilling shall always be used to form holes for friction grip bolts, even if these are in cleats. Holes shall be cleaned up and all burrs and deformed metal removed.

.7 Machining of Joints

The butt ends of compression members which are to be spliced by bolting shall, except where the bolts carry the loads, have their abutting faces machined after fabrication so that they shall be square to the member axes and in tight bearing contact throughout when erected.

Any deviation shall be within 0.25 mm for surfaces that can be inscribed within a square of side 0.5 m.

.8 Minimum Thickness

All gusset plates, rolled sections and built-up sections shall be not less than 8 mm thick. This does not apply to the webs of rolled steel universal beams and channels.

.9 Accuracy of Measurement

All dimensions shall be made with a steel tape related to a standard tape which has been certified to be correct at 20o C. The tape and steel to be measured shall be at the same temperature and proper precautions shall be taken to tension the tape correctly.

.10 Fabrication Tolerances

The maximum acceptable tolerances on fabricated items shall be as follows:

- a) Length of compression member finished for tight bearing contact: (1 mm.
- b) Length of any other member equal to or less than 9.0 m long: +0 - 2 mm.
- c) Length of any other member over 9.0 m long: +0-4 mm.
- d) Width of plate girders: (3 mm.

Depth of plate girders (measured at centre line of web):

- i) For depths up to 400 mm:(3 mm
- ii) For depths over 400 mm: (4mm

- e) Deviation from straightness, columns and struts: Length of finished member/1000 or 3 mm whichever is the greater.
- f) Deviation from straightness of sheeting rails: Length of finished member/500 but not more than 25 mm.
- g) Deviation of centre line of web from centre line of flanges in built-up members at contact surfaces: 3 mm.
- h) Tilt of flange of welded plate girders:
 - i) For flanges up to 450 mm in width: 2 mm.
 - ii) For flanges over 450 mm in width: 3 mm

The offset shall be the amount the toe of the flange is out of square with the point of intersection of the web measured at the underside of the flange.

- i) Base plates are to be perpendicular to the axes of columns within 3 mm. This dimension shall be measured parallel to the longitudinal axis of the column at the points where the outer surfaces of the column sections make contact with the base plate.
- j) Machined ends are to be perpendicular to the axes of columns within 0.50 mm.
- k) Machines faces of end plates are to be perpendicular to the axes of beam or girder within 0.50 mm.
- l) Where a tight bearing contact is specified on the drawings the abutting parts shall be deemed to be in contact when the following requirements have been fulfilled:
 - i) Over at least 60 per cent of the bearing surfaces the gap between the surfaces shall not exceed 0.25 mm.
 - ii) Over the remainder the gap shall not exceed 0.50 mm.

The above acceptable tolerances shall be uniformly distributed over the whole of the abutting parts.

Tolerances not given above are to comply with BS 5400 Part 6, including table 5.

Notwithstanding the above permitted fabrication tolerances, the structure shall be erected to comply with the erection tolerances specified in the drawings for the existing structures.

.11 Slab Bases and Caps

Slab bases and caps shall be accurately machined over the bearing surfaces and shall be in tight bearing contact over the whole area of the machined end of the stanchion or column.

Holes of not less than 40 mm diameter shall be provided in all slab bases to facilitate grouting.

Contact surfaces of connections blast cleaned as part of general surface preparation for works painting shall be masked with adhesive bands before any paint is applied. The masking shall be removed from both contact surfaces of a connection immediately before a connection is made. Masking bands shall not be treated with an adhesive which adversely affects the slip factor coefficient between the contact surfaces.

.12 Painting Near Welded Work

No paint other than pre-fabrication primer shall be applied within 50 mm of the edges of steelwork which is to be welded.

.13 Coating of Inaccessible Surfaces of Unpainted Steelwork

Surfaces of members which will be rendered inaccessible when fabrication is completed and are not in close contact with other surfaces shall be protected by filling the cavity between the surfaces with sealing compound or by application of a coating system as shown on the drawings.

.14 Identification of Steel

At all stages of fabrication, structural steel shall be positively identified by grade, either by colour marking or by another marking system.

.15 Welding

a) General

Welding of structural steelwork shall be by an electric arc process. The procedure to be followed, plant and equipment to be used and the testing and inspection to be applied shall conform with BS 5135 and this Specification.

All non-mandatory clauses and parts of the BS shall apply. In particular, the recommendations of Appendix E shall be followed and all weld procedures shall indicate compliance with these requirements.

b) Terms and Symbols

On all drawings, welding procedure sheets, etc., terms and symbols relating to the welding and cutting of metals shall be in accordance with EN 22553 or BS 5950 where applicable, unless otherwise agreed by the Engineer.

c) Electrodes

Low hydrogen basic coated electrodes to BS 639 shall be used in the following circumstances:

- i) For the welding of steel to BS 4360 grades 40D, 50B and 50C.
- ii) For butt welds in steel to grades 40D, 43C and 43D.

- iii) For the root run of butt welds in steel to grades 40D and 43B in tension flanges 26 mm thick and over.

The impact properties of the parent plate and/or the requirements of the relevant design code shall be considered in the choice of consumables.

d) Shop and Site Welding

Shop welding shall be carried out in workshops under the specified conditions of temperature, materials, welding procedure, workmanship, welding operations, supervision and inspection.

Site welding shall be avoided to the extent possible and shall only be carried out if in compliance with the conditions specified above.

e) Welding Procedure and Quality Control

The proposed welding procedures together with related quality control documentation such as electrode specification, storage, drying and handling requirements shall be submitted to the Employer for approval. No welding shall commence before the approval.

Testing of welding procedures according to BS 5135 and BS 4870: Part 1 or other satisfactory evidence of the welder competence will be called for by the Employer.

Welding procedure shall be such that distortion is reduced to a minimum.

Approval of the welding procedures shall not relieve the Contractor for this responsibility for correct welding and for the minimising of distortion in the finished structure.

The Contractor shall ensure that the design of welds is such that a full volumetric examination of the weldings may be made when ultrasonic or radiographic inspection is required.

f) Fusion Faces

The forms of weld joint preparation shall be in accordance with BS 5135 as applicable or as may be otherwise approved by the Employer.

g) Butt Welded Joints

The ends of butt welds shall have full throat thickness. On rolled sections this shall be achieved by the use of extension pieces, cross runs, or other means approved by the Employer. On all main plates this shall be obtained by the use of run-on and run-off plates cut from extensions of the main plates and securely clamped to the parent plate.

Such run-on and run-off plates shall have the same joint preparation as the parent plate and arranged so that the direction of rolling is the same as that for the parent plate.

h) Intermittent Welds

Intermittent welds shall only be permitted with the approval of the Employer.

i) Testing of Welding Operators

The Contractor shall allow in the fabrication and erection rates for the steelwork for the cost of testing his welders and all associated costs including the provision of all labour, material and equipment for the preparation and testing of test specimens and for providing the services of a qualified welding examiner.

Welders shall be qualified using the appropriate tests corresponding to the weld positions and parent materials to be employed.

Only welders who can produce evidence acceptable to the Employer of having satisfied the appropriate tests shall be employed on welding.

j) Acceptance of Welded Structures

The acceptance of the welded work shall depend upon correct dimensions and alignment and absence of undue distortion in the structure, upon satisfactory results from the inspection and testing of the joints and the test specimens, upon the soundness of the welds and upon general good workmanship.

k) Marking

Every piece of steelwork shall be distinctly marked before despatch in accordance with the marking plan prepared by the Contractor. It shall also be given other marks and symbols as necessary to assist erection at site..

Unless otherwise approved by the Employer members which are to be finished painted at works, metal sprayed or galvanised, shall have all marks hard stamped in addition to being painted. The hard stamping, to such a depth that it will not be obliterated by the metal spraying or galvanising, shall be done at one end of the member and shall be ringed with a paint mark. Where steel is given anti-corrosion treatment before arrival on site, the marks must be painted with a white paint that can easily be covered with the final site anti-corrosion treatment.

3.8.4.1.7 Surface Protection

.1 Condition of Existing Structures

a. Steel Structures

The steel structures of the ramps and the support towers consists of riveted, welded and bolted profiles and plates.

The condition of the structures are in general good but most types of corrosion attacks occur.

The Contractor shall himself register serious corrosion attacks (pit corrosion).

b. Existing Surface Treatment

The condition of the existing surface treatments are in varying states of deterioration.

The paint systems applied are not known to the Consultant.

.2 General Execution Requirements

c. Cleaning

The sand type shall be approved by the Employer during the establishment phase of the site, possibly by inspection of test blasts.

In case grinding is locally considered to be required in greater depths than 2 mm below original surface, the Employer shall be consulted before commencing of grinding.

d. Paint Application

Generally, the paint shall be applied by airless spraying and brush.

Each type of paint may require different application tools. Agreed requirements shall be obeyed to and roll application is not allowed.

e. Temperature and Humidity Requirements

The requirements given by the paint manufacturer shall be complied with but furthermore, the following shall be noted:

No paint shall be applied if there is condensed water (dew) on the surface even if water or dew is wiped off first.

No paint shall be applied if the surface temperature of the steel is below the dew point temperature plus 3(C or if relative humidity is greater than 85%.

The surface temperature of the steel shall always be measured on the coldest of the areas in question.

The results of climate control to be reported as part of the Quality Assurance. The control shall take place at the beginning of the paint work, during weather changes and at the end of the paint work, however, at least each 2 hours.

.3 Execution

a) Pretreatment

When disassembled all structures are to be mechanical cleaned where necessary to remove compact heaps of dirt, seaweed etc. and washed before sandblasting.

All structures are then to be sandblasted to remove all existing paint to a degree necessary for inspection purposes (ultrasonic testing etc.).

b) Cleaning

The rehabilitated structures are to be washed down with detergents to remove oil, grease, dust and salt before blasting.

Grit blasting to degree Sa3 according to ISO 8501-1

Areas which are not accessible to blasting, shall be manually cleaned, and pit corrosions and possible sharp edges shall be smoothed by use of hand tools (for example grinding machine).

c) Paint System

Ramps and towers, access bridge, fender shields, lining for counterweights.

The following system from J.C. Hempel A/S, shall be used (applied by spraying):

Metallizing/chlorous latex/acrylic

Technical spraying with zinc, Spr. Zn 80	80 µm
1 coat Hempanyl Primer 1606, min. dry film thickness: colour: Yellow 2209	25 µm
1 coat Hempatex Hi-build 4637, min. dry film thickness: colour: Grey 1217	80 µm
1 coat Hempatex Emaille 5636, min. dry film thickness: colour: White 1000	40 µm
1 coat Hempatex Emaille 5636, min. dry film thickness: colour: To be decided	45 µm
Total minimum dry film thickness	265 µm

Remarks: The colour of the final coat to be decided upon by the Employer for the different structures.

e) Paint Application

The surfaces shall be free of grease, oil, dust, sand and salt, etc. during painting.

The cleaning degree Sa3 shall always be in effect during paint application.

In advance of each spray application, the backside of all rivets placed closer than 10 cm from inner corners and edges shall be pre-coated/pricked out. All other areas, where ordinary airless spraying does not cover satisfactorily, shall likewise be pre-coated/pricked out.

Pre-coating/pricking out shall be assumed carried out with brush with frequent dips. The pricking out may alternatively take place with spray application with angled nozzle but the method shall be approved by the Employer beforehand. The important thing is that the result is safe and sufficient, any disagreements to be solely solved by the Employer.

Misaligned joints where the plates/profiles do not completely abut, shall be sealed by use of pre-coating with brush.

Each finished coat shall cover the previous coat completely (also pricked-out areas).

f) Synthetic Coating on Acrylic Base on Lane in Access Bridge

The following system from Ulfcar A/S, shall be used (applied by special trained labour):

Metalprimer Acrydur GRM:	0,100 kg/m ²
1 coat acrylic resin Acrydur M330 with hardener Benzoylp-eroxyd (BPO):	min. 1.5 mm
1 coat binding agent acrydur N1 methylmetacrylat (MMA):	min. 3.0 mm
Bauxites broken stones (grit size 1.20 mm- 3.35 mm):	8-10 kg /m ²
Total minimum dry thickness	6 mm

Remarks: The colour of the final coat to be decided upon by the Employer for the different structures.

g) Acrylic Coating Application

The surfaces shall be free of grease, oil, dust, sand and salt, etc. during execution.

After cleaning degree Sa3 the surface shall be dry cleaned.

The surface i coat with Acryldur GRM within time of beginning corrosion.

After dehydration of primer Acryldur M 330 are laid out with toothed filling knife to thickness of min. 1.5 mm.

After dehydration of sealing Acryldur N1 are laid out with toothed filling knife as binder to thickness of min. 3.0 mm. Without dehydration Bauxite broken stones are spread out in full dose 9-10 kg/m² in the wet binder.

After dehydration and cleaning of loose Bauxite the total thickness shall be between min. 6 mm up to 8 mm.

h) Hot-dip Galvanising

Rails and other equipment where specified in drawings and notes.

The steel shall have a treatment of grit blasting to Sa 2 1/2 in accordance with ISO 8501-1.

The galvanizing shall be carried out so as to obtain a uniform layer, adherent and free from cracks and fissures. The galvanizing shall be in accordance with ISO 1461, with a minimum thickness of 65 microns for the bolts and 100 microns for the other items, or the thickness corresponding to the material thickness as specified in the standard.

All deformation during the galvanization of the welded pieces shall be corrected carefully, in a way preventing the galvanization being harmed, and the steel being overstressed. Generally, no treatment is allowed after the hot dip galvanizing.

Small repairs can be permitted using 2 layers of zinc dust paint.

.4 Result Requirements

a) Pretreatment

Before mechanical cleaning and at each coat application the surfaces shall be efficiently oil-, grease-, dust- and salt free.

Possible use of approved de-greasing means shall be followed by flushing of the surfaces top down with clean fresh water.

Testing for oil and grease remains may be performed by the water drop test:

Water Drop Test:

The test is carried out by spraying a fine fog of distilled water on the surface and observing how the water floats together.

- a) If the water drops are gathering in limited areas repelling the surface the surface is defined as being oil or grease polluted.
- b) If the water drops gather in an even film without suddenly spreading over areas, the surface is defined as being clean.

b) Grit Blasting

Grit blasting shall be to cleaning degree Sa3 according to ISO 8501-1.

The roughness of the surface after blasting shall be to RUGOTEST No. 3, BN10g.

c) Other Cleaning

Where manual cleaning is locally used, the surface shall be cleaned to metallic pure steel (cleaning degree corresponding to St 3). Roughness of finished ground surface must not be finer than corresponding to RUGOTEST No. 2 N10.

Possible sharp edges shall be rounded to a radius greater than or equal to 2 mm.

d) Paint Application

The requirements to paint application below concern all forms of paint regardless of the extent of the work.

Surfaces shall at each coat application be clean and the result requirements as described above shall be fulfilled.

All application requirements given by the paint supplier shall be complied with.

e) Coat Thickness

Requirements regarding coat thickness are applicable everywhere, including areas with pricking out (meaning that pricking out works may have to be repeated until the requirements as to coat thickness are complied with).

The coat thicknesses stated in this specification are minimum dry film thicknesses which shall be complied with for each coat and in the total system. Below mentioned procedure and requirements shall be used (modified 90-10-rule):

A control area is determined, for example a structural element or a part of a structural element. The control area shall be situated in the part of the element which by experience is known to give rise to problems with the coat thickness.

A series of measurements is carried out consisting of at least 20 single measurement within the control area.

The distance between single measurements should be at least 2 cm (either in line or in mesh-form).

All measurement results shall be greater than 90% of the prescribed coat thickness.

A maximum of 10% of the measurement results may be smaller than the prescribed coat thickness.

The coating of the element is rejected in case of non-compliance with the requirements.

Rejected elements shall be re-done/re-painted according to the specification and without costs for the Employer.

f) Pore Density

After the second coat of paint, the following requirements to pore density shall be complied with:

Pore test to be carried out with low-tension pore finder (wet sponge, 9V).

The pore finder may at the most deflect once for each running meter on edges.

On the backside of rivets, the pore finder may at the most deflect once for each 25 rivets.

On surfaces, the pore finder may at the most deflect once for each square meter.

After the 3rd coat the surface shall be without any pores.

g) Adhesion

The adhesion shall be satisfactory everywhere and the Employer may demand testing performed on the finished surface treatment.

The adhesion of the applied system is determined by the pulling method according to ISO 4624. The values measured shall be minimum 65% of the mean value of 10 measurements carried out on test plates of a minimum of 5 mm thickness.

Control procedure and determination of mean value is stated in the control paragraph below.

The pulling must not result in pure adhesion breach of base or between two coats of paint.

.5 Monitoring and Supervision

a) General

The Monitoring and supervision work shall assure agreement between the specified material and result requirements and the quality of the work carried out.

Monitoring and Supervision include:

- Process monitoring.
- Inspection at commissioning.
- Inspection half way through the guarantee period.
- Inspection at the expiration of the guarantee period.

The process monitoring aims at establishing and maintaining a given quality level and in continuation thereof to find and prevent faults at the time of execution.

The Inspection at commissioning aims at by reviewing the finished works to ascertain whether the surface treatment carried out has obtained the specified quality.

The Inspection half way through the guarantee period aims at giving the Contractor a better opportunity to prevent/repair possible defects before any further development of these.

The Inspection at the expiration of the guarantee period aims at stating whether the surface treatment carried out complies with the requirements made with regard to durability.

b) Contractor's Monitoring

The Contractor shall make a continuous, efficient monitoring of materials and execution of work as well as inspection of the finished work.

The Contractor's supervision shall be documented as part of the Quality Assurance.

Contractor's supervision includes monitoring of climate, measurements of thicknesses of applied paint, both wet film and dry film thicknesses as well as pore testing.

The testing of coat thickness shall be carried out on each coat (if practically possible) and on the finished paint film.

The continuous wet film control shall be carried out to such an extent that each painter will at any time be sure which film thicknesses he is applying.

The extent of dry film measurements has been determined to be minimum one measurement of the total dry film thickness per square meter.

If problems occur in relation to thicknesses of single coats, the Contractor may be required to supply continuous documentation during a certain period of time, until the problems have been overcome.

All dry film measurements should be documented by print-outs from coat thickness measuring meter.

After application of the 2nd and 3rd coat, the Contractor shall make spot tests of the areas where pricking out has been carried out, with low-tension pore finder.

The Employer will put special emphasis on the obtained coat thicknesses after 2nd and 3rd coat in order to avoid that possible deficiencies in thicknesses shall result in the application of final coat of excessive thickness.

The instruments to be used for thickness measurements shall be calibrated and approved by the Employer before commencing of paint work.

c) Paint and Coat Supplier's Supervision

The paint and coat supplier's shall have access to make occasional unannounced visits on the site in order to make spot tests of all activities and carry out his own measurements of coat thickness. He will then inform the Employer in writing as to whether the work is carried out according to the specifications.

If the Contractor has any questions to the paint supplier concerning this contract, such questions shall be addressed to the Employer.

d) Employer's Supervision

The Employer will make continuous monitoring of all of the activities of the Contractor on a spot check basis.

The Contractor shall, without any costs to the Employer, supply the Employer with necessary manpower and machines to carry out the Employer's supervision.

In case of destructive tests, the surface treatment shall be re-established by the Contractor without any costs for the Employer.

.6 Reference Sections

The Contractor shall present to the Employer a programme locating suggested reference sections and their dimensions.

This programme shall be approved by the Employer and the paint supplier before treatment of the sections.

The number of sections shall be at least one at each ramp span and each support tower.

The Employer shall supervise the treatment of reference sections in all phases and for all treatments.

Considerations shall be made to a reasonable flow of work for the Employer making agreements on work in reference sections.

Each reference section shall be reported finished by Contractor and Employer, for example in Minutes of Meeting, and all parties thus makes known that the section is approved as having been correctly carried out.

In case of guarantee damages, the reference sections are used to place responsibility for the damages in question as the damages is defined as execution deficiencies (Contractor's responsibility), if the reference section is without deficiencies.

The reference section(s) with which the damages are compared shall be the nearest one, containing the same structural principles as the damaged areas.

The finished coat thicknesses in the reference sections shall be within the following limits of the required minimum thickness (= 100%):

- Smallest thickness : > 90% and < 120%
- Arithmetic mean thickness (mean) : < 150%

If a finished section does not comply with these requirements, the section may be rejected and a new one made.

.7 Guarantee

a) Guarantee Requirements

The guarantee period commences at the time of commissioning and is valid for all surface protection work done.

The Contractor shall initiate an inspection after 2.5 years to prepare for and carry out preventive maintenance if found appropriate.

During a period of five years from the commissioning of the work, the below guarantee requirements shall be complied with.

If, according to these requirements, deficiencies should appear, they shall be remedied according to the specification valid for the present surface treatment, without any costs for the Employer.

b) Rusting

No penetration due to rust must occur within the guarantee period to an extent greater than Ri 1 according to ISO 4628/3. Surface areas with penetration shall be less than or equal 0.1% of the total surface area of the item in question.

In case of penetration spots greater than according to Ri 1, the total area of the spots may still not exceed the 0.05% of the plate area for Ri 1 mentioned in table 1.

c) Blistering

No blisters caused by erroneous treatment or product fault must occur during the guarantee period, to a greater extent than degree 2 according to DS/ISO 4628/2, and the areas with blisters shall cover less than 0.1% of the total surface area of the item in question

The maximum size of blisters to be accepted is degree 2 irrespective of extent of areas blistered.

d) Flaking

Within the guarantee period, no flaking or lack of adhesion between paint coats must occur, to an extent greater than degree 1 according to ISO 4628/5. Maximum accepted area with flaking is 0.1% of the total surface area of the item in question.

e) Cracking

Within the guarantee period, no cracks must occur, irrespective of depth, to an extent greater than degree 1 according to ISO 4628/4.

The total area covered with such cracks must be less than 0.1% of the total surface area of the item in question.

f) Exceptions

Floor plating: The guarantee requirements do not apply to areas up to 2 cm from contact edges and free edges of the floor plates.

Mechanical damages: Damages caused by mechanical influence after the commissioning do not give rise to guarantee claims.

3.8.4.1.8 Site Dismantling and Erection

.1 Plant and Equipment

The Contractor shall provide sufficient plant and equipment to facilitate the efficient dismantling and erection of the ferry ramps and support towers to meet the programme and other requirements. The Contractor shall maintain the plant and equipment in good working order.

The Contractor shall submit to the Employer for his approval, crantage proposals for dismantling/erection of the ramps and towers.

The proposals shall be such as to ensure that no damage occurs to the structures, or other works.

The crange proposals which will include track positions and loadings, etc. shall be submitted to the Employer in sufficient time for a check to be undertaken on the design of concrete works prior to commencement of steelwork dismantling/erection.

.2 Dismantling and Erection Procedure

Details of proposed dismantling and erection procedures accompanied by diagrams where necessary shall be submitted to the Employer for his approval in good time prior to commencing of work on site.

The Employer may call for other erection procedures if considered necessary.

.3 Handling

Damage to any part of the structures either before or during dismantling/erection shall be immediately brought to the notice of the Employer. No damaged part shall be assembled in the structure without the approval of the Employer.

.4 Contractor's Area

The Contractor shall make adequate arrangements within his allocated area for storing and handling all his materials and the dismantled structures.

.5 Setting Out

The Contractor will, after the completion of the marine works, be supplied with particulars of data for line and level which shall be used for setting out the structure.

The Contractor shall be responsible for the correct positioning and the correct levels of the structure in relation to the data given.

The Contractor shall give the Employer not less than 24 hours notice of his intention to set out or give levels for any part of the Works.

Errors subsequently found in the alignment or levels of the ramps and the towers shall be corrected by the Contractor at his own cost.

.6 Base Slabs

Lining

The maximum permissible offset in plan of a base slab from the set out lines about both axes shall not exceed 3 mm.

Levelling

The maximum permissible deviation from level shall not exceed (3 mm.

.7 Plumbing

The maximum permissible deviation from the vertical centre line about both axes shall not exceed 0.1% of the height.

.8 Lining and Levelling

The permanent bolting up of connections shall not be carried out until a sufficient portion of the structure has been erected and temporarily connected up to ensure that there shall be no straining of members during erection, lining up and levelling of the remainder of the structure.

The maximum permissible deviation for horizontal line and level of the steelwork shall be +5 mm on any part of the structure.

Shims shall not be used without the approval of the Employer.

.9 Temperature Effect

All steelwork shall be level and plumb within the permitted tolerances at mean ambient temperature at the time of issue of the completion certificate.

.10 Foundation Bolts and Anchorage Materials

The Contractor shall supply such drawings and steel templates as may be required for the proper positioning of holding down bolts and bases. The foundation bolts shall be of an approved manufacture and shall be fitted with washer plates or anchor frames and nuts etc. as required.

.11 Temporary Bracing's

Temporary bracing's shall be provided by the Contractor to ensure the stability of his work during dismantling/erection work. Details of the Contractor's proposals in this respect shall be submitted for the approval of the Employer before work is commenced.

.12 Temporary Scaffolding

Scaffolding of adequate strength and working area together with reasonable access thereto shall be provided by the Contractor to facilitate the work of dismantling/erection and inspection.

3.8.4.1.9 Quality Assurance

.1 Quality Assurance, General

The Contractor shall be responsible for the Quality Management as stipulated in the ISO Standard:

ISO 9001: Quality systems-Model for quality assurance in design/development, production, installation and servicing.

The Contractor may be at liberty to use his own QA-model if deemed equal to the ISO 9001 by the Employer.

.2 Definitions

In the ISO 9001 Standard the following words shall have the meaning hereby assigned to them:

"The Supplier" means "The Contractor"

"The Purchaser" means "The Employer"

"The Purchasers representative" means "The Employers representative"

.3 Organisation

The Contractor shall submit to the Employer, for review, his Quality Management Organisation.

The Organisation plan shall define all key personnel who manage, perform and verify work affecting quality.

The responsibility, authority and interrelation of the personnel shall be clearly defined for the Contractors own personnel as well as for that of his sub-Contractors.

.4 Quality System

The Contractor shall establish a Quality System as a means of ensuring that all work under this Contract conforms to the specified requirements.

The Contractor shall submit to the Employer, for review, a programme which defines the procedures adopted to comply with this requirement as stipulated in ISO 9001.

The programme shall comprise all aspects of the quality system including:

- Design control
- Document control
- Purchasing
- Process control
- Inspection and testing
- Control of non-conforming products
- Handling, storage, packing and delivery
- Dismantling and Erection control

.5 Quality Records

The Contractor shall establish and maintain such records as are stipulated in ISO 9001 and these records shall be copied and submitted to the Employer.

.6 Verification of Purchased Products

The Employer shall be afforded the right to verify at source or upon receipt that purchased products conforms to specified requirements.

.7 Use or Repair of Non-Conforming Products

Proposals to use or repair non-conforming products shall be subject to approval by the Employer.

3.8.4.2 Land Works

3.8.4.2.1 Profiles

The following profiles are used as bearing and space enclosing structures:

I-profile	acc. to ГOCT 8239-89
U-profile	acc. to ГOCT 8240-89
round pipes	acc. to ГOCT 8732-81
square pipes	acc. to TY ² 36-2287-80
angles	acc. to ГOCT 8509-86
flat rolled steel	acc. to ГOCT 19904-74 and ГOCT 19903-74

Specified fastening of structural components installed in the specified position, with on-site connections by bolts shall be carried out immediately after instrumental test of position correctness and adjustment of constructions.

Structures with on-site welded connections shall be fastened in two phases - temporarily at the beginning and then in accordance to the design.

In connections, where bolts work for tension and where bolts are installed structurally, blackening shall not exceed difference between diameters of the hole and the bolt.

Bolts and nuts without a brand and marking of the manufacturer indicating class of strength can not be used.

Not more than two round washers may be installed under bolt nuts (ГOCT 11371-78).

It is permitted to install one same washer under the bolt head.

If it is required, oblique washers shall be installed (ГOCT 10906-78).

Bolt threads shall not protrude deeper in the hole than half the thickness of the fixed element.

Safety nuts (counter nuts) shall be installed to prevent self-loosening of nuts.

It shall not be permitted to lock nuts by means of hammering of the thread or by welding to the bolt bar.

After tightening, heads and nuts of bolts shall be in a tight (without clearances) touch with planes of washers or construction elements, and the bolt shall protrude from nut by not less than 3 mm.

² Technical Conditions - Soviet standards specifying methods of manufacture

Quality of tightening of permanent bolts shall be tested in way of tapping with a hammer weighing 0,4 kg. Notwithstanding this, bolts shall not be displaced.

Before installation bolt thread shall be protected against mechanical damages and corrosion.

3.8.4.2.2 Welding

Quality of materials of construction elements and details prepared for welding shall be considered as satisfactory if class and mark of the steel, dimensions of profile cross-sections, bar diameters, thickness of plates and strips conform to the design requirements with regard to tolerances specified by standards or technical conditions.

Welding materials shall be stored conditions protecting them against wetting, pollution and mechanical damages.

Electrodes shall be accompanied by manufacturer's certificates indicating the type, mark, diameter, type of coating, mechanical features and chemical composition of the steel. Before utilisation electrodes shall be kept in dry rooms.

Uncoated filling wire with a continuous size shall be cleaned from rust, grease and other pollutants before use.

Foreman of welding works shall have a document confirming his technical education or training in the field of welding. He bears responsibility for execution of welding works and keeps a log on these works.

The welding works shall be compliant with ГОСТ 14098-85.

Welders, who have a document that they have passed examination tests in conformity with certification regulations ensuring a successful implementation of welding of test butts in operational conditions similar to ones on the building site, are allowed to perform welds of constructions. Independently on availability of the above mentioned document, all welders, who are going to perform on-site welding of such complexity for the first time or who have had breaks in their work more than 3 months, as well as in the cases when new materials and equipment are to be used, shall pass a recurring test for welding of test butts.

The test butts shall be inspected, tested for continuity by non-destructive methods of control and mechanical tests for rupture, bend-over and impact.

Joining of steel constructions of different importance with utilisation of electric welding are allowed.

Types, structural elements and dimensions of welds shall be compliant with standards.

Basic types of electrodes to weld steel structures with a yield point up to 490 MPa are as follows: Э-42, Э-42А, Э-46, Э-46А, Э-50, Э-50А, and for welding of steel constructions with the yield point more than 500 MPa are: Э-60, Э-70, and Э-85 (according to ГОСТ 9467-75).

For reduction of weight of steel melted on weld, electrodes of more high types than steel types (marks) of conjugated elements are recommended to be used.

Dimensions and shape of fillet welds shall comply with for the following conditions:

- Cathetuses of fillet welds K_f shall not be more than $1,2t$, where t is the smallest thickness of connected elements
- Cathetuses of the fillet welds K_f shall be accepted as shown in the table below but not less than the indicated.

Connection type	Type of welding	Steel yield point, MPa	Minimum cathetuses of weld E_f , mm, when thickness of more thick welded elements are						
			4-5	6-10	11-16	17-22	23-32	33-40	41-80
Tee butt with double side and fillet welds lap and fillet	Manual	up to 430	4	5	6	7	8	9	10
		over 430 to 580	5	6	7	8	9	10	12
	Automatic and half-automated	up to 430	3	4	5	6	7	8	9
		over 430 to 580	3	4	5	6	7	8	9
Tee butt with single side fillet welds	Manual	up to 380	5	6	7	8	9	10	12
	automatic and half automated		4	5	6	7	8	9	10

- Length of the fillet weld shall not be less than $4E$ (and not less than 40 mm
- Dimensions of overlap shall not be less than 5 thickness' of the most thin of the welded elements.
- As a rule, ratio of dimensions of fillet weld cathetuses shall be accepted as 1:1. When thicknesses of welded elements are different, it is permitted to accept the weld with unequal cathetuses.

Welding shall be performed when voltage is stable.

Voltage variations of the electrical supply network, to where the welding equipment are to be connected, shall not exceed +/- 5% of nominal magnitude. In the course of welding it is not allowed to excite the arc and to move crater out of the weld limits to main steel.

Each subsequent layer of a multi-layer weld joint shall be performed after thorough cleaning of the previous layer from dross and metal splashes.

Galvanised steel parts shall be welded by electrodes coated with fluorine-calcium or rutile while current is maximum.

Welding in low temperatures is to be carried out when the current is increased. The welding current shall be increased beginning from 0°C proportionally to the temperature reduction in order to reach the current increased by 10-15% when the temperature will come to -30°C.

When the ambient temperature is less than 0°C, it is recommended to reduce the speed of cooling by covering (for instance, with soft asbestos), and when the temperature is less

than 5°C, the welding shall be done without breaks with an exception of time required to replace electrodes or clean the weld when performing the multi-layer welding.

3.8.4.2.3 Weld Control

Control of steel construction welds shall be carried out systematically in the course of welding.

Performing the delivery quality control for steel structures furnished for installation, an inspection shall be executed, and if it is required instrumental changes shall be carried out. Particularly, linear dimensions and their deviations, deviations of the shape and the surface locations of constructions including non-straightforwardness, non-plainness, non-perpendicularity of adjacent surfaces, irregularity of right angles (difference of diagonal lengths of rectangular elements), ellipticity (diameter difference), deviations of cross-section dimensions of weld joints, deviations of the hole diameters for bolts and distances between the bolt holes, roughness parameters of mechanically treated surfaces, type and deviations of nominal thickness of protective coat may be examined.

Delivery control includes documentation, inspection and instrumental examination of the manufactured structures quality of fasteners and welding materials.

Instrumental test for structure linear dimensions, location and quality of field holes, dimensions of factory welds shall be selectively carried out for 5% of the delivered parts but not less than 3 units of each mark when there are 10 pieces and more, and not less than 1 piece when there are a less quantity.

When deviations from the drawings have been revealed in structures, the problem on possibility for removal of the revealed faults shall be jointly solved by manufacturer's representatives and the Contractor with involvement of the Engineer if it is necessary.

Structures that have deformations, shall be straightened. The alignment shall be performed without heating of the damaged part (cold alignment) or with pre-heating (alignment in a heated condition) by thermal or thermo-mechanical method. Conclusion regarding reinforcement of damaged structures or their replacement with the new ones shall be drawn by the Engineer.

Cold alignment of constructions shall be implemented in such methods that to exclude rolling. The cold alignment is acceptable where radius of curvature of the deformed parts exceeds thickness of flat elements 50 and more times, or for profiles 100 and more times the size of the cross-section.

Deviations of dimensions and shape of structural elements with regards to alignment shall not be more than:

- Clearance between element surface and steel ruler stretched as a string (template) - 0,0015 of the element length (or the distance between points of its fastening); distortion or "mushroom"-shape of shelves, welded T and I profiles - 0,01 of the shelf width.

Faulty parts of welds shall be removed by mechanised cutting and abrasion. It is permitted to remove the weld defects by means of manual oxyacetylene cutting or air-arc cutting

with an obligatory subsequent cleaning (abrasion) of the surface of a cutter by abrasive devices to a depth of 1-2 mm with removal of projections and streaks. All surface burns of main steel due to welding arc shall be cleaned with abrasive tools to a depth of 0,5-0,7 mm.

Weld joints shall be tested by one of the following methods of non-destructive control methods:

- Butt joints of beams and girders as well as tee butts with complete melt of connections of beams and girders to columns - by X-ray or ultrasonic tests in the volume of 5%, when the welding is manual or mechanised, and 2%, if welding is automatic (except the cases specially specified in the drawings), from a length of welds performed by each welder.
- Butt welds of coating-type - by X-ray or ultrasonic test in a volume of 10%, when welding is hand-operated or mechanised, and 5%, when welding is automatic, of the length of welds performed by each welder.

If the revealed defect is unacceptable, the additional non-destructive control test for the seam shall be carried out for a length of 300 mm from the ends of preliminarily controlled part.

If unacceptable weld defect has been inspected at least on one out of two parts all the work of that welder shall be tested by non-destructive method.

3.8.4.2.4 Surface Protection

Unless otherwise specified, all steel structures shall be provided with a surface protection. The surface protection shall be performed after completion of all foregoing construction works in order not to damage the surface protection.

During implementation of the works for corrosive protection, curing of the ready protective coats, storage and transportation of structures and plant that have protective coating, precautions shall be taken to defend these coats against pollution, wetting, mechanical and other effects and damages.

Anticorrosive protection shall be executed in the following order:

- Preparation of the surface to be protected by protective coating
- Preparation of materials
- Priming that provides cohesion of the subsequent layers of protective coating with the protected surface
- Application of protective coating
- Drying of coating or its heat treatment.

High requirements shall be made on preparation of the protected surfaces. Surfaces of steel structures and equipment shall be cleaned by means of mechanical brushes and

rakes, sandblasters or wheelabrators. Open surfaces of structures and plant shall be cleaned with dry quartz sand with fineness of 0,5-2,5 mm, while pressure of compressed air shall not be less than 0,4 MPa. It is permitted to use a mix of quartz sand with water for cleaning of buried surfaces of structures and equipment. Unless otherwise indicated by the design, indoor surfaces of buried steel apparatuses can be cleaned with steel shot, while pressure of compressed air shall be in the limits of 0,55-0,6 MPa.

The compressed air used for cleaning shall be dry, clean and comply with ГOCT 9.010-80.

Surface to be protected against corrosion by metal coating and cleaned by wheelabrators shall have a continuous frosted grey tint with clearly visible roughness up to 55 mkm. Surfaces of steel structures and equipment intended for treatment with rust transformers or prime transformers shall be cleaned from rust laminations only.

Inspection of surface cleaning of steel structures and plant shall show absence of visible scale or rust for coats prepared on a base of synthetic gums and availability of loose scale and rust in limits of 15% of surface but not more than 30% on individual parts with area of 2,5x2,5 cm for coats prepared on a base of natural gums and soluble silicate.

The works to protect steel constructions and equipment against corrosion shall start not later than after 8 hours upon completion of dry cleaning of the structure surfaces.

Priming compounds applied for protection against corrosion and painted with brush shall have a viscosity in the following boundaries: 30 sec - for bituminous and silicon-organic primers; 40 sec - for epoxy, gliftal, phenol-formaldehyde, bitumen-latex and polymer primers, as well as primers-transformers of rust; 70 sec - protector primers.

Viscosity of primers applied with paint spraying machine shall be twofold less than viscosity of primers applied with brush with an exception of perchlorumvynil ones that may have viscosity of 20 seconds.

A paint system as described in section 3.8.4.1.8 or equivalent shall be applied.

In the course of acceptance of anticorrosive coating the following shall be tested:

- continuity of coat, cohesion of coat with the protected surface
- Coat surface hardening, coat thickness, completeness of polymerisation of coat or joints, air tightness of welds and trims, condition of coat.

3.9 Timber and Roofing Works

3.9.1 Extent of Works

The specifications in this section and the drawings comprise roofing and water proofing works as follows:

- For foundation walls and for floors the insulation shall be made from bituminous felt of 2 layers.

- For roof, the insulation shall be executed from 3 layers of fibre glass bituminous felt.

Further, this specification covers timber works connected with replacement of timber deck on ramp structures.

3.9.2 Documents

The works shall be carried out according to СНиП 3.04.01-87 "Insulation and Finishing Materials" including the safe operation regulations.

3.9.3 Materials

3.9.3.1 Roofing and Water Proofing Materials

The roofing and water proofing materials shall comply with standards of ГОСТ 4.203.-79 "Rolled roofing and water proofing materials"

Hot bituminous mastic is boiled from oil bituminous БН-V at the site in boilers. It is particularly necessary to follow the safe operation rules when the bituminous materials are being handled.

3.9.3.2 Timber Qualities

The timber used for ramp deck, sidewalks and deck over counterweight pits shall be the best quality Ekki or Azobé wood as stated in the General Notes.

3.9.4 Execution of the Works

3.9.4.1 Roofing and Water Proffing Works

The base under the rolled roofing materials and for the water insulation works shall be dry, plane and without potholes. The rolled materials shall be kept in unrolled status within 20 hours and cleaned from sand inclusions with the help of kerosene. The magnitude of laps shall not be more, than 7-10 cm at the places of joints. Sticking of the material on roofs shall be carried out beginning from low sides to high sides. The location of the materials shall be perpendicularly to the direction of water flow when slope of the roof is up to 15 %; it shall be from high side to low one with location of the materials along direction of water flow if the roof slope is more than 15 %.

When the rolled roofing materials are being installed, water shall be completely drained through outdoor or indoor rainwater sewers. Sticking of the rolled materials shall be solid. When one layer is being torn from another, the breach shall comprise all layers of the material, division into layers is not acceptable.

Badly glued places of the water insulation are determined by tapping of the whole area, in accordance with change of coming sound. Bubbles, plumps, runs and burls are not allowable.

While laying the materials, they shall be compacted by rollers, weighing 70-80 kg.

3.9.4.2 Timber Work

The execution of timber work shall be according to the description in General Notes.

Individual structural parts are to be joined in such a way as to avoid the formation of unintentional stresses.

Parts not properly fitted, warped and/or cracked parts shall be replaced if so decided by the Employer.

The timber deck shall after final erection be plane and flush with the rail line.

The characteristic physical properties of the timber shall be documented.

3.10 Joinery Works

3.10.1 Extent of works

The work comprises all contributions to obtain the finished work concerning windows, doors, light panels, light partition walls, etc. indicated on the drawings and in the specifications for them.

3.10.2 Documents

The work shall be carried out in compliance with СНиП-III-19-76 "Wooden Structures" and also with technical directions of the suppliers of the installations.

3.10.3 Materials

Inside doors are wooden covered with veneer of hard timber, plastic and painted, complying with ГОСТ 6629-74. The following door dimensions have been used:

Type	Dimensions, cm
ДН 21-10	210x100
ДН 21-10	210x100
ДГ 21-9	210x90
ДГ 21-8	210x80
ДГ 21-7	210x70

Plastic doors for lavatories of 1.60x0.80.

Stained glass panels with doors from PIMAPEN or similar with a black coffee colour. The doors parts of the panels consist of two double-acting leaves from tempered glass with thickness of 15 mm. Dimensions of panels (doors) are as follows:

Dimensions, m

2.2x2.5 (door 1.0x2.1)

2.6x1.2 (door 1.2x2.1)

Windows from PIMAPEN or similar with black coffee colour glazed with heat insulating unit (4x4 mm).

Dimensions, m

0.4x0.6

0.8x0.8

1.2x0.6

1.2x1.5

1.2x2.5

1.2x0.9

1.2x1.7

Door block from PIMAPEN or similar with black coffee colour glazed with 6 mm polished glass.

Dimensions, m

2.1x1.0

3.10.4 Execution of Works

The maximum moisture contents in the wooden items are as follows:

Materials	Moisture, %
Lumber of deciduous types of trees	25 +/- 3
Lumber of coniferous types of trees	22 +/- 3
Window cages	18

Materials	Moisture, %
Window frames, door blocks, ventlights, floor parts	12
Doors	10
Mouldings	15

The wood for structures and parts of the buildings shall be disinfected.

According to the standards and the technical terms, storage of parquet on the building site shall be in closed heated warehouses, the joinery items shall be kept in half-closed warehouses or under sheds.

Installation of the units from PIMAPEN or similar shall comply with the following standards:

- a) The profile shall not have any scratches.
- b) The corner conjugations shall be fixed by aluminium angle of 50x50 mm inside the PVC profile; the insulating glass unit of 2x4 mm glasses shall be produced by special equipment with creation of vacuum inside it, the edges of the insulating glass unit shall be pressurised.
Surfaces of the 2x4 glasses and of the 6 mm glass shall not have any damages.
Fastenings of the glasses to the frames shall be performed with glass mastics.

When the window and door blocks are being mounted, the wood surface close to stone walls, shall be disinfected and protected with water proofing materials. Clearances between frames and masonry of outside walls shall be filled with heat insulating materials.

The window and door blocks shall not let water, wind, dust and heat go inside, therefore the moving parts shall be thoroughly adjusted to each other and to the frame.

3.11 Finishing Works

3.11.1 Extent of Works

The work comprises surface treatment for all materials except external steel in walls, ceilings, floors, etc.

3.11.2 Wall and Ceiling Finishing

Colour schedule shall be prepared by the Contractor and approved by the Engineer.

The finishing work shall be carried out in accordance with a table for finishing works indicated on the drawings for each building and with regulations of СНиП III-21-73 "Finishing coverings of building structures. Rules of performance of the work" and СНиП 3.04.01.87 "Insulating and finishing coverings".

Moisture of the plastered surfaces of walls and ceilings shall comply with ГOCT 22753-77, before beginning of the finishing works. Drying of rooms shall be carried out naturally, by means of systematic ventilation. As a minimum, 3-multiple exchange of air shall be provided within 1 hour.

The works shall be carried out after completion of all preparation works for finishing, as well as after completion of all works for utilities and electrical installations.

Pictures and geometrical shapes of surface facing with ceramic tiles or marble tiles shall correspond to the design. The horizontal and the vertical joints shall have the same tint and the same structure, space between wall and facing shall be completely filled with plaster. The faced surface shall not have damages in the joints more than 0.5 mm or cracks, stigmas and runs.

Indoor oil painting of the walls and the ceilings shall be performed in a certain order according to the following table:

No of item	Operation	Painting			
		Opening assemblies ready for second painting (improved)	Plaster (improved)	Pre-cast structures ready for painting (improved)	Internal metal
1	2	3	4	5	6
1	Cleaning	+	+	+	+
2	Smoothing with wooden butt-end	-	+	+	-
3	Cutting of knots and tarred spots with jointing of slits	-	-	-	-
4	Jointing of cracks	-	+	+	-
5	Lubrication with boiled linseed oil	-	+	+	-
6	Partial greasing with lubrication of the greased spots with boiled linseed oil	-	+	+	-
7	Abrasion of the greased spots	-	-	+	-
8	First complete void filling	+	-	-	-
9	Abrasion	-	-	-	-
10	Second complete void filling	-	+	-	-
11	Abrasion	-	+	-	-
12	Priming	+	+	+	-
13	Painting with flat paintbrush	+	+	+	-
14	Abrasion	+	+	+	-
15	First painting	+	+	+	+
16	Painting with flat paintbrush	+	+	+	-
17	Abrasion	+	+	+	-
18	Second painting	+	+	+	+
19	Painting with flat paintbrush or treatment with a wooden butt-end	+	+	+	-
20	Pulling out of panels	-	+	+	-

Painting of the walls and ceilings with water, oil, enamel compositions shall have the tint of the same kind. Stigmas, stripes, runs, visibility of paint layers lying below, unevenness and traces of a paint-brush are not allowed.

Ceilings shall be painted with water-emulsion paints. The ceilings in the corridors of the border control building are suspended, of the PRONTO type.

The walls shall be faced with ceramic tiles in the lavatories, with marble tiles in the passenger terminal halls.

The rest of the inside wall surfaces shall be painted with oil paint.

The outdoor facades shall be painted with perchlorumvinil paint in accordance with the following table:

Operation	Paint			
	silicon	lime and cement	perchlorumvinil	polyvinilacetate and silicon organic
Cleaning	+	+	+	+
Cleaning of cracks	+	+	+	+
Priming for greasing	-	-	+	+
Greasing	+	+	+	+
Abrasion	+	+	+	+
Wetting with water	-	+	-	-
Priming	+	-	+	+
First painting	+	+	+	+
Second painting	+	+	+	+

All finishing materials shall correspond to the European standards.

3.11.3 Floor Finishing

The floor covering is carried out in accordance with table of finishing works, indicated on the drawings and regulations of СНиП III В.14-72 "Floors, rules for work execution". The floors in the lavatories shall be faced with ceramic tiles. The floors of the passenger terminal halls, of the corridors of the border control terminal, the entrance platforms and the steps shall be faced with marble tiles. In the remaining rooms, the floors shall be executed with parquet on a plank decking.

Laying of the floors can only be performed when the bedding has a minimum temperature of +5°C. The moisture content of the parquet planks shall not be more than 8 %; the moisture content of the wooden base under them shall not be more than 10-12 %. Close fitting between tiles and base shall be checked by knocking on the floors made from ceramic and marble tiles.

3.12 Electrical Installations/Controls

3.12.1 Extent of Works

3.12.1.1 Marine Works, Ramps

The electrical specifications cover the requirements for the electrical design and installation to be built by the Contractor.

The electrical specifications are not intended to cover all the details, however it is required that the Contractor provides all the elements that are inherent to sound engineering practices and workmanship in order to achieve completely satisfactory electrical systems.

The electrical specifications shall be read in conjunction with all the other chapters and paragraphs of this requisition.

The Contractor shall, in every respect, be responsible for the complete design, manufacture, supply, transport, installation at site, testing, commissioning, proper operation and safe functioning of the electrical installations.

It should be emphasised that the Contractor's performance shall include, but not be limited to the following (supply and installation):

- All the described high voltage installations.
- All low voltage installations for lighting and motive power.
- Earthing.
- Lightning protection.
- Capacitor Bank System.
- Distribution and control panels for all equipment.
- Installation for all control equipment.
- Supply, cabling and installation for telephone system.
- Drawing, manuals and maintenance instructions.

If the Contractor stipulates otherwise or proposed other current and/or power ratings for motors, heating elements, etc. the electrical installation (circuit, contactors, cables, etc.) shall be adjusted to fit the new ratings. Generally, all installations shall include a safety margin of ten per cent (10%) based on worst case conditions to be met in service.

The Contractor shall be responsible for the coordination with all other disciplines concerning: ratings, sizes, locations of equipment and cables, cable holes in walls and floors, required equipment foundations, etc.

The Contractor shall prepare for all electrical equipment documents and electrical drawings covering the whole project.

No extra payment will be effected for making the installations comply with the above-mentioned codes and documents.

Within the tender sum, the Contractor shall effect all works and supplies necessary to the contract.

The Contractor shall bear full responsibility that the completed installations function as prescribed with regard to operation.

The Contractor's duties under this contract include all notifications and applications to authorities and the procurement of all necessary certificates and permits.

The tender documents include all lists of drawings prepared by the Engineer in respect of this contract.

It shall be observed that the ferry ramps are existing ramps in duty and it shall be stated to the Contractor, that all work shall be carried out in close co-operation with the ferry authorities. The Contractor shall be aware of the fact that the one ramp shall be in full operation during the whole building period.

The Contractor shall inspect and examine the installations on the site before tendering and include all changes and new installations in the tender.

3.12.1.2 Land Works

The work shall comprise the complete supply, installation and making operational of the systems of power supply, electric lighting and control.

It should be emphasised, that the Contractor's performance (supply and installation) comprises the following types of works:

- Supply, laying of cables in trenches under ground with arrangement of bedding from sand and protective cover of bricks in order to install an outdoor system of power supply of the buildings and an outdoor electric lighting of the terminal area in compliance with all regulations according to ПУЭ when the laid cables cross other utilities and a permanent railway.
- Supply, laying of cables under ground and on supports above ground in order to arrange an outdoor system of telephone and radio communication.
- Mounting of wires and cables inside the buildings and the structures with an aim to install an indoor system of power supply and electric lighting.
- Mounting of wires and cables inside the buildings and the structures with an aim to install an inside system of telephone communication, radio net and fire alarm system.
- Mounting of all lighting fixtures inside the buildings and the structures.

- Mounting of all lighting fixtures on steel supports for outdoor lighting and on masts for flood lighting.
- Mounting of electric installations (terminal boxes, engineering outlets, switches) inside the buildings and structures for indoor system of power supply and electric lighting
- Mounting of electric installations (terminal boxes, branch boxes, limit boxes, outlets, subscriber's transformers, transmitters and control equipment) for inside system of telephone communication, radio net and fire alarm system.
- Mounting of switchboards, panels and devices for control of all equipment.
- Installation of all control equipment.
- Installation of earthing.
- Drawings, manuals and instructions for service.

Before carrying out his work, the Contractor for the electrical works shall contact the relevant departments of the local distributor in order to make the necessary agreements and obtain information, which will be useful to all demands, requirements of verification and visits made by agents of these departments, and shall submit all such documents and parts as may be required, for approval.

No extra payment will be effected for making the installations comply with the mentioned codes and documents. Within the tender sum, the Contractor shall effect all works and supplies necessary to the contract.

The Contractor shall bear full responsibility that the completed installations function as prescribed with regard to operation.

The Contractor's duties under this contract include all notifications and applications to authorities and procurement of all necessary certificates and permits.

The tender documents include all lists of drawings, prepared by the Engineer in respect of this contract.

3.12.2 Documents

3.12.2.1 Marine Works, Ramps

3.12.2.1.1 General

All equipment, material and apparatus shall be conceived, designed and carried out in compliance with the following publications (latest edition):

- The International Electrotechnical Commission (IEC)'s publications (and recommendations) shall be applied as a minimum regardless of any national standard

which may normally have been utilised in the manufacture, design or installation of any equipment.

- IEC 364 Series wiring regulations (latest edition).
- Country ordinances for the classified installations.
- All electrical equipment shall be IEC and CEE standard, tropical design and entirely suitable for the prevailing site conditions.
- Correction factor for ambient temperature 40(C shall be 0.87 for all cable installations. Correction factors for groups of cables according to IEC.
- The general specifications of the present documents, and the special specifications for the installation.
- The mounting instructions and recommendations of the suppliers concerning the installation or the maintenance of the electrical equipment; such instructions and recommendations shall be considered as forming part of the present specifications.
- The prescriptions of the Power & Lighting Company of Baku/Turkmenbashi.
- Before carrying out his work, the Contractor for the electrical works shall contact the relevant departments of the local distributor in order to make the necessary agreements and obtain information which will be useful for the performance of the work. He must agree to all demands, requirements of verification, and visits made by agents of these departments, and shall submit all such documents and parts as may be required, for approval.

3.12.2.1.2 Drawings and Diagrams for Electrical Work

The Contractor shall furnish all necessary drawings, diagrams and schedules (interconnection diagrams, wiring diagrams, installation drawings, cable and cable way drawings, switchboard elevations, control boards elevations, etc.).

The documents must be submitted to the Engineer for approval and work may not be started until approval has been received.

3.12.2.1.3 Design Basis

Low voltage supply	:	3 x 380/220 Volts
Lighting system	:	220 Volts
Control electronic equipment	:	24 V DC
Frequency	:	50 Hz
System earthing	:	TN-S system as defined in IEC (5-wire system: L1, L2, L3, N, PE).

3.12.2.1.4 Climatic Conditions

All equipment shall be in tropical execution and be able to operate under adverse climatic conditions, marine environment and withstand an ambient air temperature of 40(C in the shade and high humidity (95(RH) during long periods.

3.12.2.1.5 Earthing

The extent of this work shall comprise the supply, installation, connection and joining of all equipment such as will be necessary for the establishment of a proper and correct earthing in accordance with the standards in force:

- System earthing TN-S (5 wire system).
- All distribution boards shall be provided with a separate earth bus.
- All motors shall be earthed with a separate earth conductor included in the feeder cable serving same.
- All outlets and lightning fixtures shall be earthed by means of earth conductor connected directly to the distribution boards.
- Earthing of all steel structures, masts, poles, etc.

3.12.2.2 Land Works

3.12.2.2.1 Documents, Norms and Standards

All equipment and materials shall comply with the following:

- The general specifications of the present documents and the special specifications for the installations.
- The mounting instructions and recommendations of the Suppliers concerning the installation or the maintenance of the electrical equipment; such instructions shall be considered as forming part of the present specifications.
- The building norms and rules, standards as follows:

СНиП-III-4-80	"Safety operation rules in construction", 1987
СНиП 3.05.06.-85	"Electric devices"
ГОСТ 12.1.013-78	"ССБТ. Construction. Safe operation. General requirements."
ГОСТ 12.1.046-85	"ССБТ. Construction. Lighting norms of building sites"
ПУЭ	"Rules for installation of electrical devices", 1986

During preparation of the electric system mounting, the Contractor, besides the design documentation and general requirements of the building norms and rules, shall study and take into account regulations, approved by Gosgortehnadzor, Gosenergonadzor and other authorities for supervision where specific characters of certain systems and devices are reflected.

3.12.2.2 Climatic Conditions

All equipment shall be in "T" execution, which corresponds to tropic climate with an ambient temperature of -10°C; +40°C. It shall be able to operate under adverse climatic conditions and high humidity of 95 % at the sea coast line.

3.12.2.2.3 Voltage/Frequency

High voltage supply	:	6000 V
Low voltage supply	:	380/220 V; 3 phase, 4 wire
Frequency	:	50 Hz
Neutral of the transformers of the existing substations	:	Deadly earthed

3.12.2.2.4 Earthing

The extent of this work shall comprise supply, installation, connection and joining of all equipment such as will be necessary for the establishment of a proper and correct earthing in accordance with the standards and regulations in force ПУЭ, chapter 1.7 and ГОСТ 12.1.038-82 "Extremely allowable levels of pick-up voltages and currents."

- . Use protective earthing for provision with safe electric operation of potentially dangerous conductors.
- . All of the switchboards shall be equipped with separate earthing bars.
- . All motors, switchboards, lighting fixtures, outlets shall be earthed.
- . Casings of the meter boards, boards, boxes with electric equipment shall be earthed or neutralised by means of bolt joints of steel earthing conductors, if they are not neutralised through a neutral operating wire of the feed circuit or not neutralised through feed cable sheathes.

It is also necessary to follow the CH-102-76 instruction for installation of earthing and neutral nets in electric devices when the mounting is being carried out.

3.12.3 Materials

3.12.3.1 Marine Works, Ramps

3.12.3.1.1 General

All electrical equipment shall be approved in accordance with the IEC or CEE standards and shall be new and non-defective.

All fittings and metal parts shall be protected against corrosion. Hot-galvanized execution shall be used for outdoor installations.

It shall be emphasised that all outdoor installations and materials shall be able to withstand the outdoor condition soft seawater.

The quality of the equipment shall be highest standard and chosen from the positive list (see 3.12.3.1.4). All equipment chosen shall be approved by the Engineer.

3.12.3.1.2 Conductors and Cables

All cables shall comply with IEC.

- All cables in the fixed installation: PVC insulated cables type PVIK, PVIK-S or equivalent.
- Flexible cable for mechanical installations and processes: type H07RN-F.
- Cables in water between the lifting towers.
- Flexible cable for lighting fixtures in buildings: type H05RN-F.

Conductor insulation shall be rated at 70(C). Colour identifications of the protective conductor shall be green-yellow, neutral shall be light blue.

Where nothing else is prescribed, cables shall be placed directly on the constructions.

As a general rule, the permissible loading capacity of cables shall only be 87% of the values in IEC due to ambient temperature.

Cables less than 10 mm in cable trays can be laid in several layers. Cables of size 4 x 10 mm² or more shall be spaced approx. 2 x cable diameter. The vertical spaces between the cable trays or cable ladders shall be approx. 300 mm.

Cables shall be protected against chemical and mechanical effects to be expected at the place of installations.

With regard to the load distribution, parallel connected cables shall be of exactly equal lengths.

Where several cables run in parallel, common saddles shall be used. Bends on cables shall be made with minimum radii in accordance with the manufacturer's specifications.

Descending cables shall be mounted on the buildings or structures on cable ladders or plates or pulled in PVC conduits.

Cables descending to floor shall normally be protected against mechanical damage up to a height of 1.0 m above finished floor level. The protection shall be galvanized steel plate or galvanized steel conduit.

All final cable connections shall be properly relieved, and shall be long enough to avoid sharp bends and tensile stresses.

Where Al-cables are used the electrical Contractor shall ensure that the connecting pieces in the switchboard are suitable for connection of Al-cables, and, if necessary, mount adaptor pieces so that connection can be executed in accordance with the cable manufacturer's instructions.

Buried cables must undulate slightly in a trench. The radius of curvature must never be less than 10 times the cable diameter. Cables must be placed on a bed of sand or sifted earth at least 10 cm thick and covered with an identical layer of same thickness. The presence of the cables must be indicated by small slabs or a grill placed approximately 60 cm below the ground surface.

Where cables are placed below asphalt, concrete or similar areas the cables shall be placed in pipes, conduits or ducts.

If installed in the same duct or tray, power, instrument, control and signal cables shall be separated from each other.

Individual cables which have not been laid in duct or tray shall be protected, where necessary, by galvanized conduits.

All cables shall be identified at both ends by securely fixed plastic cable markers, indicating cable number.

All cables and wires for external circuits shall be wired to screw type terminals.

All wiring and terminals shall be securely fixed and easy accessible. The wiring shall be adequate for the circuits full load.

All outdoor installations shall be carried out as IP67 installations. Cables placed on building or other structures shall be pulled in heavy-duty hot-dip galvanized pipes with fittings.

All installations inside the lifting tower buildings shall be IP44 installations with cable glands.

3.12.3.1.3 Cable Ladders, Cable Trays

Steel cable ladders and cable trays shall be used for carrying several cables together, Where cables will be subject to physical damage, steel conduits shall be used.

Cable ladders and cable trays shall be supported in accordance with the manufacturer's instructions, with due consideration to maximum load occurring.

Regardless of the load, the distance between supports for cable ladders and trays may not exceed 2 m.

All steel parts shall be hot-dip galvanized after preparation.

Where cables are carried through the roof, it shall be done through steel tubes welded to a flange, fastened water-tight to the roof. The tube and the flange shall be galvanized after welding.

On top of the tube, approx. 50 cm above the roof, a junction box shall be fixed by screws. Under the roof the cable shall be led into the tube through an airtight gasket.

Sizes of cable trays shall be suitable for all cables to be installed by the Contractor, for specified future consumers, and for 20% general spare place. The Contractor shall take into account heat dissipation of cables.

Cable trays shall be designed to withstand the loading of all cables including spares without undue deflection. At locations where cable trays can be passed near walk-ways, tray and cover shall be suitable for walking on.

At wall, ceiling and floor passages with rooms at different room temperature conditions, cable ducts and trays shall be sealed inside and outside duct or tray with non-hardening type fire proof sealing compound.

3.12.3.1.4 Electrical Components

Connection Boxes and Junction Boxes

Make ROSE or equivalent IP 65 series Polyester, with polyester cable glands IP65, equipped with rail-mounted terminals. All metal parts shall be stainless steel. Terminals shall be equipped with markers.

Limit Switches

To control the ramp movements limit switches shall be used. The limit switches shall be make Bernstein or equivalent, heavy-duty type IP65, metal housing type D(1) or D(11).

Socket outlets and Power Outlets

1 x 220 V, 10 A, weatherproof IP55, German Standard Sucko.
3 x 380 V, N, PE, conform to CEE17, IP44.

All electrical components and machinery shall be of a recognised manufacture, e.g.:

Outlets and switches:	Legrand, Menneks
Switchboards:	Løgstrup, AAB, Merlin Gerni, Siemens
Contactors, relays:	Telemecanique, Siemens, Klöckner & Moeller
Circuit breakers:	Merlin Gerin, Siemens, Klöckner & Moeller
Frequency converter and control equipment:	Danfoss
Lighting fixtures:	See dwg. T3.03.72.
Capacitor bank:	ABB, Siemens
Cables:	Siemens, NKT.
PLC:	Siemens (see 3.12.3.1.7.12)
Rotary Encoders:	Idec or Baumer electric (reversible)
Inclination sensor:	Celesco IP67, stainless steel, 4-20 mA.

3.12.3.1.5 Lighting Fixtures

Lighting fixtures shall be as indicated in the drawings.

All fixtures requiring ballast shall be furnished by the fixture manufacturer with integrally mounted and pre-wired ballast and other starting components. All the components shall be of tropical execution.

Terminals must be fixed, e.g. at the lighting fixture, and must be protected against accidental contact with the live parts.

All fixtures for fluorescent or sodium lamps shall show 0.9 power factor (the ballast and the capacitor shall be placed next to the fixture). All incandescent lamps shall, in general, be of the inside frosted type rated for 240 Volt operation.

The following illumination levels shall be obtained (burned-in values measured 80 cm above the floor):

- Lifting towers 200 lux
- Control room 300 lux
- Outdoor lighting (ramp) approx. 25-50 lux

3.12.3.1.6 Capacitor Bank

After handing-over and with the complete installations in use the equipment shall meet a power factor of $\cos = 0.9$.

To meet this requirement, automatic controlled capacitor bank systems shall be supplied and installed. Where only a small load is installed, a fixed capacitor max. 20 KVAR, 3 x 380 V may be connected to the switchboard (fuses and main switch shall be installed).

The capacitor bank shall be connected to the low voltage system and shall be placed next to the main low voltage switchboard (same size and make as the switchboard).

The capacitors shall be of a type with low losses, compact dimensions and without PBC or other material injurious for the environment. Each capacitor step shall not exceed 15 KVAR and shall be of the make ABB or equivalent.

After the capacitor bank has been installed measurement over one week shall be carried out and the results shall be handed over to the Engineer.

3.12.3.1.7 Switchboards

.1 I.E.C. Standards

Unless otherwise specified LV boards shall conform in design, material, equipment, construction and performance to the latest editions of the I.E.C. 439 Series: Type-tested, factory made low-voltage switchgear and control gear assemblies. The installations on the ramps shall be designed according to EN 60 204-1.

.2 Electrical System

The electrical system for all LV boards shall be 3-phase, neutral and earth.

.3 Phase Sequence

Phase sequence shall be specified in alphanumerical order, with each phase reaching its maximum in the time sequence in the order specified.

Phase marking shall correspond to the alphanumerical marking rotation employing Arabic numerical numbers, L1, L2, L3.

The neutral conductor shall be marked N and colour coded light blue. The earthing conductor shall be marked PE and/or colour coded green and yellow.

.4 Equipment Duties

Switching devices shall be capable of the following duties unless otherwise specified. The number of operational cycles shall be in accordance with the requirements of the specified standards.

Circuit breakers shall be capable of making and breaking prospective short circuit current for which the board is specified.

Switches shall be capable of making and breaking prospective short circuit currents. However, they shall be capable of breaking load currents.

Contractors shall be capable of making and breaking load currents and conform to class 1 for intermittent duty with mechanical endurance of not less than one million off-load operating cycles.

The electrical endurance shall correspond to utilisation category AC3. This category being:

AC3 - Starting of squirrel cage motors and switching off motors during running.

Overload protection shall be incorporated in all phases and shall include protection against single phasing.

Protecting devices of the magnetic, thermal or inductive type shall be used.

All Mini Circuit Breakers (MCB) for lighting circuit and outlets shall be type C. All Circuit Breakers (MCB) for motors shall be type K.

All overload devices shall have an easily visible manual reset facility accessible from the front of the board. The protective device shall be mounted in such a way that settings can be read conveniently and that adjustment can be made without the need for special tools.

.5 Enclosure

The boards shall be mounted in complete enclosure having sufficient mechanical strength to be self-supporting and free floor standing. The height of the boards shall not exceed 2100 mm.

Unless otherwise specified on the data sheet(s) the boards shall have front access only for all requirements of installations, operations and maintenance.

The board enclosures shall be complete and the floor may not be considered as being part of the enclosure. The doors shall be provided with non-absorbent non-sticking gaskets.

Sections and compartments which need to be accessible during operation, e.g. replacement of fuses, shall in the open position contain no exposed live parts under normal operational conditions or shall be provided with means to prevent opening of doors or covers before disconnection of supply to the exposed parts.

All structural parts of the boards shall be adequately protected against corrosion. Painted structural work shall consist of one coat of primer and two coats of oil resistant, finishing paint.

Unless otherwise specified on the data sheet(s) or accompanying documents, the paint finish of the boards shall be light grey on the outside.

Switchboards placed outdoor shall be executed in Polycarbonate splash-proof IP57, safe to touch, maintenance free, temperature resistant UL 125(C, corrosion resistant for common acids, petrol and mineral oil solutions, and shall be recognised by Lloyds register of shipping (make Vynckier, LK-NES, MENNEKES or equivalent).

.6 Cables and Wires

The internal cables and wires of the LV distribution board shall be single core stranded copper PVC insulated conductors. All wires and cables shall be continuous and without joints.

Wires and cables shall run in insulated tubes, channels, cleats or plastic strips. Mounting of wires and cables directly onto metal shall not be acceptable.

Individual wires and cables shall be identified at both ends by interlocking plastic ferrules or plastic tape marked in accordance with the corresponding wiring diagram.

All wires shall be terminated in spade type lugs, and cables in bolted type lugs. If the terminals are of the wedge type, constructed in such a way that direct contact between screw, bolt or nut and conductor is avoided, then no lugs are required.

Secondary wiring shall have a minimum conductor size of 1.5 sq.mm. Cables in circuits connected to current transformers shall have a minimum conductor size of 2.5 sq.mm.

.7 Earthing

The LV distribution boards shall have a main earth bar fitted along the whole of its length. The bar shall be of hard drawn high conductivity copper of adequate size to allow convenient connection of earthing cables to it.

Connected to the earth bar shall be the board enclosure, all individual cubicles and boxes, all fixed and withdrawable equipment and parts when in service position, and all metal cable sheaths.

Joints in the earth bar shall be tinned and bolted with galvanized or cadmiumized bolts, nuts and non loosening washers.

.8 Cable Terminations

Top or bottom cable entry to the board, number of cable, their sizes and types are as specified on the data sheet(s), drawing(s) and/or accompanying documents. The cable entries, glands and terminal shall be suitable to accept same.

.9 Name Plates and Labels

The name plate(s) shall be of non-corrosive material fixed to non-removable part(s) of the board. Enamelled plates are not acceptable. All text in English language and Russian language.

.10 Testing

LV boards shall be tested by the manufacturer to the requirements of the specified international standards. Some or all of the tests may be witnessed by the Engineer or inspector representing the principal.

The witnessed tests shall be indicated on the data sheets or accompanying documents and the manufacturer has to inform Engineer's representative one week in advance of the test dates.

Routine Tests

All LV boards shall be subjected to the following routine tests:

- Dielectric tests of all electrical components of the board. These shall consist of applying AC voltage test in accordance with IEC 439 for one minute between poles, poles to frame and poles connected to frame.
- Insulation resistance test of all electrical components using DC Megger. The insulation resistance shall not be less than 1000 Ohms per Volt of rated voltage.
- Performance tests of all mechanical and electrical equipment and components of the board, including the operations of control and protection circuits, measuring devices, C/T's, etc.

.11 Elevations

Switchboard elevations, control circuit diagrams and lists of parts shall be approved by the Engineer before the manufacture of the switchboards is started.

.12 Control System

The existing control system is based on an old-fashioned relay system.

The new control system shall be based on a PLC system and relay system as indicated in drawing.

In the following, equipment shall be used in the control system (transparency system):

PLC - Make Siemens S7 - 314 / 313 or equivalent including:

Power supplies

I/O modules

Analog modules

All installation and connection equipment.

MPI - communication equipment and network (Sinec L2)

Step 7 software, batteries and EPROM

PC pentium, 16 MBite RAM, 1GB HARDDISK

Printer and PC table.

The PLC programming system and Windows 95 shall be in Russian language making it possible for the maintenance staff to make programming.

Frequency converter - Danfoss VLT and VLA 52

The emergency operation No. 2 system (electrically) in each lifting tower shall be designed independently of the PLC system. These systems shall be hard wired and it shall be possible to run the systems locally with the PLC out of order, but in a safe way.

In each lifting tower and in each of the control panels emergency stop systems shall be designed according to EN 60 204.

The system shall be constructed as indicated in the principle drawings.

Before any parts or materials are put into order, the Contractor shall hand-over detailed project drawings (in English and Russian languages) to the supervision for examination and approval.

The new regulation principle shall be based on Danfoss VLT and Danfoss VLA 52 synchronic regulator system (Master-slave system).

3.12.3.2 Land Works

3.12.3.2.1 Materials

.1 General

All electrical equipment shall be approved in accordance with the ГOCT, IEC or CAA standards. It shall be new and non-defective.

All fittings and metal parts shall be protected against corrosion. Hot-galvanised execution shall be used for outdoor installations.

All outdoor installations and materials shall withstand conditions of the soft sea water.

.2 Conductors and Cables

All cables and conductors mentioned below shall comply with ГOCT or relevant IEC standards:

- All cables laid under ground in trenches and insulated with PVC cable sheath as well as reinforced with steel strips to protect them against mechanical damages correspond to ГOCT-16442-80 or relevant standards of IEC.
- All cables laid in the buildings or the structures with PVC sheath or rubber insulation comply with ГOCT 1642-80 and ГOCT 433-73E, or corresponding standards of the IEC.
- Wires, laid in the buildings and structures with plastic insulation comply with ГOCT 6323-79Å or relevant standards of the IEC.
- Wires, laid in steel pipes (supports of the outdoor lighting and on the flood lighting masts) with rubber insulation comply with TU5 16-705.456-87 or relevant standards of the IEC.
- Flexible cables for lighting fixtures in the buildings and the structures are by ГOCT 13497-77Å or relevant standards of the IEC.
- Telephone cables comply with ГOCT 22498-88 or corresponding IEC standards.

Insulation of the conductors shall be rated at 70°C.

Cables shall be protected against chemical and mechanical effects to be expected at the place of installation.

With regard to load distribution, parallel connected cables shall be of exactly equal lengths.

Bends on cables shall be made with minimum radius in accordance with the manufacturer's specifications.

Cables shall be laid with a length reserve of 1-2 %. The reserve shall be reached by a "snake" type6 laying of the cable in trenches and on even surfaces inside the buildings. The reserve on the cable structures is used to create a sag.

Cable laying in a way of winding (spirals) is not allowed.

Cables laid horizontally on structures shall be rigidly fixed at the end points next to the ring connectors and on the cable bends from both sides of the bends.

Cables laid vertically on structures and walls shall be securely fixed to the structures.

Cables on spots where mechanical damages are to be expected shall be protected to a safe height but not less than 2 m from the ground or floor level and to the depth of 0,3 m under ground.

Trenches for underground cable laying shall be completely prepared at the beginning of laying: water is pumped and stones, earth pieces, debris are removed from the trench; a bed is prepared from earth broken up or from sand on the trench bottom; underpressing of cable pipes is carried out where the line crosses roads and other utilities.

When it is impossible to pass these places, the cable shall be laid in a pure neutral soil in non-pressure asbestos cement pipes coated with bituminous composition from inside and outside.

The cables laid in the trench shall be covered with a first soil layer and mechanical protection of bricks. After that the representatives of electric mounting and construction organisation together with the Engineer's representative shall inspect the trench line and fill out a statement for the buried works.

The trench shall be completely filled and compacted after the connectors have been mounted and the line has been tested. Filling of the trench with soil containing stones and metal pieces is not allowed.

The cable entries into the buildings shall be executed in asbestos-cement non-pressure pipes. The pipe ends of the entries shall project from the building walls by 0,6 m if the foundation does not protrude from the wall. If the foundation protrudes from the wall, the pipe projection shall be measured from the former and shall be the same (0,6 m). There shall be a pipe inclination towards the trench. The pipes shall be sealed at ends.

If installed in the same duct or tray power, instrument, control and signal cables shall be separated from each other.

Laying of outside cables is not allowed when temperature is lower than -15°C.

Cables under plaster coats or in thin-walled (up to 80 mm) partitions, shall be placed in a such way that they are parallel to architectural-construction lines. The distance from floor slabs must not exceed 150 mm. Wiring in constructions shall be implemented in shortest possible lines.

All connections and branching of the installed wires shall be performed by means of soldering, pressing in cartridge cases or with a help of terminals in branch boxes.

Fastening of buried plane wires shall provide with tight fitting to the constructions.

Ducts shall be smooth and without sharp bends throughout the whole length.

Passages of the installed cables through fire-proof walls (partitions) and floors shall be performed in tubes, in boxes or in opening and through non-fire-proof ones in steel pipe sections with further filling of clearances between the wires and the pipe (the box, the opening) with easy removable fire resistant material from each side of the tube (the box, the opening).

.3 Cable Ladders, Cable Trays, Steel and Plastic Pipes

Steel cable ladders and cable trays shall be used for carrying several cables together. Where cables will be subject to physical damage, steel conduits shall be used.

Regardless of the load, the distance between supports for cable ladders and trays may not exceed 2 m.

All steel parts shall be hot dip galvanised after preparation.

Where cables are carried through a roof, it shall be done through steel tubes welded to a flange, fastened watertight to the roof. The tube and the flange shall be galvanised after welding.

On top of the tube, approx. 50 cm above the roof, a junction box shall be fixed by screws. Under the roof the cable shall be led into the tube through an airtight gasket.

Sizes of cable trays shall be suitable for all cables to be installed by the Contractor for specified future consumers, and for 20 % general spare space. The Contractor shall take into account heat dissipation of cables.

Cable trays shall be designed to withstand the loading of all cables including the spare without deflection.

At wall, ceiling, floor passages with rooms at different room temperature conditions, cable ducts and trays shall be sealed inside and outside duct or tray with non-hardening type of fire proof sealing compound.

Boxes shall be installed in such a way that accumulation of moisture is avoided.

Fastening of unprotected wires and steel sheathed cables by steel buckles or bandages shall be performed with gaskets from flexible insulating materials.

Steel pipes used for wiring shall have an internal surface eliminating insulation damages of wires and cables when pulling them into pipes. The external surface shall be corrosion protected. Where wiring goes out of the pipes, insulating bushes shall be installed.

The distance between fasteners of the surface laid steel pipes shall not exceed 2,5; 3,5; 4 and 6 m for the pipes with sizes of 15-20; 25-32; 40-80 and 100 mm respectively.

Wires and cables in the pipes shall lay freely, without stretching.

Laying of plastic (PVC) pipes for pulling of wires and cables is not allowed in temperatures less than -20°C and over 60°C.

Fastening of the PVC pipes laid on surface shall allow their free motion (movable fastening) when linear expansion or shrinkage occur due to the ambient temperature changes. The distance between the fastening points must be not exceed 1; 11; 1,4; 1,6; 1,7; 2; 2,3 and 2,5 m for the pipes of diameters 20; 25; 32; 40; 50; 63; 75 and 90 mm respectively.

Connection of the PVC pipes shall be executed as follows:

- the polyethylene pipes - by tight connection with connectors, by shrinkage into bell-ends, by connectors of shrunk-on materials, welding
- the polyvinylchloride pipes - tight connection to bell-end or with an aid of connectors.

Glue connection is permissible.

.4 Marking of Cable Lines

Each of the cable lines shall be marked by labels indicating number.

The labels shall be applied where the line changes direction, on both sides of passages through floors, walls and partitions, and where a cable goes to and from a trench.

Labels shall be installed at the terminations of cables.

The labels to be utilised are: from plastics, steel or aluminium in dry rooms; and from plastics in wet rooms, out of the buildings and under ground.

The labels on cables shall be fastened with kapron³ fibre or plastic tape with a button.

.5 Contact Connections

Dismountable connections of wires and cables to contact terminals of the electric installations, accessories, busbars shall comply with ГOCT 10434-82. Where the wire and cable strands are to be connected, a reserve of the cable or the wire shall be maintained to provide with the possibility of future connection.

The connection and branching places shall be accessible for inspections and repairs. Insulation of the connections and the branches shall be equivalent to insulation of the connected wires and cables.

The connection and branching spots of wires and cables shall not be affected by mechanical forces.

³artificial fibre, similar to nylon, produced in Soviet Union

All cables and wires of external circuits shall be led to screw-type terminals.

When aluminium cables are used, the Contractor shall ensure that the connecting parts in switchboards are suitable for connection of aluminium cables, and if it is necessary install adapting parts in such a way that the connection is performed in accordance with the manufacturer's prescriptions.

.6 Electric Components

Branch, connecting, straight-way boxes for wiring

shall comply with ГОСТ 8223-81 or equivalent international standards; the boxes are executed from plastics with rubber sealing; the УПК-4 type plastic universal boxes to be used for buried wiring, the Ó-420, 419 boxes or their equivalents to be used for surface wiring

Socket outlets and switches

use socket outlets for 220 V 6A; 10 A double-pole, of carbolite and with earthing contact, ordinary for dry rooms and splash-proof for installation in lavatories and utensils washing rooms; switches are throw-over single-pole with one or two buttons for 220 V 6 A key-type, in plastic casing.

.7 Lighting Fixtures

Lighting fixtures shall be delivered by the manufacturer with start-control apparatus (SCA), which rises $\cos \phi$ of the system lamp-SCA up to 0,92.

All lighting fixtures shall be of tropical execution.

The lighting fixtures shall be in an operational order and checked for luminous effect before mounting. Fastening of the fixtures to bearing surface shall be dismantlable.

Hooks and pins for suspension of fittings shall have devices isolating them from fixture.

Entries of wires and cables to fixtures installed outdoor shall be sealed against dust and moisture intrusion.

Lighting fixtures with incandescent lamps shall be either with milky glass or with incandescent frosted lamp. The fixtures shall be wall mounted, ceiling mounted or suspended execution depending on importance of the room or architectural decision.

Mast flood lights with sodium lamps of high pressure of the ПHaТ type or its equivalent rated at 220 V, 150(250 W shall be supplied with all fasteners. The height of the flood lighting masts is 18 m.

Lighting fixtures to light the terminal area belong to type CK3P-250 with mercury (discharge) lamps of high pressure for 250 W or equivalent; they should have $\cos \phi$ 0,9 with compensation of the reactive power.

The lighting fixtures with mercury lamps of high pressure shall be installed on steel supports by means of brackets.

Illumination levels for all rooms of the buildings and the structures, for the terminal area (traffic lanes, roads, squares) shall be compliant with СНиП II-4-79, "Design norms. Natural and artificial lighting"

3.12.3.2.2 Switchboards

.1 Standards

Switchboards and boxes shall be delivered by the manufacturer completely assembled, passed the check, the adjustment and the tests in accordance with RIED, state standards or the manufacturer's prescription or conform to the latest editions of IEC.

They shall correspond to ГОСТ 14254-80 by their way of protection against influence of environment, and to ГОСТ 15150-69 by climatic execution.

All switchboards of ГОСТ 14254-80 shall be supplied as IP 54, of ГОСТ 15150-69 - as T 1.

Operational conditions on corrosion activity of atmosphere shall comply with group of execution T1 - Æ 1 by ГОСТ 15150-69.

Operational precautions shall conform to ГОСТ 12.2.007.0-75 and ГОСТ 12.2007.7-75.

According to way of mounting, the switchboards can be built-in, suspended or floor mounted depending on place of their installation.

Operational and transportation conditions shall be in accordance with ГОСТ 17516-72 - M1.

.2 Electrical System

The electrical system of LV boards shall be 3 phase, with neutral and earth.

.3 Phase Sequence

Phase sequence shall be specified in alphanumeric order with each phase reaching its maximum in the time sequence in the order specified.

Phase marking shall correspond to the alphanumerically marking rotation employing Arabic numerical numbers, A, B, C, A1, B1, C1 or L1, L2, L3 corresponding to IEC.

The neutral conductor shall be marked O or N. The earthing conductor shall be marked \perp or PE, according to IEC and shall be yellow/green.

.4 Equipment Modes

When selecting the control equipment, an operational mode specified for these equipment shall be taken into consideration. Depending on area to be applied for these apparatuses, ГOCT 12434-83Å and corresponding standard of IEC establish criteria for their utilisation.

Number of operation cycles depending on utilisation category defines commutation durability of all control apparatuses for alternating current when the operational mode is switching on and switching off motors of pumps, ventilators and air conditioners installed in the buildings and the structures in accordance with ГOCT 12434 - 83Å, category AC 3.

All switches and circuit breakers shall be capable to protect the circuits from short circuits currents and overload.

Circuit breakers and mini circuit breakers shall be equipped with thermo- and electromagnetic release.

Moreover, besides the protection functioning, the knife-switches and the automatic switches can be used for seldom commutation of the circuits (switching on and off).

All fuse switches, switches of entries and automatic switches shall be installed by the supplier in the switchboards and they shall have a free access for manual adjustments of protecting devices.

.5 Enclosure

The switchboards shall be mounted in complete enclosure having sufficient mechanical strength for free floor standing and opening and closing of the doors.

The maximum height of the switchboards of all installation types shall be 1,8 m from the floor level to the switchboard top level.

All switchboards shall have front access only for all requirements of installations, operations and maintenance.

Handles of gears of entry commutation apparatuses shall be outside (on the front panel or on a side).

Switchboard mini circuit breaker shall be provided with door interlocks, disconnecting the power supply when the doors are open.

All switchboard parts shall be protected against corrosion by priming or painting.

Switchboards installed out of the buildings and the structures shall be splash-proof execution IP57.

.6 Cables and Wires

The internal cables and wires of the LV distribution boards shall be single core stranded copper PVC insulated conductors. All wires and cables shall be continuous and without joints.

Wires and cables shall be run in insulated tubes, channels, cleats or plastic strips. Mounting of wires and cables directly on metal shall not be acceptable.

Individual wires and cables shall be identified at both ends by interlocking plastic ferrules or plastic tape marked in accordance with the corresponding wiring diagram.

All wires shall be terminated in spade type lugs, and cables in bolted type lugs. If the terminals are of wedge type, constructed in such a way that direct contact between screw, bolt or nut and conductor is avoided, then no lugs are required.

Secondary wiring shall have a minimum conductor size of 1.5 sq. mm. Cables in circuits connected to current transformers shall have a minimum conductor size of 2,5 sq. mm.

.7 Earthing

The LV distribution boards shall have a main earth bar fitted along the whole of its length. The bar shall be of hard drawn high conductivity copper of adequate size to allow convenient connection of earthing cables to it.

The earth bar shall be connected to the board enclosure, all individual cubicles and boxes, all fixed and removable equipment and parts in service position, and all metal cable sheaths.

Joints in the earth bar shall be tinned and bolted with galvanised or cadmiumised bolts, nuts and non-loosening washers.

All earth wires shall have yellow/green coloured insulation.

.8 Cable Terminations

Top or bottom cable entry to the board, number of cables, their sizes and types are as specified on the data sheet(s), drawing(s) and/or accompanying documents. The cable entries, glands and terminals shall be suitable to accept the same.

.9 Name Plates and Labels

The name plate(s) shall be of non-corrosive material fixed to non-removable part(s) of the board. Enamelled plates are not acceptable. All text in English language and Russian language.

.10 Testing

LV boards shall be tested by the manufacturer to the requirements of the specified international standards. Some or all of the tests may be witnessed by the Engineer or inspector representing the principal.

The witnessed tests shall be indicated on the data sheets or accompanying documents and the manufacturer has to inform Engineer's representative one week in advance of the test dates.

All LV boards shall be subjected to the following routine tests:

- Dielectric tests of all electrical components of the board. These shall consist of applying AC voltage test in accordance with IEC 439 for one minute between poles, poles to frame and poles connected to frame.
- Insulation resistance test of all electrical components using DC Megger. The insulation resistance shall not be less than 1000 Ohms per Volt of rated voltage.
- Performance tests of all mechanical and electrical equipment and components of the board, including the operations of control and protection circuits, measuring devices, C/T's, etc.

.11 Elevations

Switchboard elevations, control circuit diagrams and lists of parts shall be approved by the Engineer before the manufacture of the switchboards is started.

3.12.3.2.3 Telephone Communication

The project includes a complex telephone communication including a connection to the city telephone network (CTN- ГТC) through department automatic telephone exchange (DATE-YATC), administrative-household communication, executive controller and loud speaking communication or equivalent types of communication. The Contractor shall:

- Install DATE in one of the buildings constructed at the ferry terminals which are the most loaded by telephone subscribers (consumers)
- Lay a cable telephone network in a cable trench from DATE to distributing telephone boxes KPTП-10, installed in the buildings and the structures
- Perform an indoor wiring of telephone network in the buildings and structures with the TPП - 2(0,4 mm type wire having copper strands; the wiring shall be surface and removable.
- Install telephone socket outlets and connect the telephones for subscribers (consumers).

3.12.3.2.4 Radio Communication

The project includes a system of local wire radio communication, which includes a complex of station installations and lines branching from it.

The Contractor shall:

- Mount the station installation transforming voltage of transmission (subscriber's transformer TAMY -25) on the Border Control Building which has a capacity for switching of up to 67 radio outlets.
- Lay cable radio lines from the subscriber's transformer to the terminal boxes in the buildings and the structures, lay indoor radio network wiring with wire of type ППВ-

2(0,6 mm, in corridors - with removable surface wiring about walls, above suspended ceiling, in rooms - with buried non-removable wiring.

- Install radio socket outlets in the rooms and install transmitting devices.
- Install radio socket outlets in the rooms and install transmitting devices (radio with loudspeaker).

3.12.3.2.5 Fire Alarm Signalling

The system of the automatic fire alarm signalling shall be autonomous, on fusible transmitters of type ИП-105-2/1, connected to each other by series in a loop and which work for contact breaking when the ambient temperature exceeds 70(C(10(C. When the transmitter contact has been broken, a fire signal goes to the fire alarm station ТОП-10-С, that informs about the fire in any room of the buildings and the structures by means of sound and light signals.

The Contractor shall:

- Install the fire alarm station with connection to the electrical network of alternating current for voltage 220 V 50 Hz in the rooms of each of the ferry terminal buildings and the structures where presence of the staff is permanent or equivalent installation.
- Mount sound and signal apparatuses at entrances to each of the buildings and the structures.
- Install a reserve power supply (accumulator battery for 24 V) next to the fire alarm station.
- Install push-button fire informants (to give a signals manually) in corridors.
- Mount heat transmitters on ceilings.
- Connected the transmitters to each other in a loop by means of surface wiring throughout the ceiling with copper core wire ТПП - 1(2(0,5 mm.

3.12.4 Execution of the Work

3.12.4.1 Marine Works, Ramps

3.12.4.1.1 General

The electrical installations on the ferry ramps and piers are of old construction and worn-out.

Generally, all the electrical installations (cable trays, cables, limit switches, motors, switchboards, control boards, lighting fixtures, etc.) shall be changed. The following chapters describe in outline the work to be done in the different areas.

It shall be emphasised that during the whole construction period shall the Contractor organise the electrical work in a way making it possible to operate the left ramp system when right ramp system is renovated and vice versa.

3.12.4.1.2 Power Supply to the Ramp System

For the time being, the whole ramp system is supplied from 3 (3x150 + 1x70 Cu cables. These cables are out of order and shall be changed to new cables with the same cable size and placed in the existing cable trench after it has been renovated. The cables are placed along the access pier and ending at the Ramp Control Building. The cables are supplying the Ramp Control Building and the big power outlets placed on the ferry pier (600 A outlets). The Contractor shall:

- Install new cables.
- Repair cable ducts and cable pits.
- Connect the cables (extension if necessary) to the new main switchboard, and connect the supply cables to the existing 600 A outlet.
- Repair, painting and renew damaged parts on the 600 A outlets.

3.12.4.1.3 The Ramp Control Building

From this building the ferry ramps are controlled. Operation of the ramps at the present moment is controlled from a left side control panel and a right side control panel. Between the control panels the main switchboard is placed as an open switchboard panel.

All the electrical installations in this building shall be changed. The Contractor shall organise the work in the building in a way making it possible to operate one ramp side during the renovation. If it is necessary to make temporary electrical installations to fulfil changes, it shall be incorporated in the contract. See relevant chapter for changes in the building works.

The installation inside this building shall be IP 21 installations and shall bear comparison with offices. Cableways from the main switchboard to the control boards shall be placed below the floor (cable trays, cable ladders) and under the ceiling (Tehalit trunking).

The electrical work in this building shall contain but not be limited to:

- Delivery and installation of new lighting systems.
- Delivery and installation of power and socket outlets.
- Delivery and installation of outlets for heating equipment.
- Delivery and installation of main switchboard and control panels including all connections to the ramp control systems and quay systems.

3.12.4.1.4 Installations on the Ramps and Pier System

The existing fixed bridge from land to the pier will be changed to a combined car and passenger bridge according to the drawings. Along the edge of the existing bridge all the supply and control cables for the existing systems are placed.

Supply and control cables for the renovated ramp system shall be placed on this new bridge system in cable trays placed under the bridge structure.

To make it possible to renovate the bridge and at the same time to operate with left or right ramp side, the existing supply and control cables shall be moved from the bridge cableways to a temporary cableway along the bridge. This temporary cableway and removing of the cables shall be established within this contract.

The cableways for supply and control of the ramp sections shall be placed at the fixed bridge. From the cabletrays on the bridge to the switchboards in the inside lifting towers, all cables (supply and control) shall be pulled in heavy duty hot-dip galvanized water pipes placed on the structure.

Cables between the lifting towers (e.g. cables between 1A03 and 1A04) shall be installed and pulled in heavy duty hot-dip galvanized water pipes placed in the sea bottom to avoid any moving cables.

The cables shall be installed without any connection points, junction boxes, splicing, etc.

For protection of the link systems between the intermediate span structure and the coastal span - and sea span structure limit switches shall be installed. Connection from the lifting towers to the ramps shall be carried out and thorough flexible cables placed in steel flex hoses (see drawings).

3.12.4.1.5 Lifting Tower Buildings

All the existing electrical installations in these 6 buildings shall be totally replaced. After the building and the machinery has been repaired and renovated, the new electrical equipment can be installed.

The installation inside these lifting towers shall be IP 44, watertight installations. Installations outside the buildings shall be IP 65, splash proof installation.

All the installations can be placed on walls and on the ceiling but no cables and pipes shall be placed on the floor (cables and pipes to be placed below the floor).

The electrical work in each lifting tower building shall contain but not be limited to:

- Delivery and installation of new lighting system.
- Delivery and installation of power and socket outlets.
- Delivery and installation of new switchboard.
- Delivery and installation of frequency converter system for controlling of the ramps included power and control system, limit switches, brake system, emergency stop, etc.

3.12.4.1.6 Outdoor Lighting Installation

The outdoor installations on the piers and the buildings shall be total new installations.

New masts (3 nos.) shall be furnished, each 25 m high. The 3 masts shall be placed at the same spots as the existing ones. All iron parts (masts, brackets, bolts, etc.) shall be hot-dip galvanized.

Within the contract all concrete foundations shall be carried out.

Lighting fixtures on the buildings shall be placed as indicated in the drawings.

The outdoor lighting system shall be controlled from the operation control centre (see the drawings).

After the installation the Contractor shall make the future angle adjustments and carry out the lighting measurements and hand over the measurements to the engineer.

3.12.4.1.7 Heating in the Ramp Control Building

After renovation, electrical heating in the Ramp Control Building shall be delivered and installed:

Four electrical heaters, make Siemens CS3-10, IP43, or equivalent, each 1000 Watt - 380 Volts with thermostat shall be supplied.

3.12.4.1.8 Ramp Control System

.1 General

The existing control systems are described in the existing drawing. The way to move the ramps with electrical motors, gears and counterweights shall be retained but the total electrical installations and materials (motors, limit switches, control boards, cables, breaks, etc.) shall be changed to new materials and new technology. Further, the motor control shall be changed from slip ring AC motors to frequency controlled AC motors.

It shall be pointed out that the control system shown in the new drawings is a principle system and that the Contractor shall carry out all necessary final design drawings and have the full responsibility for final design, final construction and running in of the total ramp control system. The necessary changes and adjustment to obtain a reliable and safe control system shall be carried out by the Contractor during the running-in period.

.2 Description of the Existing System

a) General

The motors 5 and 6 (towers 5 and 6 of the seaward spans) are activated each time a ferry is arriving or departing. The motors 1, 2, 3, 4 on the land span and the intermediate span will only be activated once or twice a year for adjusting the ramps to the actual water level in the Caspian Sea.

b) The Seaward Span (Normal Operation)

The Controller of the Operation Centre gets initial information about arrival (departure) of the ferry from Service for Vessels Sailing (SVS) through telephone. The SVS communicates with the vessels by "Seiner"-type radio.

When the ferry is approaching the berth (berthing), 1 or 2 assistants to the Captain of the ferry gives order to the Controller. After the Controller of the Operation Centre has received the order, he visually, through window, begins to carry out procedures on the control panel in order to lower or to hoist the ramp. (see Photo 2).

- A. Push-button No. 36 is pushed, the main contactor for the control circuit is switched on. Indicator lamp No. 35 turns on. Indicator lamps No. 1 and 2 for towers 5 and 6 of the seaward span turn on indicating that the stretching load is at the fixed upper position.
- B. When push-button No. 31 is pressed, the control circuits of motors 5 and 6 are switched on.
- C. When activation push-button No. 30, motors Nos. 5 and 6 start and the ramp is going down. Indicator lamp No. 29 is lighting for down travel and indicator lamps Nos. 9 and 10 are turned on for motor running. The position indicators Nos. 46 and 47 are moving clockwise indicating that the pulleys of the stretching load for towers 5 and 6 are working simultaneously. When the bar with the stretching load is completely down, a limit switch is activated and motors Nos. 5 and 6 are switched off. Indicator lamps Nos. 5 and 6 turn on indicating that the stretching loads of towers 5 and 6 are in the down position and the ramp is fixed on the ferry. The wire ropes will be held stretched out by small counterweights.
- D. When a ferry is ready for leaving, push-button No. 36 is pressed turning on the main contactor for the control circuit. Indicator lamp No. 35 turns on. Indicator lamps Nos. 5 and 6 are also lighting up showing that the stretching loads are in the down position.
- E. By turning the lever No. 5 (connection of motor starting resistors) will motors Nos. 5 and 6 begin to turn and the ramp begins to hoist, the stretching loads go up, the wire rope is being wound around the drum. Indicator lamps 5 and 6 turn out and indicator lamps 3 and 4 turn on showing that motors 5 and 6 are working in hoisting mode. Position indicators 46 and 47 will move simultaneously in the counterclock direction. When the stretching loads are in the up position, indicator lamps nos. 3 and 4 turn out and indicator lamps Nos. 1 and 2 turn on indicating that the ramp is in the upper position.

When the ramp is in down position, fixed on the ferry and everything is ready for loading or unloading, the train traffic light will be turned from "prohibited" to "approved" position. In "approved" position, the power for moving any of the ramps will be switched off.

c) The Land Span and the Intermediate Span

These ramps are only activated once or twice a year.

From the central board, the procedure for operation of the ramps are almost the same as for the seaward span, but the way of moving the ramps up and down are different. Lifting of the land span and the intermediate span is done through large spindles. The electrical motors driving the spindles are connected as an "electrical shaft".

To avoid any damage to the spindles (ramp spindles running unequal) the machinery on both sides is equipped with a synchro. When the spindles are running equal, the synchros are unbalancing each other. When the spindles are running unequal, the synchro system will produce a fault signal which through an amplifier will pick up a relay and temporarily stop one of the spindle motors until the fault signal is within limit again

.3 Description of the New Control System

a) General

It is important for the electrical modifications that chapter 3.17 Machinery and Equipment is consulted before the electrical design is carried out.

This description and the drawings describe the principal control system. Detailed design is to be carried out by the Contractor.

Especially the final design drawing for all control panels for each ramp side shall be carefully examined and discussed with the Employer's staff to eliminate any misunderstandings. Furthermore, the final arrangement of the panels inside the management building shall be approved by the Employer's staff.

During modification of the first ramp system, the other ramp system shall be in service. Modifications carried out during the running-in period for the first ramp shall be carried out in the other ramp, too.

It is a demand from the owner and the ferry company that the equipment used and the technical solutions in Baku and Turkmenbashi are exactly the same to make service and repair easy.

The switchboard system to operate the ramps and lighting shall be established as shown in outline dwg. no. T.03.84.

It shall be taken into account that only the Ramp Control Building is equipped with heating system. All the lifting towers are non-heated. All switchboards shall be equipped with heating element. The control panel for operating the ramp shall be placed near the window (to be agreed with the supervision) so that the ramp movements can be controlled by the operator.

b) Main Operation Methods

It shall be possible to operate the ramps in the following ways:

A. Land Span (e.g. Lifting Towers 1 and 2)

- Operation from the control panel in the lifting tower No. 1 with visual contact to the ramp. Position indicators shall inform the operating personnel that the ramp movements are within tolerance of the spindle limits.
- Emergency operation (electrically) round the PLC from each lifting tower. Coordination between the lifting towers manually or by walkie-talkie. Coordination marks e.g. on the bridge construction shall be established.
- Limit switches for protection of ramp movements shall function in all operation methods.

This ramp is only operated once or twice a year and shall be operated directly from the lifting towers and not from the control room. During the operation, visual contact with the ramp can be obtained.

The existing mechanical machinery shall be used after renovation. All electrical equipment shall be new and modern construction.

The lifting and lowering operations shall be carried out from lifting tower Nr. 1 and lifting tower No. 3 (see dwg. T.03.80).

The control system shall contain but not be limited to:

1. Delivery and installation of new IP 55 switchboards as indicated in the drawings.
2. PLC system and VLT system to be installed in the switchboards including the total programming work.
3. Delivery and installation of control panel for operating the ramp system.
4. Modify and build-in rotary encoders on the gear shaft or the gear wheels. This modification shall be carried out in a stable and robust way.
5. Delivery and installation of all external equipment (limit switches, service switches, etc.) making it possible to operate the ramp system in a safe way.

B. Intermediate Span

Same operation principle methods as for the land span.

C. Sea Span

It shall be possible to operate the ramp in the following ways:

- Remote control from the control panel in the Ramp Control Building. Position indicators shall inform the operating personnel that the ramp movements are within tolerances (normal operation).
- Possibility to operate the ramp with only one motor running from the control panel in the managing building (emergency operation 1.).
- Possibility to operate the ramp (electrically) round the PLC from each lifting tower (one motor mode, emergency operation 2).
- Possibility to operate the ramp with the manual handle as for the existing system (emergency operation 3).

These ramps are activated every day and safe, quick and reliable operation is very essential for servicing the ferries. The normal operation shall be carried out from the managing centre and the control panels for operation shall be placed in the room so visual contact with ramp and ferry can be obtained.

The existing mechanical machinery shall be used after renovation. All electrical equipment shall be new and modern construction.

The system shall be constructed as indicated in the principle drawings No. T.03.84, T.03.98, T.03.90.

The operation of this span is different from the land span and the intermediate span as no spindles are involved in the lifting system. The mechanical system is designed in a way making it possible to hoist and lower the ramp with one motor only (emergency operation 1).

With the ramp in upper position (no ferry, upper parking) the mechanical brake will keep the ramp fixed.

When a ferry enters the terminal, the operator will start lowering the ramp (approximately 2.7 m/min.). When the ramp is near to the ferry stern, the speed will go down (approximately 0.84 m/min.) and the ramp will be placed exactly and interconnect with the ferry. Limit switches will indicate that the ramp is placed correctly in proportion to the railway. When the ramp is in place, the rope counterweight is lowered (approximately 8 m/min.) to a fixed point, limit switches making it possible for the ferry to change position up and down due to weight and waves. Ready signal for unloading is sent to the port office.

When the ferry is ready for leaving, the lifting procedure is started. The small rope counterweights are lifted (approximately 7 m/min.) until they are approaching the lifting buffers. Now the lifting speed is lowered to approximately 2.0 m/min. controlled by limit switches. When the counterweight has reached the lifting buffers, the ramp lifting can start (approximately 3.0 m/min.).

The ramp will be lifted to a fixed position calculated in proportion to the water level.

A synchro connected to the gear shaft will tell the operator the actual place of the ramp on meters placed on the control desk.

For emergency operation 1 the same procedure as described with only one motor running shall be present.

For emergency operation 2, it shall be possible to operate the ramp from lifting tower no. 5 and 6 around the PLC system.

For emergency operation 3, it shall be possible to operate the ramp manually from lifting tower No. 5 (0.06-0.08 m/min.).

The existing mechanical machinery shall be used after renovation. All electrical equipment shall be new and modern construction.

The control system shall contain but not be limited to:

1. Delivery and installation of IP55 switchboard as indicated in the drawings to be placed in lifting tower 5 and 6.
2. Main PLC system to be installed in the Ramp Control Building switchboard no. 1A including the total programming work.
3. Delivery and installation of desk control panels for operating the ramp system.
4. Delivery and installation of all external equipment (limit switches, service switches, positions transducers, encoders, etc.) making it possible to operate the ramp system in a safe way.

3.12.4.1.9 Testing and Commissioning

.1 Testing

The Contractor shall provide all necessary testing apparatus and facilities for testing and installations, and any defective work shall be replaced immediately and shall be the subject of re-testing until found satisfactory.

All tests shall be carried out in the presence of the Engineer or his representative.

All existing installations used shall be tested as mentioned above, and if necessary, defective work shall be replaced and re-tested until found satisfactory by the Engineer.

It shall be pointed out that the first ramp shall be completely finalized and put into operation before ramp no. 2 is renovated.

.2 Commissioning

Before handing over the Contractor shall submit the following documentation to the Engineer:

- Manuals for operation, maintenance and overhaul.
- Electrical circuit diagrams for the whole system and other drawings necessary for maintenance and overhaul.
- Brochure and specification for all the electrical equipment in the switchboards, etc.
- Part lists with brochures.
- Recommended spare parts.

The documentation shall be submitted in 6 copies, 4 in Russian and 2 in English language.

Before handing over, the Contractor shall confirm that the installation has been examined, tested, is ready for use, that it will operate and can be maintained efficiently.

3.12.4.1.10 Technical Assistance to Operations

In order to ensure the maximum benefit from the operation of the new equipment from the beginning, and the introduction of proper, regular maintenance procedures, technical assistance and training shall be provided.

During the erection and installations of plant and equipment, the Employer's maintenance staff which shall be running the ramp facilities after completion, shall have a possibility to follow the work closely and hereby acquire a thorough understanding of the function and structures of the equipment. Especially handling of the PLC equipment including programming and communication with the personal computer shall be demonstrated and the staff shall be trained in handling this equipment.

When handing over, the Contractor shall demonstrate to the Employer's maintenance staff the methods of operation, limitations, the maintenance requirements and the safety precautions to be observed and shall also hand over any tools for operating, cleaning, testing and maintenance of the installation.

The different operation modes mentioned in Section 3.12.4.1.8.3.b shall be demonstrated.

3.12.4.2 Land Works

3.12.4.2.1 General

The following chapters describe in general the volume of work to be done by the Contractor on different areas.

3.12.4.2.2 Power Supply of the Ferry Terminal Area

According to the drawings of outdoor utilities and the general layout, the Contractor shall:

- Lay cable lines in the trenches from the existing substation 6/0,4 kV to switchboards of the new buildings and structures following all norms for crossing with existing and newly laid utilities.
- Connect cables to branched feeders of low voltage supply of the substation 6/0,4 kV.
- Connect cables to the switchboards of the buildings and the structures.
- Perform cable tests for insulation durability by high voltage.

3.12.4.2.3 Electric Lighting of the Terminal Area

According to the drawings of the outdoor utilities, and the general layout, the Contractor shall:

- Install 9 m high steel masts including foundations for mounting of the outdoor lighting fixtures.
- Mount the outdoor lighting fixtures including mercury lamps ГДЕ type of high pressure by means of brackets on the.
- Perform cabling in the trenches.
- Mount outdoor installation board to control the outdoor lighting.
- Carry out all connections of cables to the outdoor lighting board and to the switchboard of a building or substation 6/0,4 kV.
- Execute connection of the outdoor lighting fixtures to the laid location line with observation of phase sequence to reduce illumination pulsation.
- Perform testing of cable insulation.
- Carry out test switching of the whole outdoor lighting system.
- Carry out filling and aligning of the trenches.

The flood lighting of the ferry terminal area also includes installation of flood light masts, 18 m high, including foundations. The Contractor shall:

- Install flood lights on the masts.
- Install boxes at the mast toes to control the flood lighting.
- Carry out all necessary connections of wires and cables to the boxes and the floodlights.

- Adjust the direction angles of the floodlight axes with the lighted surfaces, take measurements of illumination and hand the results over to the Engineer.
- Carry out a test switching of the whole floodlighting system.

3.12.4.2.4 Border Control Terminal

The electrical work carried out by the Contractor in this building shall include:

- Supply and installation of switchboard, control and protection apparatuses
- Delivery and installation of electric adjusting items (switches, socket outlets, branch, connecting, straight-way boxes, buckles, hooks, boxes and trays, plastic insulating pipes).
- Supply and installation of cables and installation wires.
- Supply and installation of lighting fixtures which according to СНиП II-4-79 shall provide the following levels of the horizontal illumination measured 0,8 m above floor or at floor:

Service rooms, offices	300 lux	(H-0,8 m)
Lobby	150 lux	(floor)
Toilets	100 lux	(floor)
Corridor	100 lux	(floor)
Area under the shed	50 lux	(floor)

The whole wiring in the offices and toilets shall be executed hidden in hollow slab and under plaster. In the lobby and corridor, the wiring shall be mounted over the suspended ceiling. Under the shed, the wiring shall be in PVC pipes.

3.12.4.2.5 Ticketing Terminal

The electrical works carried out by the Contractor in this building shall include:

- Supply and installation of all switchboards, control and protection apparatuses.
- Supply and installation of motors for pumps and starter equipment (for Baku).
- Supply and installation of electrical adjusting items.
- Supply and installation of cables and installation wires.
- Supply and installation of lighting fittings, which according to СНиП II-4-79 shall provide the following levels of horizontal illumination, measured at 0.8 m above floor or at floor:

Offices	300 lux	
Rest room	100 lux	(H- 0,8 m)
Kitchen	200 lux	(H - 0,8 m) IP44
Corridor	100 lux	(floor)
Toilet	100 lux	(floor)
Basement (pump-room)	75 lux	(H- 0,8 m)

The wiring shall be surface mounted in PVC pipes in the Ticketing Offices. Elsewhere, the wiring shall be executed hidden in hollow slabs and under plaster.

3.12.4.2.6 Public Service Building

The electric works carried out by the Contractor in this building:

- Supply and installation of all boards, control and protection installations.
- Supply and installations of electrical adjusting items.
- Supply and installation of cables and instalaltion wires.
- Supply and installation of lighting fixtures, which according to СНиП II-4-79 shall provide the following horizontal illumination measured at the height of 0,8 m above floor or at floor:

Cafeteria	200 lux	(H- 0,8)
Wash room for utensils	200 lux	(H- 0,8)
Kitchen	200 lux	(H-0,8) IP44
Toilets	100 lux	(floor)

3.12.4.2.7 Passenger Bridge

All electric installation work carried out by the Contractor in this part comprises:

- Supply and installation of the electric adjusting items.
- Supply and installation of adjusting wires with copper cores.
- Supply and installation of lighting fixtures, which shall provide the following illumination levels at floor according to СНиП-II-4-79 :
 - 100 lux working level
 - 40 lux stand-by level

- Connection of the lighting network to the passenger terminal switchboard.

3.12.4.3 Testing and Commissioning

3.12.4.3.1 Testing

The Contractor shall provide all necessary testing apparatus and facilities for testing and installations, and any defective work shall be replaced immediately and shall be the subject of re-testing until found satisfactory.

All tests shall be carried out in the presence of the Engineer or his representative.

All existing installations used shall be tested as mentioned above, and if necessary, defective work shall be replaced and re-tested until found satisfactory by the Engineer.

3.12.4.3.2 Commissioning

Before handing over the Contractor shall submit the following documentation to the Engineer:

- Manuals for operation, maintenance and overhaul.
- Electrical circuit diagrams for the whole system and other drawings necessary for maintenance and overhaul.
- Brochure and specification for all the electrical equipment in the switchboards, etc.
- Part lists with brochures.
- Recommended spare parts.

The documentation shall be submitted in 6 copies, 4 in Russian and 2 in English.

Before handing over, the Contractor shall confirm that the installation has been examined, tested, is ready for use, that it will operate and can be maintained efficiently.

3.12.4.4 Technical Assistance to Operations

In order to ensure the maximum benefit from the operation of the new equipment from the beginning, and the introduction of proper, regular maintenance procedures, technical assistance and training shall be provided.

During the erection and installations of plant and equipment, the Employer's maintenance staff which shall be running the ramp facilities after completion, shall have a possibility to follow the work closely and hereby acquire a thorough understanding of the function and structures of the equipment.

When handing over, the Contractor shall demonstrate to the Employer's maintenance staff the methods of operation, limitations, the maintenance requirements and the safety precautions to be observed and shall also hand over any tools for operating, cleaning, testing and maintenance of the installation.

3.13 Plumbing (Water Supply/Sewerage/Heating)

3.13.1 Extent of Works

3.13.1.1 General

The works shall comprise the complete supply, installation and making operational of the plumbing installations as indicated on the drawings and/or in the technical specifications.

The plumbing specifications are not intended to cover all the details, however it is required that the Contractor provides all the elements that are inherent to sound engineering practices and workmanship in order to achieve completely satisfactory plumbing systems.

The plumbing specifications shall be read in conjunction with all the other chapters and paragraphs of this specification and the tender drawings.

The Contractor shall, in every respect, be responsible for the complete manufacture, supply, transport, installation at site, testing, commissioning, proper operation and safe functioning of the plumbing installations.

The Contractor shall provide necessary drawings, manuals and maintenance instructions.

The Contractor shall be responsible for the co-ordination with all other disciplines concerning: ratings, sizes, locations of equipment and pipes, pipe holes in walls and floors, required equipment foundations, etc.

The Contractor shall prepare for all plumbing installation documents and plumbing drawings covering the whole project.

No extra payment will be effected for making the installations comply with the above-mentioned codes and documents.

Within the tender sum, the Contractor shall effect all works and supplies necessary to the contract.

The Contractor shall bear full responsibility that the completed installations function as prescribed with regard to operation.

The Contractor's duties under this contract include all notifications and applications to authorities and the procurement of all necessary certificates and permits.

The tender documents include all drawings prepared by the Engineer in respect of this contract.

The Contractor shall inspect and examine the installations on the site before tendering and include all changes and new installations in the tender.

3.13.1.2 Underground Water Supply

The work comprises:

- complete underground water supply/distribution system including connection to existing water supply system

3.13.1.3 Sewerage and Sanitary Installations

The work comprises:

- complete gravity sewerage system and sanitary installations including underground site connections to sewerage tank.

3.13.1.4 Water Supply Installations

The work comprises:

- complete water supply installations for buildings

3.13.1.5 Drainage System

The work comprises:

- complete underground drainage system for surface water for buildings and outdoor areas including oil separators, sea outfalls, etc.

3.13.1.6 Heating Installations

The work comprises:

- laying of pipelines in floor ducts and above floors, along outdoor walls with a slope of $i=0,003$ to the side of the heat distribution point (in the pavilion) and to the side of the entry of the heating piping to the building (in the Border Control Terminal, in the Public Service Building, in the Ticketing Terminal);
- installation of convectors and radiant heaters;
- mounting of piping and fittings to the heaters;
- heat insulation and painting of the heaters and heating system pipes.

3.13.1.7 Heat Exchange Point (HEP) and Heat Piping

The work comprises:

- laying of the heat piping
- installation of pipelines and fittings

3.13.1.8 Ventilation and Air Conditioning

The work comprises:

- installation of air conditioners
- installation of axial flow fans
- mounting of air ducts
- installation of air discharge, recirculation and exhaust grilles
- installation of silencers
- heat insulation of the air ducts

The work shall comprise complete provision of the rooms with clean and fresh air and setting of the ventilation-air conditioning system into a workable condition.

3.13.1.9 Fire Fighting Installation

The work comprises:

- installation of fire hydrants on the terminal area
- installation of fire hydrants on the central pier
- installation of portable fire extinguishers in the following buildings: Public Service Building; Border Control Terminal and Ticketing Terminal
- Installation of fire hydrants in the Passenger Terminal with a set of hoses

3.13.2 Documents

All works shall be carried out in accordance with:

- Building Norms and Rules of the USSR.
- By-laws of the Local Authority.
- The Engineer's instruction.

All standards used by the Contractor shall be introduced to and acknowledged by the Engineer before execution of works.

Where the name of a particular type or make of equipment or item is referred to on the drawings or in this part of the Specification, this is intended to indicate only the acceptable standard.

The Contractor may offer alternative equipment to that specified and in all such cases the Contractor's offer shall be at least of equal quality. When alternatives are offered, the Contractor shall submit to the Engineer for approval a statement detailing the alternatives and shall include full technical descriptions, drawings and specifications, and shall provide such full information, as it is required to enable the Contractor to demonstrate to the Engineer that the alternative is equivalent to the item specified. Any further information that the Engineer may require shall be produced by the Contractor when called for.

3.13.3 Materials

3.13.3.1 General

All materials used for the works shall be of the best quality of their respective kinds as specified or described in the Specifications, Drawings and Bills of Quantities and shall comply wherever possible with relevant Standards.

The whole of the materials used in the works shall be subject to inspection and tests as specified or as the Engineer may direct from time to time, as the work proceeds. The Contractor shall submit test certificates in accordance with relevant Standards.

3.13.3.1.1 Pipes

Pipes for the distribution system shall comply with the requirements of the standards quoted wherever applicable. Test certificates shall be provided for each consignment of pipes.

Galvanised pipes for water supply shall be seamless steel pipes inside and outside galvanised in accordance with standards as ГOCT 3262-80.

The pipes shall be hot-dipped galvanised (100 microns) and zinc used for galvanising may not contain more than 1% Pb.

Galvanised and welded pipes under ground shall be coated with bituminous coat and embraced with glass fibre wrapping material.

Main and secondary sewer pipes shall be cast iron sewage pipes made in compliance with ГOCT 6942.3-80. All pipes shall be dimensioned for sewage with a temperature of 100°C in 2 minutes. Pipes shall be dimensioned for a working pressure of 6 bar at 20°C and a permissible deformation of the nominal outer diameter of 5 per cent.

Asbestos-cement pipes of BT-6 type, executed in accordance with ГOCT 539-80, are used for underground sewerage and drainage systems.

Gutters are as gutter pipes, made from galvanised roofing steel sheets.

3.13.3.1.2 Bends

All formed bends shall be made so as to retain the full diameter of the pipe.

3.13.3.1.3 Fill

Filling shall consist of material, which shall be durable, granular, free from organic substance and from excess clay and silt, and not liable to decomposition in sea water. Levelling layer under and filling around and until 150 mm above the pipes shall be well graded gravel with grain sizes between 0.06 and 2 mm.

Filling more than 150 mm above the pipes shall be excavated materials approved for re-use of well graded materials with stones max. 60 mm approved by the Engineer or materials in accordance with the Specifications for the actual works, where pipes are laid in or adjacent to roads, bays or otherwise surfaced areas.

3.13.3.1.4 Fasteners

Hangers, straps etc. used for anchoring the pipes shall be of hot-dipped galvanized iron and shall be in the dimensions shown on the drawings.

If corrosion is likely to occur precautions must be taken by the Contractor to prevent such corrosion.

3.13.3.1.5 Heat Insulation of Pipes, Insulation of Pipes

Insulation material for cold water installations and heat supply shall conform to relevant standards. The Contractor shall ensure that the insulation materials used are in accordance with the requirements of GOCTs.

In order to provide the cold water pipelines and pressure sewerage with insulation they shall be coated with mastic compound of bitumen and embraced with glass fibre wrapping material. See section 3.13.4.1.2.

In order to insulate welded pipes of heat piping glass fibre half-cylinders shall be applied with cover from rolled glass fibre reinforced plastics of PCT type or equivalent.

The insulation shall be finished with a membrane to prevent intrusion of damp with minimum 30 mm overlaps and finally wrapping with textile fabric suitable for painting with minimum 10 mm overlaps, all to the approval of the Engineer. When applied, the fabric shall be brushed with glue ensuring proper adhesion to the membrane and allowed to dry before painting.

3.13.3.1.6 Manholes, Wells

Manholes, inlet wells shall be of pre-cast RC elements of sulphate resistant cement as shown on the drawings and in accordance with relevant standards. Where otherwise stated manhole covers, manhole step irons, gully grates and frames shall comply with relevant standards.

3.13.3.1.7 Cement

Cement for concrete for anchorings shall be Sulphate Resistant Portland cement in accordance with international standards. Concrete shall consist of cement, graded aggre-

gate, water and approved admixtures thoroughly mixed, placed and compacted as specified in the following subsections.

3.13.3.2 Underground Water Supply

3.13.3.2.1 Pipes

- Distribution pipe lines shall be of galvanised pipes. All procedures are in accordance with section 3.13.3.1.

3.13.3.2.2 Fittings

- Bends and sliding sockets for primary and secondary distribution pipe lines shall be special cast iron with epoxy glazing and comply with the same requirements as for the pipes.
- Tees, reducers, tees for service pipes, saddle pieces and end caps shall be of nylon coated alloy (200 microns) and shall be dimensioned for a working pressure of 10 bar at 20°C.
- Fittings on service connections shall be of special cast iron with epoxy glazing or equivalent quality and shall be dimensioned for a working pressure of 10 bar at 20°C.

3.13.3.2.3 Valves

- Stop valves on distribution pipelines shall be sluice valves of special cast iron with epoxy glazing for socket joint or equivalent quality. All valves shall be dimensioned for a working pressure of 10 bar at 20°C.
- Stop cocks on service connections shall be sluice valves of special cast iron with epoxy glazing for connection with steel pipes or equivalent quality. All valves shall be dimensioned for a working pressure of 10 bar at 20°C.

3.13.3.3 Sewerage and Sanitary Installations

3.13.3.3.1 Sanitary Appliances and Fittings

Sanitary appliances shall be of first class quality to a standard not less than the appropriate local standard or equivalent approved international standard.

The glazing to ceramic and fireclay shall be hard and smooth and without scratches, high spots, etc.

The installation of sanitary appliances shall be in accordance with approved codes of practice.

The appliances shall be fixed in the positions shown on the drawings or as directed by the Engineer.

For all sanitary appliances, the necessary number of supports, brackets, plugs, screws, washers, jointing material etc. shall be provided.

The design implies Western type W. C. pans like "Kompakt" type and Eastern type pans of type "Chasha Genuja". Western type W.C. suites shall in vitreous china complete including low capacity cistern and black plastic seat. For each W.C., both eastern and western type, a bib tap with hose connection and 0.5 m hose shall be installed.

Wash basins shall be in vitreous china including screw to wall brackets, cold water tap and 32 mm outlet.

Kitchen sinks are to be of stainless steel including fittings, cold water taps and 40 mm outlet.

Cleanness sinks to be in stainless steel including galvanised frame and wall brackets for building in, cold water taps as shown, and 40 mm outlet.

All taps for appliances mentioned above shall be chromium plated.

3.13.3.3.2 Valves, Cocks, Taps etc. for Water Services

All valves and cocks shall have the same flow area as the corresponding pipes and shall be accessible for operation and maintenance and suitably labelled by an approved method.

All valves, cocks, and taps shall of the correct pressure rating according to the recommendations of the relevant standard of the Local Authority.

Safety valves shall be mounted on pipes when long pipelines occur without frequent draining, i.e. long pipes for hoses. Opening pressure for safety valves shall be 10 bar.

Connections to all appliances shall be with copper tubing and stop valves like "Ballofix" shall be provided for all cisterns and taps.

Cock for outdoor areas shall be of raw brass with built in non-return valve.

3.13.3.3.3 Pipes

- Main and secondary pipes shall be cast iron and site underground pipes shall be asbestos-cement pipes according to section 3.13.3.1.1.

3.13.3.4 Water Supply Installations

Installations shall be as described in section 3.13.3.2.

3.13.3.5 Drainage System

3.13.3.5.1 Pipes

Pipes shall be asbestos-cement pipes BT-6 type with matching fittings of an approved manufacture. Down pipes and gutters shall be of galvanised roofing steel sheets and shall be firmly fixed to roof construction.

3.13.3.5.2 Drains/Inlets

See section 3.13.3.1.6.

3.13.3.5.3 Oil Separators

- Oil separators shall be of steel and in accordance with relevant standards. The capacity of the tank is 250 Lt.
- Oil separators at dangerous goods' area shall be of 250 liter storage as shown on the drawings.

Ventilation, cleaning hole and precautions to prevent suction from oil separators shall be in accordance with acknowledged standards and Codes of Practice.

3.13.3.5.4 Sea Outfall

- Sea outfall shall be asbestos-cement pipes of type BT-6 in accordance with ГOCT 539-80. All pipes shall be rated for a working pressure of 6 bar at 20°C.

3.13.3.6 Heating Installations

3.13.3.6.1 Heaters/Convectors

The heat appliances are accepted as "M140A0" type radiant heaters.

The design temperature for winter period shall be retained in all of the rooms. The design criteria are mentioned below:

- for the halls, the ticketing offices, the rooms of administration, customs, police, passport control, border police t= 18°C
- for the buffet, the service rooms t= 16°C
- for the lobbies and the corridors t= 10°C
- the lavatories t= 15°C

3.13.3.6.2 Pipes

The heating pipelines shall be from welded steel pipes according to ГOCT 10704-76 and ГOCT 8732-78.

Pipelines laid in ducts shall be heat insulated with mineral wool half-cylinders based on synthetic linking, 30 mm thick. A rolled glass fibre reinforced plastics of the PCT type shall cover the pipelines. Pipes and the M140A0 heating appliances not insulated are to be painted with a 2 layer paint.

3.13.3.6.3 Bends

Bends of the heating and heat supply pipelines shall be performed in a manner of bending of the pipes or using weldless (without seam) branch bends from carbon steel according to ГOCT 17375-83.

3.13.3.6.4 Valves, Fittings

Valves, fittings, cocks, etc. shall be mounted in compliance with the drawings.

3.13.3.7 Heat Piping

3.13.3.7.1 Pipes

- The pipelines shall be executed from welded steel pipes in accordance with ГOCT 10704-76 and ГOCT 8732-78.

The pipelines are to be covered with corrosion preventing coat from mastic compound and shall be insulated with mineral wool half cylinders, based on synthetic linking. The PCT type rolled fibre-glass reinforced plastics shall cover them from the top. Mounting of the heat insulating constructions and protecting coats shall comply with СНиП 3.04.01-87.

- Laying of the heat piping shall be carried out in RC ducts of type K?

3.13.3.7.2 Valves, Fittings

Flaps and valves shall be steel.

3.13.3.8 Ventilation and Air Conditioning

3.13.3.8.1 Air Conditioners/Fans

- Roof mounted conditioners shall be "ROOFTOP" BIH-240 and BCH-90 type. The following conditions shall be maintained in the rooms with the help of these conditioners:

Temperature:	summer 25°C winter 22°C
Relative humidity:	summer 40% winter 55%
Speed of the air:	summer 0,5 m/sec winter 0,2 m/sec

Characteristics of the conditioners relatively air production are the following:

Type of the conditioners	Output Relatively Production of Air, m ³ /hr		
	Outdoor	Recirculation	Inflow
BIH-240	5,600	8,000	13,600
BCH - 90	1,750	2,500	4,250

Taking into account economic operation and improvement of utilisation, calculation of the system has been carried by multiples of air exchange. The design conditions are within the tolerance as follows:

$t = \pm 2^{\circ}\text{C}$, $W = \pm 3\%$

At the bottom of the conditioners, there are 2 branch pipes for inflow and recirculation air. In order make a horizontal connection with these pipes, the conditioners shall be installed on bearers with a length of 0,7 m.

- The wall mounted air conditioner of the "БК-2300" type.
- The AXC type axial flow fans shall be installed in the lavatories and in the rooms for washing of the utensils. For exhaustion from the lavatories, it is necessary to install an abat-vent of type ДVK-5 in the air duct on the roof of the Ticketing Terminal Building.

3.13.3.8.2 Air Ducts

Air ducts shall be executed from thin sheet galvanised steel according to ГOCT 19904-74.

Connection of the air ducts is executed by flanges. Gaskets between the flanges of the air ducts shall not protrude into the air ducts.

The gaskets shall be executed from the following materials: sponge type insulator, strip porous or monolithic rubber with a thickness of 4-5 mm.

3.13.3.8.3 Grilles

The following grilles shall be utilised in the buildings:

- air discharge grilles (ceiling grilles) shall be fastened on the suspended ceiling to provide supply of air; PP type grilles are to be installed above doors in rooms
- the ceiling grilles, fastened to the suspended ceiling, shall be also used for recirculation; P type grilles shall be installed in walls
- the P type grilles intended for exhaustion shall be mounted in the air ducts in the lavatories and the rooms for utensil washing

3.13.3.8.4 Silencers

Pipe silencers of type ØØ shall be mounted to reduce noise in air ducts.

3.13.3.9 Fire Fighting Installation

3.13.3.9.1 Fire Hydrants

Fire hydrant types shall be according to ГOCT 8220-89.

The fire hydrants of this type are to be installed on water piping for fire fighting purposes with a help of fire water fountains (ГOCT 7499-89).

The assembled hydrants shall be water tight in closed position when hydraulic pressure is 1,5 MPa (15 kgs/cm²). When the hydrant is open, leakage shall not occur through the plug hole in a casing (a water fountain) of the hydrant. Volume of water left in the hydrant after its work shall not be over 50 cm³.

Outside surfaces of the hydrant shall be painted with water resistant paint, the paint coat shall be plane, without streaks, bubbles, cracks and runs. The colour shall be "fire red".

3.13.3.9.2 Hose Reels

Boxes with glass doors and with a cock and hose reel, 20 m hemp hose having a size of 50 mm, with spray/jet/shut off nozzle in accordance with relevant standards.

The boxes, cocks and nozzles shall be of fire-red colour.

3.13.3.9.3 Portable Fire Extinguishers

Portable fire extinguishers shall comply with approved international standards

- 6 kg CO₂ extinguishers
- 6 kg ABC extinguishers

Fire extinguishers shall be supplied in colour "fire red".

3.13.4 Execution of Works

3.13.4.1 General

The works shall include all labour, materials, tools, instruments, etc. necessary to execute the work in a first class manner including such labour or materials which are not specifically mentioned but which are necessary for a satisfactory completion of the work. The works must be delivered up clean, complete, and be operational in all details.

Exact pipe alignments and location of valves etc. shall be marked by the Contractor for approval by the Engineer prior to execution of the Works. The Contractor shall ascertain that his work will not foul other services.

3.13.4.1.1 Excavation and Filling

Trenches shall be excavated to the lines shown on drawings to levels that will allow for the bedding thickness and to widths that will allow proper and efficient jointing and laying to be carried out.

Excavated materials which are approved for re-use may be stacked along the trenches or at nearby areas if approved by the Engineer. Spoil unfit for re-use shall be removed to sites designated or approved by the Engineer.

No filling except for the levelling layer may take place before the pipes have been tested and approved by the Engineer.

Generally, pipes shall be bedded in a levelling layer of gravel min. 150 mm thick, well compacted by manual power so as to resist subsequent movement of the pipes.

When stones bigger than 60 mm occur in the bottom of the trench, the levelling layer shall be thicker than 150 mm.

Filling up to 150 mm above the pipes shall be gravel similar to the levelling layer, well compacted by manual power in layers not thicker than 250 mm. No stones should be in contact with the pipes.

Filling from 150 mm above the pipe and to the ground level can be compacted by machines in layers not thicker than 200 mm to a density appropriate to the material, through which the pipeline runs. All surplus excavated material shall be disposed of as directed.

Backfilling around accessories for valves etc. shall be with approved material similar to the levelling layer, special care shall be taken to prevent damage to the actual constructions.

When crossing of roads or surfaced area formation pipes shall have a minimum cover of 1,000 mm, elsewhere a minimum cover of 800 mm shall be maintained.

Damages to roads or surfaced area formations or surfaces due to subsidence of trench filling shall be made good at the Contractor's expense.

The final surface shall be evenly graded and finished after compaction to correct levels, falls, profiles and original materials.

Where in the opinion of the Engineer backfilling is unsatisfactory, it shall be removed and replaced in accordance with the Specifications.

3.13.4.1.2 Pipe Laying and Jointing

The bottom of the trench shall be carefully prepared so that the pipes when laid are well bedded down for their whole length on a firm surface and are true to line and gradient.

Before laying, each pipe and filling shall be thoroughly cleansed internally and the nets temporarily plugged. After laying and jointing, the leading end shall remain temporarily plugged to prevent access of water, soil, etc. Precautions shall be taken to prevent floating of the plugged pipes should the trench become flooded.

The Contractor shall supply and fix in all pipe runs all necessary bends, tees, valves, standposts, and other specials and shall carry out all necessary cutting, jointing and connections. All joints shall be made strictly in accordance with the manufacturer's instructions and recommendations and comply with the appropriate International Standards or Codes of Practice.

Special precautions shall be taken to prevent damages because of extension or contraction of the pipes strictly in accordance with the manufacturer's instructions and recommendations.

3.13.4.1.3 Supports and Anchorings

Thrust-blocks of concrete shall be formed at all bends, tees, plugs, reducers, etc. to transmit the hydraulic thrust on to undisturbed ground and to spread it over a sufficient area.

Anchor plates, with galvanised hangers or straps shall be made for all stopvalves shown on the drawings.

3.13.4.1.4 Service Connections

The pipelines shall be laid to lines and the stop cocks placed in positions corresponding with the drawings. At all times, at minimum cover of 1,000 mm shall be maintained over pipelines passing roads or surfaced area formations. As the service connections have to be completed before the internal piping provisions shall be made for plugging the temporarily open ends of the service connections.

3.13.4.1.5 Buoyancy

Precautions to prevent buoyancy for the pipes and tanks shall be taken. The Contractor shall be entirely responsible for damages, etc. caused by buoyancy and shall immediately replace the damaged parts at his own expense.

3.13.4.1.6 Handling and Storage

To prevent damage to the pipes it is of importance that the pipes are loaded and unloaded individually, large dimensions should be handled by at least two men.

Pipes should not be stacked in piles higher than 1 m.

Bearer battens should be laid on the ground and possibly between each layer across the length of the pipes. The site for unloading must be even and free of stones etc.

Pipes and rubber rings for jointing shall be protected from direct sunshine by storing in a dark place or otherwise sheltered.

3.13.4.1.7 Pipe Supports

All piping exposed on faces of walls shall, unless otherwise specified, be fixed at least 50 mm clear of adjacent surfaces (incl. insulation) with approved holder bats built into walls; where fixed to woodwork, suitable clips shall be used.

All piping specified as fixed to ceilings, roofs or roof structures shall be fixed with approved mild steel hangers, cut and pinned to ceilings, roofs or roof structures. Where tubes are fixed to ceilings, roofs or roof structures close to each other, they shall be fixed in positions which leave the lower surfaces at the same horizontal level, unless otherwise specified.

Pipes shall be fixed to true lines parallel to adjacent lines of the building, unless otherwise specified.

Pipe fixings and supports shall be arranged at intervals not greater than those given in the following table:

Diameter of Pipe mm	Maximum Spacing of Fixing in mm	
	Horizontal Runs	Vertical Runs
15	1,800	2,400
20-32	2,400	3,000
40-50	3,000	3,600
65-100	3,600	4,600

Each support shall take its due proportion of the weight of the pipe and shall allow free movement for expansion and contraction.

Where pipes are laid in trenches care must be taken to ensure that fittings are not strained.

Sleeves shall be provided where pipes pass through walls and solid floors to allow movement of the pipes, without damage to the structure. The overall length of the sleeve shall be such that it projects at least 2 mm beyond the finished thickness of the wall or partition.

Pipes shall be cut by hacksaw or other method which does not reduce the diameter of the tube or form of bead or feather which might restrict the flow.

3.13.4.1.8 Insulation

Welded pipes of the heat piping shall be heat insulated in the following way:

1. Priming with mastic compound;
2. Glass fibre half-cylinders, 40 mm thick;
3. Rolled glass fibre reinforced plastics of PCT type.

Galvanised pipes of underground laying for cold water supply and pressure sewerage shall be coated with highly strengthened bituminous polymer insulation in the following way:

1. Priming;
2. Mastics, 3 mm thick 1 coat;
3. Glass fibre wrapping material 1 coat;
4. Mastics, 3 mm thick 1 coat;
5. Glass fibre wrapping material 2 coats;
6. Mastics, 3 mm thick 1 coat;
7. Hessian paper.

3.13.4.2 Underground Water Supply

Cleaning and disinfection: All used drinking water pipes shall be cleaned by flushing with clean fresh water and disinfected in accordance with approved International Standards.

Further procedures, see 3.13.4.1.

3.13.4.3 Sewerage and Sanitary Installations

The Contract shall see to that all sewer pipes are laid with the highest possible gradient, if possible 20 (2 %) in accordance with the present conditions.

Pipe connections have to be established with great caution for cleaning and positioning of gaskets.

Where support, brackets, etc. are screwed to wall or structure, raw plugs or similar shall be used.

No trap for any appliance whatsoever shall be with less seal than 75 mm.

All traps below floor level shall be recast with concrete.

All floor gullies shall be mounted 100 mm from wall.

Care shall be taken at all times and particularly after fixing, to appliances from damage.

Upon completion of the work, all appliances shall be cleaned for plaster, paint, etc. and carefully examined for any defects.

Further procedures, see 3.13.4.1.

3.13.4.4 Water Supply Installations

All drinking water pipes shall be cleaned by flushing with clean fresh water and disinfected in accordance with approved International Standards.

Further procedures, see 3.13.4.1.

3.13.4.5 Drainage System

- Sea outfall appear from general location plans.

The bottom level of the pipe at the outfall shall be approx. 0.5 m below LW. The outlet end of the pipe shall be placed and anchored to prevent damages from manoeuvring ships.

- The anchoring of the outfall pipe shall be placed as shown on the drawings. The pipes shall be bedded on a levelling layer of gravel and the filling around and above the pipe shall be similar to the levelling layer.

The depth and exact location of the outfall shall be determined on site by the Engineer in consultation with the Contractor.

Further procedures, see 3.13.4.1.

3.13.4.6 Heating Installations

A water heating system has been prescribed for all buildings. Before the mounting of heating systems starts, the Contractor shall execute the following works:

- mounting of floors, walls and partitions upon which the heating installations will be installed
- installation of foundations or platforms where boilers, heat exchangers, pumps, ventilators, air conditioners are to be installed
- installation of floors in spots where the heat appliances will be placed
- preparation of floor ducts for laying of the heating pipelines
- installation of supports for pipelines to be laid in the floor ducts
- preparation of holes in the foundations, walls, partitions, floors and coverings necessary for laying of the pipelines and air ducts.
- plastering (or facing) of wall and recess surfaces in the places where the heat appliances will be installed and where the pipelines and the air ducts will be laid.
- provision with possibility for switching of the electric tools and electric welding equipment at the distance of not more than 50 m from each other.

The heat appliances (heaters, convectors, etc.) shall be placed according to the drawings.

Supply pipes of the heating appliances shall have fastening, if they are longer than 1500 mm. Inclinations of the supply pipes shall be from 5 to 10 mm along the length of the supply pipe to the direction of heat carrier's motion. If the length of the supply pipe is up to 500 mm, the inclination shall not be performed. Radiant heaters of all types shall be installed at the following distances, but not less: 60 mm - from floor, 50 mm - from bottom surface of window boards and 25 mm - from plaster on walls.

The heating appliances shall be installed on brackets or stands, performed in accordance with standards, technical directions or working documentation.

Number of the brackets shall be one per 1 m² of the heated surface of a cast iron radiant heater, but not less than 3 per a heater. The brackets shall be mounted under necks of the radiant heaters. The brackets for the heating appliances shall be fastened to walls by studs or by burial with cement mortar, which has a type of not less than 100. The burial shall be to the depth of not less than 100 mm (without taking into consideration a plastering layer).

When the steel pipes are being mounted, their connection shall be executed in correspondence with requirements of СНиП 3.05.01-85.

Distance between supports of the steel pipelines at horizontal areas shall be as indicated in the following table.

Pipe size, mm	Maximum Distance Between Fastening of the Pipelines, in m	
	not insulated	insulated
15	2,5	1,5
20	3	2
25	3,5	2
32	4	2,5
40	4,5	3
50	5	3

Welding of the steel pipes can be carried out in any manner acceptable by standards. Sizes of welds shall correspond to the requirements of ГОСТ 16037-80. Welding of the steel pipes, the parts and the details must comply with ГОСТ 12.3.003-75.

As a general rule, holes in the pipes with a diameter of up to 40 mm for welding of branch pipes shall be executed by drilling, milling or cutting by press. Diameter of the hole shall be equal to the inside diameter of the branch pipe within a tolerance of (1 mm).

Bends of the heating and heat supply pipelines shall be performed in a manner of bending of the pipes or using weldless (without seam) branch bends from carbon steel according to ГОСТ 17375-83.

Radius of the pipe bend with pipe size of up to 40 mm inclusive shall be not less than 2,5 D-outside, and it shall be not less than 3,5 D-outside for pipe size of 50 mm and more.

Fittings for the pipelines are as follows:

- a valve shall be installed at the piping entry to the Border Control Building, the public service building, the ticketing building.
- a double control valve shall be mounted on the supply pipeline to the heating appliances.
- the "Air valve of Engineer Maevsky" shall be mounted on a last heating appliance (at the end of branches) in all buildings.

The installation of the valves shall allow water to pass under the closing part. Spindles of the double control valves shall be installed in vertical position if the heating appliances are not located in recesses. If they are located in recesses they shall be installed at an angle of 45° upwards.

3.13.4.7 Heat Piping

3.13.4.7.1 Heat Piping

A trench shall be prepared for underground laying of the pipelines from the boiler house under construction to the buildings. Before the earthworks start, availability and location of the existing utilities shall be verified precisely by digging of shafts. When existing utilities have been revealed, the representative of the owner of the revealed utility must be called. Trenches with a depth of up to 2 m shall be excavated with preparation of a 10 cm thick sand base. The sand base width shall be by 10 cms more from each side than the duct width. RC ducts shall be laid in the trenches. The pipe guides with the support pads and fixed supports shall be installed in the trenches. Movable supports shall fit to support surfaces of the structures with clearances and distortions. Spots where the fixed supports have to be installed are indicated on the drawings. Distances between the pipe guides are mentioned below.

Pipelines, diameters in mm	Distance between the pipe guides, in m
100	4
80	3,5
50	3
40	2,5
32	2,0
25	1,7

Pull of an expansion loop shall be executed on completion of pipeline mounting, quality control of the welded joints (except end joints used for stretching) and fastening of the fixed supports.

The magnitude of the expansion loop pull shall be indicated on the working drawings. Correction on ambient temperature has to be taken into account when the end joints are being welded.

The pull of the expansion loop shall be simultaneously executed from both sides of the joints, located at a distance of not less than 20 and not more than 40 diameters of the pipeline from axis of symmetry of the expansion loop. The pull shall be executed by means of pulling devices if not otherwise specified.

Pipeline branching shall be executed in chambers for pipeline details. Fittings shall be stationed on the branch pipes. Fittings of the heat piping shall be steel due to the high seismic activity stated as 9 degrees. The pipeline fittings shall be mounted in a case.

Dewatering of the chambers shall be considered. In order to perform drainage of the chambers, drainage wells are envisaged. Therefore, design inclinations of the pipelines need to be followed. Variation of the pipeline inclinations from the design values are acceptable with accuracy of $\pm 0,005$. The actual inclination shall not be less than a minimum allowable in accordance with СНиП 2.04.07-86.

Before the ducts are closed, they shall be thoroughly cleaned from building rubbish. The ducts shall be closed by RC slabs. After the work has been finished, the duct shall be filled with sand. Before filling of the ducts, outside surfaces of walls and of the covers shall be tarred with hot bituminous 2 times.

When the pipelines are laid in ducts in trenches, back filling of the trenches shall be performed after preliminary tests of the pipelines for durability have been carried out.

Further procedures see 3.13.4.1.

3.13.4.8 Ventilation and Air Conditioning

The "ROOFTOP" type BCH-90 conditioners shall be mounted on the roof of the Border Control Building.

At the bottom of the conditioners, there are 2 branch pipes for inflow and recirculation air. In order make a horizontal connection with these pipes, the conditioners shall be installed on bearers with a length of 0,7 m.

The air conditioner of the "БК-2300" type shall be mounted in the wall of the Public Service Building and the Ticketing Building.

The AXC type axial flow fans shall be installed in the lavatories and in the rooms for washing of the utensils. For exhaustion from the lavatories, it is necessary to install an abat-vent of type ДБК-5 in the air duct on the roof of the Ticketing Terminal Building.

The air ducts are to be mounted on the roof and in the suspended ceiling inside the building. In the lavatories the air ducts shall be mounted under the ceilings. The air ducts shall be executed from thin sheet galvanised steel according to ГОСТ 19904-74.

The air ducts shall be mounted independently in accordance with the design siting and levels. Connection of the air ducts to the equipment shall be carried out after the equipment has been installed.

Connection of the air ducts is executed by flanges. Gaskets between the flanges of the air ducts shall not protrude into the air ducts.

The gaskets shall be executed from the following materials: sponge type insulator, strip porous or monolithic rubber with a thickness of 4-5 mm.

Fastening of the air ducts shall be executed in accordance with the working documentation. Deviation of the air ducts from vertical axis shall not exceed 2 mm per 1 m of air duct length. The ducts shall be fastened in a way that their weight is not transmitted to the conditioners. As a rule, the air ducts shall be connected to the conditioners and to the grilles through flexible connectors eliminating vibration. The connectors are made from glass cloth or another material providing flexibility, tightness and durability.

Fastening of the horizontal steel air ducts, which are not insulated and connected to flanges, of round or rectangular configuration with a dimension of up to 2000 mm shall be executed with a distance of 6 m.

The connectors shall tightly embrace the steel air ducts. Fastenings of the vertical steel air ducts shall be mounted at a distance of not more than 4 m.

In the exhaustion systems air ducts from pressure branch pipes shall be raised 0.7 m above roof and closed with a cowl.

The pipe silencers have to be installed in order to reduce sound in the air ducts. Reduction of sound coming from the ventilators has been considered in design of the conditioners.

Heat insulation of the conditioners shall be supplied by the manufacturer. The air ducts, laid on roofs, shall be insulated with butts (mats) of glass fibres and covered with bituminous foil on the top. Mounting of the heat insulation structures and the protective coats shall be performed in accordance with requisitions of СНиП 3.04.01-87. Insulation of the air ducts shall be executed by specialised construction organisations after they are mounted.

3.13.4.9 Fire Fighting Installation

The hydrants shall be transported by means of sheltered wagons and or containers. Before the hydrants are packed for transportation, the open threads and all treated surfaces of parts shall be covered with corrosion preventing lubricant.

The Contractor shall mark all fire fighting equipment wherever mounted with appropriate labels and signs.

3.13.5 Testing and Control at Commissioning

3.13.5.1 General

3.13.5.1.1 On Testing

The Contractor shall give 7 days' written notice of testing to the Engineer.

The Contractor shall provide all necessary testing apparatus and facilities for testing the installations and any defective work shall be replaced immediately and shall be the subject of re-testing until found satisfactory.

By testing insulated pipes, any defects, faults, etc. that might appear through the tests shall be corrected by the Contractor at his own expense.

All tests shall be carried out in the presence of the Engineer or his representative.

All existing installations used shall be tested and cleaned as mentioned above, and if necessary, defective equipment etc. shall be replaced and re-tested until found satisfactory by the Engineer.

Upon completion of the works, including re-testing if necessary, the installations shall be thoroughly flushed out and water pipes refilled with clean water ready for use.

All materials used for the Works shall be of the best quality of their respective kinds as specified or described in the Specifications, Drawings and Bills of Quantities and shall comply wherever possible with relevant Standards.

The whole of the materials used in the works shall be subject to inspection and tests as specified or as the Engineer may direct from time to time, as the work proceeds. The Contractor shall submit test certificates in accordance with relevant Standards.

Test pressure shall be applied by means of a manually operated test pump. Pressure gauges shall be re-calibrated before the test.

The test pressure shall be maintained for about one hour without decreasing.

Where pipes are to be insulated the work shall be tested prior to insulating.

All fresh water and sea water installations shall be tested to a cold water pressure of 7 bar.

3.13.5.1.2 On Commissioning

Before handing over, the Contractor shall confirm that installations have been examined, tested and are ready for use, that they will function and can be maintained efficiently.

All equipment used shall bear identity sign showing manufacturer's name, type and serial number, test pressure, normal working pressure etc.

All pipes shall be marked with the content and direction of the flow.

When handing over, the Contractor shall demonstrate to the Employer's maintenance staff the methods of operation, limitations, the maintenance requirements and the safety precautions to be observed and shall also hand over any tools for operating, cleaning, testing and maintenance of the installations.

3.13.5.2 Underground Water Supply

All potable water pipes, both new ones and existing which are used, shall be pressure tested, existing pipes shall be tested for 1 1/2 hours at the actual working pressure and new pipes for 1.5 x maximum working pressure (15 bar), in accordance with relevant International Standards.

The test shall take place before insulation of pipes.

The Contractor shall provide all equipment, anchors and the like necessary for testing and shall carry out all tests to the satisfaction of the Engineer.

3.13.5.3 Sewerage and Sanitary Installations

All sewerage pipes shall be tested by flushing cisterns or discharging water through as directed by the Engineer.

3.13.5.4 Water Supply Installations

Pipes, valves, cocks, flaps shall be absolutely tight under the test pressure during testing.

3.13.5.5 Drainage System

All drainage system shall be tested by flushing or discharging water through as directed by the Engineer.

3.13.5.6 Heating Installations

Upon completion of the works, the following shall be performed:

- testing of the heating, heat supply and air conditioning systems by hydrostatic or manometer method filling out a statement as well as flushing of the heating systems in accordance with requirements of ГOCT 28 74-82
- individual tests of the mounted equipment, a statement on results shall be filled out
- heat testing of the systems for uniform heating of the heat appliances.

Individual testing of the equipment shall be carried out during idling and under load for 4 hours of constant work.

Hydrostatic test of the heat piping and of the heat exchanger shall be executed only when an ambient temperature inside the rooms is positive. The water temperature shall be not less than 5°C.

Value of the test pressure shall be 25 atm (2,5 MPa) for the hydraulic test of the pipelines from the boiler house to the HEP and 16 atm (1,6 MPa) for the pipelines from the HEP to the buildings-consumers.

Details of the pipelines for heating and heat supply, taps, cocks, valves, drain pockets shall be tested by hydrostatic (hydraulic) or by bubble (pneumatic) method in accordance with ГОСТ 25136-82 and ГОСТ 24054-80. Testing of the heating system and the heat supply system shall be carried out by hydrostatic method when boilers and heat exchangers are switched off. Pressure shall be equal to 1,5 of the pressure value of the system but not less than 0,2 MPa (2 kgs*cm²) in the most below point of the system. If, within 5 minutes under the test pressure, reduction of the pressure does not exceed 0,02 MPa (0,2 kgs/cm²) and leakage do not occur in welds, pipes, thread joints, fittings, heat appliances and equipment, the system shall be considered as passed through the test.

Cast iron radiant heaters shall be tested by hydrostatic method under 0,9 MPa (9 kgs/cm²) pressure or by bubble method under pressure 0.1 MPa (1 kgs/cm²). After the testing the water shall be removed from the heat appliances.

The test pressure of the hydrostatic test for the heating systems connected to the HEP shall not exceed the extreme test pressure for the heat appliances installed in the system.

Heat testing of the heat systems and heat supply shall be implemented when water temperature in the delivery lines of the systems is not less than 60(C and ambient temperature is positive. Moreover, all heat appliances shall be heated uniformly.

The heat test of the heating systems shall be carried out within 7 hours. Heat uniformity of the appliances shall be checked (by touch) during this.

3.13.5.7 Heat Exchange Point and Heat Piping

For general requirements, see 3.13.5.6 above.

Pipelines laid in the engineering ducts shall be pre-tested for durability and tightness when the construction and mounting works are being carried out.

The pre-tests of pipelines shall be implemented before installation of cut-off valves, closing of ducts and back filling of the ducts.

As a rule, the pre-tests of the pipelines for durability and tightness shall be executed by hydraulic method.

The pipes of the water heat piping shall be tested by pressure equal to 1,25 of the working one, but not less than 1,6 MPa (16 kgs/cm²).

Results of the tests for durability and tightness shall be included to statements according to forms mentioned in annexes 2 and 3 of СНиП 3.05.03-85.

The hydraulic tests of the pipelines shall be carried out according to the following basic requirements:

- the test pressure shall be provided in a top point (level) of the pipelines

- water temperature during tests shall not be less than 5°C
- when ambient temperature is negative, the pipeline shall be filled with water which has temperature of not less than 70°C; filling and removal of water from the pipe shall be done within 1 hour
- the pipeline air shall be removed when the pipeline is being gradually filled with water
- the test pressure shall be maintained for 10 minutes and then reduced up to the working one

Inspection of the pipeline shall be carried out under the working pressure along the whole length.

The results of the hydraulic tests for durability and tightness are satisfactory if reduction of pressure, ruptures, leakage through welds, flange joints, fittings, expansion joints and other parts of the pipelines are not observed during the test period.

The pipes of the heating systems, buried and not buried, shall be flushed by hydropneumatic method with drinking water till the moment of complete clarification of the flushing water.

After the flushing, results of laboratory analysis of the flushing water shall correspond to the requirements of ГOCT 2874-82.

Pressure in the pipeline shall not exceed the working one while the flushing is executed. Air pressure of the hydropneumatic flushing shall not be over the working pressure of the heat carrier, and it shall not be more than 0,6 MPa (16 kgs/cm²).

Carrying out the hydraulic flushing, water speed shall not be less than design speed of the heat carrier, indicated in the working drawings. As regards the hydropneumatic flushing, it shall exceed the design speed by not less than 0.5 m/c.

3.13.5.8 Ventilation and Air Conditioning

While making the individual tests, it is necessary to fulfil the works as follows:

- to check correspondence of actual execution of the ventilation and air conditioning systems to the working design
- to check air tightness of air duct sections by method of aerodynamic tests according to ГOCT 12.3.018-79, outcomes of the tightness test shall be described in a statement in accordance with СНиП 3.01.01-85
- to test idling of the ventilation equipment following prescriptions stated by manufacturers.

It is necessary to perform the following making adjustments of the ventilation and air conditioning systems up to the design parameters in compliance with ГOCT 12.4.021-75:

- test of ventilators and air conditioners connected with electric distribution network (definition of correspondence of actual characteristics to data in manuals: supply and pressure of the air, frequency of revolutions, etc.)
- examination of uniformity of heating (cooling) of heat exchangers in the conditioners
- examination and adjustment of the system for air consumption in the air ducts inside rooms and determination leakage or losses of the air through holes in the air ducts
- checking of exhaust devices of natural ventilation.

Deflections of values for air consumption comparatively with the design values after adjustments and tests of the ventilation and air conditioning systems are allowed:

- (10% - for consumption of the air passing through air discharge grilles of air conditioning stipulating provision with pressure (negative pressure) required for a room
- + 10 - for recirculation air consumption.

Testing the ventilation and the air conditioning systems in whole, composition of the adjustment works include:

- test of the simultaneously working systems
- test of efficiency of the ventilation and the air conditioning systems
- test of installations for protection, blocking, signalling and control of the equipment.

The complex adjusting of the systems shall be carried out by an adjusting organisation together with the Contractor and the mounting organisation.

Procedures for execution of the complex system adjustments and removal of revealed faults shall correspond to СНиП III-3-81.

3.13.5.9 Fire Fighting Installation

Pipes and valves shall be absolutely water tight under the working pressure during testing.

3.14 Paving and Road Works

3.14.1 Extent of Works

The work comprises sub-bases, bases and pavements for

- Asphalt paved access road leading from terminal area to the main public road
- Repair of railway crossing and installation of new rail crossing with container road
- Asphalt paved internal roads on the ferry terminal area

- Various reestablishment repair and alignment of pavements at various items, due to demolishing of existing pavements or excavation for foundations for buildings, pipes, etc. and for repair of existing pavements.

Further the work comprises the execution of drainage, traffic and lane marking, road signs, fencing, lighting, etc., according to specifications and drawings and as instructed by the Engineer.

3.14.2 Documents

The works shall be executed in accordance with relevant local standards, like:

1. СНиП III-38-75 "Railway"
2. СНиП 2.05.02-85 regarding materials
3. СНиП 2.05.07-85 "Industrial traffic"
4. Designer(s) Reference Book - Industrial traffic
5. Designer(s) Reference Book - Railway Station
6. СНиП - IV-2-82, vol. 4 - Rules for elaboration and use of element estimation norms for building constructions and works
7. Kerb-stones of concrete and reinforced concrete, ГОСТ 6665-82
8. Instructions for design of flexible pavements, ВСН 46-83
9. СНиП III-40-78 - Rules for execution and acceptance of works, "Automobile roads"

3.14.3 Materials

3.14.3.1 Sub-Base Sand

The sub-base material shall be clean, sound, well graded natural sand or quarry run, having such properties to ensure a minimum dry density of 95% according to СНиП 2.05.02 (Modified Proctor Optimum). Any oversize materials shall be removed prior to commencement of works, if prescribed by the Engineer.

New materials for sub-grade shall not be applied unless the present sand fill is not sufficient or compliant with the requirements to sub-grade materials.

3.14.3.2 Sub-Base Gravel

The material shall be composed of clean, hard, sound durable, crushed stone with grading as follows from the below table:

B S Sieve Size (mm)	% Passing
37.5	100
19/0	65 - 90
9.5	45 - 75
4.75	30 - 50
2.36	21- 40
0.425	8 - 20
0.075	5 - 12

Any oversize material in excess of 50 mm shall be removed from the works prior to processing if so directed by the Engineer.

Gravel base shall comply with the following specification:

Min. CBR at in-situ density	80%
Max. PI (%) (Plasticity Index)	6
Min. Grading Modulus	2.0
Min. Field Compaction	98% according to СНиП 2.05.02-85 (modified AASHTO)

The abrasion loss as determined by СНиП 2.05.02-85 or A.A.S.H.O Standard Method shall not exceed 45%.

Where an existing sub-base layer is present, furnishment of new materials is not necessary unless the existing layer is not sufficient or compliant with the requirements to sub-base materials.

3.14.3.3 Top Aggregate Base

The material shall be from clean, hard, sound and durable crushed stone with the following fractions:

1.	Crushed stone - 40-70 mm	92%
2.	Crushed stone - 10-20 mm	8%
3.	Water	30 m ³ per 1000 m ² of the base

The top aggregate base shall comply with the requirements of СНиП IV-2-82.

3.14.3.4 Asphalt Wearing Course (Base Course and Carriageway Surfacing)

The base course shall be of coarse grained asphalt, hot, porous of type "Big/Medium Granulaty" according to СНиП IV-2-82, with added mix of sand and gravel.

The bitumen shall be of type БНД 40/60, according to BCH 46-83.

The carriageway surfacing shall be of middle-grained asphalt, hot, dense, of type "Б" according to СНиП IV-2-82, with sand-gravel mix.

The bitumen shall be of type БНД 40/60, according to BCH 46-83.

The maximum size of stones shall be 30 mm and the fraction grains with size more than 2 mm shall not be over 35%.

These compositions are for guidance only and the Contractor shall submit a composition for the Engineer's approval, together with all the supporting evidence required to obtain the best possible strength including the Marshall test results for four contents of binder, bracketing the binder content selected.

3.14.3.5 Letters, Figures and White Lines

Letters and figures on the pavements at the container stacking yard are to be made in a wear resistant white road paint. The size of the letters and figures is 500 x 80 mm and the lines are to be 100-300 mm wide.

3.14.3.6 Crossings

The road/railway crossings shall be constructed or moved using either the continuous pavement or RC paving slabs in accordance with existing situation and as directed by the Engineer.

Existing signals and traffic signs shall be moved and reused if their condition allows so. Any renewal and replacement shall be agreed with the Engineer.

Crossings shall be equipped with automatic signal lights. Illumination of the crossings shall not be less than 3 lux.

In case of RC slabs, these shall be of one type (2480(1000(100 mm), mark II, from concrete of mark 400 and frost resistance of not less than - 200 and estimated at live load 130 and 180 in compliance with relevant standards.

3.14.3.7 Traffic Signs and Markings

3.14.3.7.1 Traffic Signs

Type and location of traffic signs to be installed are shown on the dwg. "Plan of Traffic Signs". The traffic signs comprise the following types:

- High gallow type, height 5 m
- Low gallow type - short
- Low gallow type - long
- Ordinary tube post type

In general, supporting structures like gallows, posts, etc. shall be made from closed galvanised steel profiles, like RHS profiles, tubes, etc. Foundations in the ground shall be concrete or steel base plate type, as appropriate.

Sign boards shall be made from aluminium with reflecting folio cover on the front side and non-reflecting folio or varnish cover on the back side. The materials shall be resistant to the local light and climatic conditions. The signs shall be produced by a well recognized sign manufacturer to be approved by the Engineer.

Size, colour, symbols and text of signs (boards) shall be in accordance with approved national or international rules for road signs and markings. Text shall be in both English and Russian.

Before installation, the Contractor shall submit a detailed design of each road sign, including design drawing, specification and description of materials, reflection characteristic/parameters, etc. for the approval of the Engineer.

3.14.3.7.2 Pavement Markings

Letters, figures and lines on the pavements to be painted according to the "Traffic Sign Plan". They shall be made from a wear resistant white road paint. The painting shall be executed as specified by the paint manufacturer. The size of the letters and figures is 500 x 80 mm and the lines are to be 100-300 mm wide.

3.14.3.8 Traffic Barriers (Booms)

Booms shall be provided at the Ticketing Building (incoming traffic lanes) and at the Border Control Building (both incoming and outgoing traffic lanes). The barriers shall be made from steel with boom possibly from aluminium, type Ovitor or similar.

The booms shall be balanced with counterweight and vertically movable by electrical motor operated from the cabins under the sheds.

Effective reach of the boom is 3.5 m, with single support (half boom type).

The boom shall be painted yellow/black complying with specifications given in section 3.8.4.2.

Foundation of the vertical support for the boom shall be concrete.

3.14.3.9 Fencing

Wire Fence, General

All wire mesh shall be chain link netting of 2.5 mm thick galvanised mild steel wire interwoven to form 50 mm diamond meshes and with both edges clinched and of widths as later specified. The netting shall be fixed to posts by means of four strands of straining wires. Joints in the running lengths shall coincide with posts or standards and shall be securely bound at each mesh to same with tying wire.

Corner posts shall be manufactured out of galvanised mild steel tubing of \varnothing 100 x 2.5 mm. They shall be 3200 mm in length.

They shall be provided with a 230 x 230 x 5 mm galvanised mild steel baseplate.

Standards shall be placed with max. 3.0 distance.

Standards shall be manufactured out of \varnothing 50 x 2.0 mm galvanised mild steel pipe. They shall be 3200 mm in length.

They shall all be provided with galvanised mild steel baseplates 150 x 150 x 3 mm thick.

The struts used for supporting all corner posts shall be exactly the same as the standards except that the top 100 mm of each standard is to be flattened and provided with a 14 mm diameter bolt hole 50 mm from the flattened end.

All tying and straining wire shall be galvanised mild steel. Tying wire shall be 2.0 mm nominal thickness. Straining wire shall be 4.0 mm nominal thickness and shall be bound around posts and secured to same at one end, with one end fixed to eye bolts fitted through the next post and tightly strained and secured.

The wires shall be threaded through all intermediate standards and securely bound to same with tying wire.

Gates

Gates shall comprise an outer frame of welded black steel tubing with all corners rounded, covered with chain link mesh fencing tightly strained and securely bound all round to frame with tying wire as previously described. Gates in 2.4 m high fencing shall be \varnothing 60 x 2.5 or \varnothing 76 x 2.9 for the 10.0 meter gate. Double gates vary from 5000 mm x 2800 mm, 6000 mm x 2800 mm to 10000 mm x 2800 mm overall width.

Each leaf of pairs of gates shall have two diagonal braces of the same material as the outer frame with a 300 x 300 x 6 mm thick centre plate welded to each brace.

Gates shall be hung to gate posts with 15 mm diameter loose threaded eye bolt hinges with nuts and washers, with a steel ring collar welded on to gate stile below each hinge. Each gate or pair of gates shall be provided with an approved spring catch and striking plate or a hinged hasp formed of 50 x 5 mm flat mild steel welded on to gate stile and a steel staple welded on to post or other gate stile, as specified. Each pair of gates shall be provided with a 15 mm diameter x 375 mm long mild steel drop bolt, with a 20 mm x 100 mm long tubular keep set in ground and surrounded with a 200 x 300 x 100 mm thick class B20 concrete block including all excavation and disposal.

Security Wiring

On the 2.4 m high security fencing is specified four rows of barbed wire. Each fence post shall have an extension 450 mm long welded on, four times drilled and the barbed wire securely bound to same with tying wire. All gates in security fencing shall have a similar vertical extension welded on to each stile. The tops of all overhangs shall be closed or capped to approval.

3.14.4 Execution of Works

3.14.4.1 General

For automobile roads, requirements of СНиП sections as to establishment of construction production, survey works during construction, safety precautions during construction as well as the basic items of the chapter in СНиП concerning operational acceptance of enterprises, buildings, structures finished by construction and demands of other by-laws on relevant issues shall be followed besides requirements of the present chapter.

Construction schedule showing planning of temporary and final road works, permitting the continued traffic flow through the terminal during construction works, shall be prepared by the Contractor for the approval of the Engineer.

Prior to beginning of preparatory works, documents on procurement of land sites for construction of roads and structures as well as for temporary production base, borrow pits for excavation of building materials and soil required by the design, temporary roads, buildings and structures shall be filled out as demanded by norm for land procurement.

The following conditions shall be observed while executing road works:

- As a rule, construction of the platform shall be started after levelling works for definition of vertical levels, laying of drainage piping and other utilities, erection of drainage and other installations have been carried out at the road construction site;
- As a rule, pavement construction shall be executed after establishment of permanent railway crossings;
- Installation of separate structural elements of footpaths shall be executed simultaneously with installation of equivalent structural elements of the pavements.

Prior to the start of installation of each base and pavement layer it shall be necessary to perform setting-out and levelling works.

Works for arrangements on the site comprising installation of fences, traffic signs and markings, pegging-out of driveway, etc. shall be carried out after completion of the pavements and shoulders.

3.14.4.2 Preparatory Works

The Preparatory works shall be executed in the following composition:

- Execution of geodetic setting-out basis;
- Displacement and rearrangement of overhead lines for communication and power supply, pipelines, etc.
- Demolition and displacement of buildings and structures;

- Preparation and strengthening of roads intended for use in the course of construction.

Works for displacement and rearrangement of communication lines, cable lines, pipelines, crossed by the road alignment, demolition and displacement of buildings and structures shall be carried out in agreement with the authorities and enterprises concerned.

In the event if the road works have to outstrip the works for arrangement of underground utilities, a preliminary laying of casings and other protective means shall be envisaged at the spots of crossing with the roads in order to provide with possibility in future to lay utilities without excavation of the road platform.

3.14.4.3 Subgrade/Road Bed

The construction of the subgrade includes the following types of work:

- Stripping and storage of the top soil;
- Demolition and displacement of the buildings and structures;
- Installation of dewatering structures to drain surface waters coming from outside of the platform boundaries (out of the lane);
- Preparation of the fill base with multi-layer levelling and consolidation of soil up to specified limits;
- Planning of surfaces and slopes of the subgrade, strengthening of the slopes;
- Additional reclamation and strengthening of the shoulders.

Fills with a height of more than 3 m from dusty heavy clays shall be completed 1 year before installation of surfaced area.

The material shall be spread in even layers having a thickness of not more than 0,25 m and it shall be compacted up to an optimum moisture content of $\pm 1\%$ / to reach density of not exceeding 95% (СНиП 2.05.02-85 or AASHTO).

Density control by the specified cross-members shall be carried out for each section of the work performed by shift of compacting equipment but not less than every 200 m when the height is up to 3.0 m and every 50 m when the height is over 3.0 m.

Deviation of the compacting factor from the specified magnitude is permissible for not more than 10% of samples to the side of reduction and shall not exceed for 4%. Number of points with maximum deviation shall not exceed 10% from the total number of measurements performed.

Control of the soil compactness in the fill and subsoil shall be executed by weight-by-volume method in compliance with ГОСТ 22733-77.

3.14.4.4 Sub-Bases

The sub-bases comprise two types of sub-base: a sand sub-base and a gravel sub-base.

Materials of the sub-base shall be applied into spreaders and spread with a free layer in order to get the required thickness after compaction.

After the spreading has taken place, the loose material shall be treated with blade grader up to design profile and crown. Each of the layers shall be compacted to the whole depth up to 98% of the density at least when the moisture content is optimal.

Carrying out rolling operations, water shall be added into materials in quantities necessary to obtain the design density.

Density tests shall be carried out as directed by the Engineer, or at a minimum for each 500 m² of surface area.

Test of the compacted sub-base for the specified thickness and uniformity shall be carried out before acceptance. Any area of the compacted sub-base having a less thickness after compaction than indicated on the drawings or having waves and non-uniformity more than 0.01 m per 3 m or 0.02 m per 15 m shall be repaired by scarifying, re-construction, re-compaction and finishing as prescribed or approved by the Engineer. Patching without scarifying of the surface providing a proper bond of the applied material shall not be allowed.

3.14.4.5 Aggregate Base

When carrying out installation of the pavements, the works for spreading and consolidation of the stone materials shall be executed at an optimal moisture of the below laying material and if the platform is not exceedingly wetted.

The kerb-stones shall be installed before spreading of the stone materials over the base.

The minimum thickness of the base layer shall exceed the most big grains of the stone material to be used for application by 1.5 times.

The minimum thickness of the layer from crushed stone and gravel shall not be less than 10 cm. The maximum thickness of the layer shall not be less 18 cm when compacting by steel wheel roller and 25 cm in dense condition when consolidating by rubber tyre rollers.

Safety factor for crushed stone and gravel compaction shall be accepted as 1,25-1,30 approximately.

If the moisture content is insufficient, the mix shall be watered 20-30 minutes before compaction commencement.

When ambient temperature is between 0 and -5(C duration of the works for shaping and compaction shall not be over 4 hours and if the temperature is less the period will equal 2 hours.

Compaction quality of the crushed stone, gravel bases shall be checked per each 500 m² of surfaced area by means of control passing of a roller weighing 10-18 t; trace on the base shall not be observed.

Layer thickness shall be controlled in three cross-sections per each 500 m² of surfaced area of the road by measuring along the axis at a distance of 1 - 1.5 m from the verge.

Smoothness of the surface and cross fall shall be controlled every 100 m of the road by means of three meter long plank or template with level.

The completed base course shall be maintained in an acceptable condition at all times, as directed by the Engineer until pavement is applied. When the base course is to carry traffic before receiving a surfacing or pavement, the Contractor shall maintain the surface until final acceptance and shall prevent ravelling by wetting, blading, rolling and the addition of fines as may be required to keep the base tightly bound and leave a slight excess of material over the entire surface which must be removed and the finish restored.

3.14.4.6 Asphalt Concrete Pavements and Bases

Crushed stone and gravel shall be stored in warehouses in stacks of bins separately in accordance with fractions of 20-40, 10-15, 5(3)-25, 5(3)-15, 5,(3)-10 mm.

Sands shall be kept in stacks fenced with walls and shall be stored individually in compliance with the following characteristics: natural sands, fine grained (fineness modulus not less than 1 mm), middle grained (fineness modulus 2,5-2 mm) and coarse grained (fineness modulus not less than 2,5 mm), manufactured sands, as well as sands from different borrow pits.

Mineral dust at a Asphalt Concrete Factory (ACF) shall be stored in sheltered rooms of the bin type or in silos with measures to protect it against stickiness.

Bitumen furnished to the ACF shall be placed into mechanised facilities for bituminous storage. The bituminous storing facilities shall be equipped with a permanent heating system and pump installation to supply bitumen to the bituminous melting installations.

The appliance for heating of the binder shall be able to heat it up to the maximum temperature of 150°C.

This temperature of bituminous heating may be maintained not more than 5 hours. It is permissible to retain bitumen in a heated condition more than 5 hours but less than 12 when the temperature is 80°C.

Before delivery into drying drum, crushed stone and sand shall be preliminarily dosed. Drying of the mineral materials for preparation of asphalt concrete mixes without utilisation of the surface active agents shall provide complete removal of water.

When the surface active agents are used, moisture content of the mineral materials can be accepted if it is not more than 1%.

Exactness of component batching composing the asphalt concrete mix shall conform to the requirements of ГOCT 9128-76.

Mixing period for middle grained mixes in machines shall be 30 sec. Duration of mixing of the coarse grained mixes in agitator of free mixing shall be 120-180 sec.

Temperature of the asphalt-concrete mixes depending on bituminous type shall comply with ГOCT 9128-76 when discharging from mixers.

Transportation period for the asphalt-concrete mix shall be determined coming from condition to provide a minimum placement temperature specified by ГOCT 9128-76.

Asphalt concrete pavement and base shall be established on a dry, clean and not frozen layer laying below.

The pavement and the base shall be executed from hot asphalt concrete mix; the pavement and the base shall be manufactured in a dry weather either in springtime or summertime when temperature is not below +5°C, and in autumn if temperature is not less than +10°C.

Before placement of the mix (3-5 hours beforehand) sub-base shall be treated with bituminous emulsion or with liquid bituminous of type CF-130/200, MF-130/200.

When using an asphalt placing machine, thickness of the applied layer of hot bituminous mixes shall be more than design thickness by 15(25%, and thickness of manual placement allowable for inaccessible for the machine spots shall be more by 25-30%.

When rolling the first layer it is necessary to maintain a distance of 10 cm between rollers and verge faced towards the road axis.

During compaction operational speed of rollers shall be 1,5(20 km/hr at the beginning of rolling and it can be increased up to 3,0-5,0 km/hr after 5-6 passes along the same lane for road rollers with smooth rollers; up to 2,0-3,0 km/hr for vibrating rollers and up to 5,0-8,0 km/hr for rubber tyre rollers.

In the course of compaction, cross fall and pavement smoothness shall be verified by template or three meter long plank after first 2-3 passes of the roller.

Carrying out construction of the asphalt concrete pavement on the existing road in the course of reconstruction, defects of the old pavement shall be eliminated (potholes, cracks, breeches, etc.) and treated with bituminous emulsion or liquid bituminous of type CF-130/200, MF-130/200.

The routine quality control includes sampling of gravel from each fraction not seldom than once per five days, sampling of sand not rarely than once per three days, mineral dust sampling - once per three-five days, bituminous shall be sampled once a shift. Exactness of mineral material and bituminous batching, temperature regime of heating of bitumen and asphalt concrete; duration of mixing of mineral materials with bitumen, temperature of the prepared asphalt concrete mix and quality of the ready mix shall be controlled in course of asphalt concrete mix preparation.

Quality of the ready asphalt concrete mix shall be checked in a laboratory by determination of physic and mechanical features of the samples as well as grading of the mineral

mix and content of bitumen in it by express method. Characteristics of the physic and mechanical features shall comply with demands of ГOCT 9128-76.

1-2 test samples per shift shall be extracted for laboratory control from each agitator.

Quality of the ready asphalt concrete mix shall also be defined by visible characteristics of uniformity as follows: colour, homogeneous size distribution of the components, workability when the mix is being discharged, placed and compacted.

Temperature of the hot asphalt concrete mix in each dumper coming to the site of placement shall be controlled in compliance with ГOCT 9128-76.

Controlling quality of the ready pavement and base, compacting factor, thickness of layers, bond strength of the top layers with below laying ones, correspondence of the characteristics of asphalt concrete with ГOCT 9128-76 shall be verified; roughness parameters and bond factor of the automobile tyres with the surface shall be checked for the carriageway surfacing.

Width and crown shall be checked every other 100 m.

For definition of the physical and mechanical properties of the asphalt concrete in the pavement and in the base, the samples shall be taken coming from:

- If the width is more than 7 m, three samples per 7000 m² shall be extracted. The sampling shall take place on pavements and bases from hot bitumen 10 days after they have been established and traffic allowed to drive;
- Samples from asphalt concrete mixes of hot types A and B and for base course from porous asphalt concrete mixes shall be compacted by combined method of vibration for 180 sec. with further compaction by press with a loading of 200 kg/cm²;
- Compacting factor of the asphalt concrete pavements from hot mixes shall be 0.99 for carriageway surfacing of types A and B and 0.98 for base course and porous asphalt concrete;
- If the compacting factor equals 1, amount of saturation shall be in the limits of prescriptions mentioned in ГOCT 9128-76;
- Saturation in per cents by volume for samples extracted from the pavement (cut samples or core samples) shall be 2,5(4,5 for mixes of type A, 2(4 for type B and 3(8 for base course from porous asphalt concrete.

3.14.4.7 Tolerances

Tolerances of the design dimensions for acceptance of work for subgrade, sub-bases, bases and pavements shall not exceed the figures specified by the table.

PARAMETERS	Allowable deviations from design dimensions for acceptance of works for establishment of the subgrade, sub-base, base and pavements of the roads (surfaced areas) (\pm) when in use	
	sets of machines without automatic system for specifying of vertical levels	sets of machines with automatic system for specifying of vertical levels
1	2	3
1. The Subgrade		
- Height of the profile level, mm	50	10
- Distance between the central axis and verge of the platform, cm	10	10
- Cross falls	0,010	0,005
- Steepness of slopes, %	10	10
- Cross dimensions of drainage, cm	5	5
- Longitudinal falls of drainage, %	10	10
- Width of filled offsets, cm	20	20
- Thickness of top soil layer on the slopes, %	20	20
2. Sub-Base and Aggregate Base		
- Width of the base, cm	10	10
- Thickness of the layer, %	10, but not over 20 mm	7, but not over 15 mm
- Cross falls	0,010	0,005
- Clearance (deviation) under plank of 3 m, mm, for II category roads	10	5
3. Asphalt Base, Asphalt Concrete and Concrete Pavements		
- Thickness of the pavement, %	10	10
- Height levels by axis, mm	10	5
- Height levels by axis, mm	50	10
- Cross falls	0,010	0,005
- Clearance (deviation) under plank of 3 m, mm	5	3

1. 95 % of clearance measurements under the plank shall be in boundaries of the tolerances, and 5% of the measurements shall not exceed the doubled value of the tolerances.
2. 90% of definitions of layer widths and thickness(of the pavement shall be in the limits of the tolerances, and 10% of the measurements shall not come over the interval, the bottom border of which is 1.5 of the tolerance value and the top one equals a double value of the permitted deviations.
3. 90% of measurements for the rest parameters shall be in limits of tolerances, and 10% of the definitions shall not exceed the tolerances by 2 times.

Smoothness measurements shall be executed every other equal distance:

- 100-130 clearance measurements or continuous graphic records of the surfaces

- 80-100 measurements of cross falls by plank with level
- Measurements of vertical absolute and relative levels by means of levelling with a pitch of 5 m

Values of the bond factors measured shall not be less than mentioned in sections of СНиП for road design.

The following shall be verified carrying out control of workmanship of road arrangements:

- Correspondence of location, quantity and structure of installed fences to the design as well as their compliance with requisitions of standards;
- Correctness of location of traffic signs and indicators, depths and construction of posts, their correspondence to the requirements of standards;
- Compliance of driveway setting-out to the design and standards.

3.14.4.8 Crossings

When the crossing is located on a fill, the road shall have a horizontal area at a distance of 10 m from the edge of the rail track or the road may have a vertical curve line or inclination, caused by more high location of one rail over another. Width of the crossing driveway shall be equal to the road driveway width.

Traffic signs shall be placed in conformance with traffic rules.

Possible RC pavement slabs shall be placed on a well aligned and compacted wooden ground beams placed on crushed stone and located between sleepers.

Fastening of the slabs between each other and to the ground beams shall be executed by means of special buckles and extended rail screws.

Slab edges for fastening shall be bordered with steel angles from two long sides.

Joints between the slabs shall be filled with hot bitumen of type БН 70/30 in compliance with ГОСТ 6617-76, and bed of crushed stones screening the butt ends of the slabs shall be poured with bitumen of mark БНД 90/130 in conformance with ГОСТ 22245-76.

Timber of coniferous specimens in compliance with ГОСТ 8486-66 is to be used to manufacture wooden ground beams and collapsible beams.

All timber to be used shall be disinfected by impregnation method.

3.15 Quay Equipment

3.15.1 Extent of Works

The works comprise:

- Rubber fenders behind steel fender structures
- Polyethylene lining of fender shields
- Bollards
- Ladders
- Sacrificial anodes on new steel sheet pile walls
- Sacrificial anodes on new steel pipe piles
- Sacrificial anodes on existing steel sheet pile walls

3.15.2 Documents

See material specifications.

3.15.3 Materials

3.15.3.1 Rubber Fenders Behind Steel Fender Structures

Rubber fenders shall be as "Trellex MV 800 x 2000 B" or similar. Behind each fender shield is used 2 pieces, which each have the following properties:

Height:	H = 800 mm
Length:	L = 2000 mm
Energy absorption rated	E = 220 kNm
Reaction rated	R = 599 kN
Deflection rated	$\varepsilon = 57.5 \%$

Rubber elements shall be homogenous and free from defects, pores or cracks and moulded under high heat and pressure.

Integral metals shall have an adhesion strength stronger than the rubber itself and no delamination problems can be allowed.

Steel parts shall be fully encapsulated in rubber.

Fastening details, anchors, bolts, nuts etc. shall be of size and quantity recommended by the fender manufacturer and it shall be hot dip galvanized or from stainless steel.

Technical specification of "Trellex Rubber Marin B":

Property	Testmethod	Condition	Typical value
Hardness	DIN 53505	Original	60° Shore A
		Aged for 168 hours at 70 degrees C.	+ 5° Shore A
Tensile Strength	DIN 53504	Original	20 MPa
		Aged for 168 hours at 70 degrees C.	18 MPa
Elongation at Break	DIN 53504	Original	500 %
		Aged for 168 hours at 70 degrees C.	350 %
Compression Set	DIN 53517	Aged for 24 hours at 70 degrees C.	< 40 %

3.15.3.2 Polyethylene Lining of Fender Shields

The facing of fender shields shall be made from UHMW polyethylene, UV - stabilized.

Material specification for UHMW polyethylene:

Property	Test Method	Value	Unit
Density	DIN 53479	0.95	g/cm ³
Molecular Weight	Viscosimetric Method	approx. 4.0	Million
Coefficient of friction for black, UV-stabilised	DIN 53375	0.10 - 0.15	-
Tensile strength	DIN 53455	19 - 22	N / mm ²
Breaking Strength	DIN 53455	33 - 35	N / mm ²
Break Elongation	DIN 53455	400 - 450	%
Ball Indentation Hardness	DIN 53455	38 - 40	N / mm ²
Shore Hardness	DIN 53505	64 - 66	Shore D
Impact Strength	DIN 53453	approx. 130	mJ / mm ²
Abrasion Sand Slurry Test	-	90 - 120	-
Temperature Range	-	-80°C up to +80°C	-
Crystalline Melting Point	Polarisation microscope	137°C	-
Coefficient of Linear Expansion	DIN 52328	1.6 x 10 ⁻⁴	k ⁻¹

3.15.3.3 Bollards

All new bollards shall be as "Bean - bollards" type X.10.A or similar with a design load of 100 tons.

3.15.3.4 Ladders

Steel materials according to section 3.8.

All steel shall be hot dip galvanised.

3.15.3.5 Sacrificial Anodes

Cathodic protection of the steel sheet piles shall be sacrificial Aluminium (alloy) anodes. The alloy shall contain indium but no mercury. The capacity shall be minimum 2680 Amp x hour/Kg anode material and potential -1050 mV in respect to copper/copper sulphate anode. Each anode shall have a weight as specified in drawings.

Reinforcement bar shall be sandblasted and with guarantee for adhesion. A typical composition of the Aluminium Alloy might be:

ELEMENT	COMPOSITION BY WEIGHT %
INDIUM ZINK IRON COPPER SILICON ALUMINIUM	0,005 pct - 0,05 pct 2 pct - 6 pct max. 0,1 pct max. 0,006 pct max. 0,2 pct rest

3.15.4 Execution of Works

3.15.4.1 Rubber Fenders Behind Steel Fender Structures

The installation of rubber fender elements is designed for 3 different positions depending on actual water level in the Caspian Sea. Sets of bolts shall be prepared for all 3 positions. Bolts and threads in positions out of use shall be protected from dust and corrosion by applying grease and galvanised bolts to close bolt holes.

3.15.4.2 Polyethylene Lining of Fender Shields

The low friction facing made from UHMW polyethylene shall be fastened to steel plates by M20 bolts (welded studs) as shown in drawings. Max bolt distance to free edge is 100 mm and max. internal distance between bolts is 600 mm.

3.15.4.3 Bollards

Fastening of bollards shall be with bolts according to manufacturers specification. The bollards shall be painted in black with a paint system suitable for the marine environment. Bollards shall be installed with about half the footplate thickness into concrete surface. The bollard hull shall be concreted with cement mortar.

3.15.4.4 Ladders

Workmanship according to section 3.8.

3.15.4.5 Sacrificial Anodes

The anodes shall be placed as shown in Drawings. Mounting shall be done by under water welding directly to sheet piles after driving. Welding areas shall be cleaned mechanically.

The anodes shall be uniformly distributed between water level and bottom level.

3.16 Rail Track Works

No major railway works are to be carried out in the first phase of the project. Only minor changes in connection with replacement of rails on ferry ramps and widening of road shall be executed.

Railway works comprise

- provision and installation of new P-65 rails on the ferry ramps
- repair of the existing road/rail crossings at the access road and installation of new crossing at the container road.

The rails type P-65 shall be delivered and installed according to requirements of СНиП 2.05.07-85. Otherwise the works connected with shifting of rails on ramps are described under section 3.8 Steel Works.

The works connected with road/rail crossings are described in section 3.14, Paving and Road Works under crossings.

3.17 Machinery and Equipment

3.17.1 Extent of Works

It is the intent of this contract to provide for a complete rehabilitation of the 12 operating machineries of the two ferry ramps to ensure a continuous and reliable performance within the Design lifetime of 50 years.

In accordance with the specifications and as indicated on the drawings, the Contractor shall furnish all materials, equipment, tools and labour which is necessary to disassemble, rehabilitate and reassemble the hoisting machineries for the two ferry ramps.

The specifications are not intended to cover all details of the work, as the machinery need to be disassembled and inspected for the Employer and the Contractor to be able to agree upon the extent and the procedure for the rehabilitation.

However, it is required that the Contractor provides all the elements inherent to good engineering practices in order to achieve a completely satisfactory machinery.

The specification for the machinery shall be read in conjunction with all other relevant chapters and paragraphs of this specification.

The Contractor shall, in every respect, be responsible for the complete rehabilitation, testing, commissioning, proper operation and safe performance of the machinery.

The extent of works to be provided under this contract shall include but not be limited to the following:

- Dismantling of all machinery in the 12 support towers including motors, couplings, gearboxes, spindles, spindle drives, winches, pulleys, brakes, sheaves, and counterweight ropes.
- Dismantling of all bearings, guides, shock absorbers, sheaves etc. from the ferry ramp structures.
- Discarding of the following equipment:
All electric motors, gearboxes for and auxiliary electric control equipment, hoisting spindles, counterweight ropes, shock absorbers at the land side span, shock absorbers for the hoisting counterweights at the seaside span and all mechanical elements which are rejected following the inspection.
- Delivery of new equipment:
12 no's electric motors, 12 no's auxiliary gearboxes for new position transmitters, 8 no's hoisting spindles, 12 set's counterweight ropes, 6 no's shock absorbers for the land side spans, 16 no's shock absorbers for the hoisting counterweights.
- Disassembling, inspection and rehabilitation of all equipment not scrapped.
- Application of complete surface protection upon new as well as reworked equipment.
- Assembling of all equipment into the rehabilitated support towers.
- Delivery of documentation:
Inspection results, design drawings and calculations, operation-, maintenance- and spare parts manuals.

The intent is for as many parts of the existing machinery as possible to be reused. Only if the inspection reveals parts to be in such poor condition that rehabilitation is impossible or financial unsound, the parts should be replaced by new ones according to the specification or to the original specifications for the existing parts and in agreement with the Employer.

The Contractor's duties under this contract includes all notification and applications to authorities and the procurement of all necessary certificates and permits.

It shall be observed that the ferry ramps are existing ramps in commercial operation and all work shall be carried out in close co-operation with the ferry terminal authorities. The Contractor shall be aware of the fact that one ramp shall be in full operation during the whole site work period.

The Contractor will be required to set up a Quality Assurance Organisation and a Quality Assurance Programme and to keep and maintain such Quality Assurance Records as are necessary to secure that the work is executed and the materials are such as set out in the specifications.

The Quality Assurance Organisation and Programmes shall be submitted to the Employer for consideration one months prior to commencement of manufacture.

3.17.2 Documents

In general the work shall comply with the standards, norms and codes of the former Soviet Union, as the machinery has been designed according to these.

Other standards and codes of practice, such as ISO, British standards or equivalent may be used if applicable cf. section 3.8.2.1.

As reference on the classification of the machinery's BS 2573: "Specification for Permissible stresses in cranes and design rules", Part 2.: "Mechanisms" may be used.

According to this standard the machinery may be classified as follows:

Machinery in	Class of Utilization	State of Loading	Group of Mechanism
first row	T1	L3	M3
second row	T1	L3	M3
third row	T5	L3	M6

Where:

T1 denotes: Irregular use

T5 denotes: Regular intermittent use

L3 denotes: Heavy load

3.17.3 Materials

The materials used to manufacture machinery parts shall be the best grade and quality for the purpose intended.

New principal load bearing components manufactured from high grade steels, i.e. axles, gear shafts, gears, spindles etc. will require to be identified with the original material mill certificates.

3.17.4 Execution of Works

3.17.4.1 General

All mechanical components shall be designed with permissible stresses in accordance with the standard used and according to the a classification of the various drives made on basis of the lifetime and the loading spectrum of the drive.

The rehabilitation shall be based upon a general design lifetime of the hoisting machinery's of 50 years.

The operating loads to be considered in the design of the various drive mechanisms are indicated below.

All drive components and supports thereof, where applicable, shall be designed so as to be able to withstand the stresses imposed upon them by the stall torque of any motor.

A high standard of workmanship is required for machine parts and in particular all components and housings are to be thoroughly cleaned, by an approved means, to remove all sharp edges, burrs, swarfs and machine/casting dust before assembly in clean workshop conditions. On completion of assembly units must be painted in accordance with the painting schedule and bare metal parts protected against corrosion.

Welding in highly stressed areas should be avoided, but may be considered if stresses are proven to be well within fatigue limits for the material.

Weldings should be stress relieved and heat treatments to be in accordance with Soviet, ISO or British Standards where applicable.

All fastenings shall be secured with locking devices. Locknuts, lockwashers and snaprings should not be used on rotating machinery. Loctite should not be used on fasteners being frequently disassembled.

Grease nipples shall be grouped as far as possible without extended metallic pipe runs and be clearly visible and within easy reach from platforms and walkways.

3.17.4.2 Cleaning and Inspection

Following the disassembling all machinery's are to be mechanical cleaned where necessary to remove compact heaps of dirt, oil and grease etc. and washed with a suitable detergent before sandblasting.

All parts are then to be sandblasted or mechanically cleaned to remove all existing paint to a degree necessary for inspection purposes.

All parts are to be thoroughly inspected for mechanical damage, excessive corrosion, excessive wear, laminations, cracks and deterioration, which are detrimental to the parts.

All findings shall be reported to the Employer as part of the Quality Assurance and decisions as to the effect of the findings shall be made in agreement with the Employer.

Any cracks which might appear to be caused by fatigue shall be cut out from the parts and brought to an experienced metallurgy laboratory for microscopic examination to establish the cause of the cracks.

If possible the entire crack should be cut out in order to facilitate the revelation of the cause of the crack.

Searching for cracks should preferably be done by magnetic particle methods, as fatigue cracks will almost always appear at the surface of the parts.

Observed excessive wear and tear of parts shall be thoroughly examined to establish the cause of the damage, if necessary at an experienced metallurgy laboratory.

If damages after thorough examination are judged to have been caused by fatigue, excessive pressures or stresses in the parts rather than lack of proper maintenance, the parts shall be deemed to have been improperly designed and shall be redesigned by the Contractor.

3.17.4.3 Electrical Motors

The existing motors shall be dismantled and discarded, and new motors for all machinery's shall be installed.

Motors shall be according to IEC 34: "Rotating electrical machines, part 1 through 14" and IEC72 and 72A: "Dimensions and output ratings for rotating electrical machines" or equivalent standards.

Motors shall be totally enclosed AC Squirrel-Cage motors, class IP54 protection rated for 380 V, 50 Hz, with 8 poles for 750 rpm.

They shall be amply rated to continuously carry out the duty cycle of the ferry ramp.

All machines shall be of standard sizes, with standard shaft sizes, extensions and keyways.

All machines shall be so mounted upon the existing frames that they are safely and easily accessible for maintenance, testing, inspection or replacement purposes.

The requirements for the drive motors are as follows:

- | | |
|---|----------|
| - Rated output for motors in first and second row from land side: | 7.5 kW |
| - Rated output for motors in third row (sea side): | 11.0 kW |
| - Insulation : | Class F |
| - Intermittent duty: | |
| motors in first and second row: | S3 - 40% |
| motors in third row: | S3 - 60% |

All motors shall be designed for an ambient temperature of 40°C.

3.17.4.4 Hoisting Spindles and Spindle Drives

The spindle drives for machinery's in first and second row (i.e. 8 drives) shall be disassembled, thoroughly cleaned and inspected as described above.

The gear teeth and the spindle nut shall be inspected by penetration or magnetic particle methods for cracks in the root zones and the flanks of the teeth and thread. Excessive wear, pitting and scoring shall deem the gearwheels and/or the nut to replacement.

The replaced parts shall comply with the original specifications except if redesign is necessary in order to obtain the required design life.

Bearings, bushings and axles shall be inspected for excessive slackness, dents and corrosion.

At assembling, the drives shall be fitted with a complete new seal kit.

Eight new spindles shall be provided.

The spindles shall allow for the new greater travel distance of the ferry ramps, i.e. the spindles of the first row shall have a total travel of 2500 mm and the spindles of the second row shall have a total travel of 5090 mm.

The length of the spindles shall be determined by the new position of the support towers and the geometry of the ferry ramp structures and the spindle drive so as to ensure the total travel length.

The type of thread and geometry of the spindles except for the lengths shall be as for the existing drives.

It is preferred that the thread is manufactured by rolling techniques.

The material shall be as for the existing drives or better.

It is anticipated that the design force of the spindles will be approx. 6500 kN which, taking into consideration the notch effects calls for a hardened and tempered steel having physical properties as follows:

Property	Value	
Yield Strength	700	MPa
Ultimate Strength	900 - 1000	MPa
Elongation	12	%
Hardness	250 - 350	HB

Upon installation of the machinery's in the support towers and the connection to the ramp lifting beams, the spindles shall be protected against the environment i.e. against dirt, water etc. by the installation of rubber bellows between the roof structure of the support towers and the spindle drive and between the spindle drive and the lifting bearing arrangement upon the bridle beam of the ramp.

3.17.4.5 Gearboxes and Drive Trains

The existing main gearboxes in all 12 machinery's shall be disassembled, cleaned and inspected as described for the spindle drives.

Cracks, excessive wear, pitting and scoring as well as severe corrosion attacks shall deem the parts involved to be scrapped and new ones manufactured to the specifications of the original parts shall be furnished, except if redesign is necessary in order to obtain the required design life.

At assembling, the gearboxes shall be fitted with complete new seal kits.

Elastic couplings connecting gearboxes with electrical motors and with spindle drives and winches respectively shall be disassembled cleaned and inspected.

Any damaged or worn parts as well as all elastic inserts shall be replaced by new ones.

The couplings shall be fitted to the shafts of the new motors according to the requirements of the motor manufacturer, and the drive trains shall be carefully aligned when mounting the motors upon the frames.

Twelve new gear reducers shall be furnished to replace the scrapped gear reducers connecting the main gearbox secondary output shaft to the control equipment.

In the first and second row eight new gear reducers shall be connected to the main gearbox secondary output shafts through elastic couplings, and shall be carefully aligned and mounted upon the existing or upon new frames whichever is the most feasible.

In the third row four new gear reducers shall be furnished and connected similarly to the main winches through elastic couplings.

The output shafts of these secondary gear reducers shall be connected to a control device (Potentiometer type transmitter) cf. section 3.12.1.

The reduction ratio of the reducer and the transmitter shall be adapted so that the transmitter output shall be neutral with the applicable ferry ramp span in horizontal position while the output shall be maximum and minimum with the ramp span in max. hoisted and min. lowered position respectively.

It is preferred that the transmitter be directly mounted upon the output shaft without intermediate couplings and drive trains.

All gearing in the new reducers shall be of quality steel, machine cut and preferably through hardened.

Drive gears should be keyed to drive shafts.

All gear shafts should run on roller bearings, and seals should be easily replaceable externally.

All gearing shall be contained in totally enclosed oil-bath type robust housings.

Gear housings shall be provided with facilities for inspection, filling and drainage, and be equipped with the necessary expansion vents.

The gear reducers shall be the standard products of a manufacturer having profound experience in gear drives for crane service or similar service.

Gear and transmitter design, application and source of supply shall be subject to the approval of the Employer.

3.17.4.6 Hoisting Winches, Brakes and Emergency drives.

The hoisting drive train's for the machinery's in the third rows (i.e. 4 drives) shall be disassembled, thoroughly cleaned and inspected for cracks, excessive wear and tear as well as corrosion.

Damaged parts shall be replaced by new ones which shall comply with the original specifications for the parts in question.

Gear teeth, bearings, bushings and axles shall be inspected, rehabilitated and replaced as described above in section 3.17.4.4.

The rope drums and sheaves shall be treated as the drive train.

Four new hoisting ropes including the necessary fittings shall be furnished and mounted.

The steel wire ropes shall preferably be 6x36 Warrington Seale plus I.W.R.C., and shall be made to the same diameter as the existing ropes from bright drawn 1800 MPa grade steel.

All ropes shall be galvanised, internally lubricated and supplied with manufacturer's test certificates.

All fittings used in connection with the wire ropes shall be designed to the same SWL as the ropes and shall be provided with the manufacturers SWL stamp.

The SWL shall be at least five times the design load of the rope.

The length of the ropes shall be so determined as to allow for a total travel of the bridle beams of the third spans of 7800 mm.

In calculating the rope lengths, consideration shall be taken to the new position of the support towers and the necessary slack induced by lowering the tension counterweight 3600 mm below the top buffer stop after the span has been positioned upon the ferry.

The ropes shall be fixed upon the rope drum with at least two clamps, and the rope shall be wound at least 1.5 times around the drum with the ferry span in the lowermost position.

The length of rope wound upon the drum must be in one layer only.

In the unlikely event that the existing drum is not able to accommodate the necessary rope length, a new drum must be furnished.

The electromechanical brakes connected to the main gearbox and the manual emergency drives shall be disassembled, inspected and treated as described above in section 3.17.4.4.

The rehabilitation of the brakes shall as a minimum include the turning of the brake drums to obtain a clean, smooth and cylindrical surface and the replacement of brake shoes.

3.17.4.7 Counterweight Arrangements

All twelve counterweight assemblies including sheaves, sheave bearings and protective covers shall be dismantled, disassembled, inspected and treated as described above in section 17.4.4.

Counterweight ropes shall be scrapped and 96 new counterweight ropes with the necessary fittings shall be furnished and mounted.

The steel wire ropes shall preferably be 6x36 Warrington Seale plus I.W.R.C., and shall be made to the same diameter as the existing ropes from bright drawn 1800 MPa grade steel.

All ropes shall be galvanised, internally lubricated and supplied with manufacturer's test certificates.

All fittings used in connection with the wire ropes shall be designed to the same SWL as the ropes and shall be provided with the manufacturers SWL stamp.

The SWL shall be at least five times the design load of the rope.

The length of the ropes shall be so determined as to allow for a total travel of the bridle beams of the third spans of 7800 mm, whereas the travel for the first and second spans shall be as mentioned in section 3.17.4.4 for the spindles.

In calculating the rope lengths, consideration shall be taken to the new position of the support towers and an allowance of 700 mm free travel between the counterweight and the top and bottom of the counterweight pit with the counterweights in the upper- and lowermost position.

Sheave bearings shall at assembly be fitted with new seals.

3.17.4.8 Shock Absorbers Bearings and Sheaves etc.

Shock absorbers positioned at the land side of the first span (totalling 6 no's) shall be scrapped and replaced with new ones of the same make and type as the existing ones.

Shock absorbers positioned in the counterweight pits of the third row (totalling 16 no's) for support of the tensioning counterweight shall be scrapped and replaced with new ones of the same make and type as the existing ones.

All bearing arrangements supporting the ferry ramps at.

- The land side of the first span,
- between the three spans at the first and second row,
- the equaliser beams (lifting beams) under the bridle beams of the first and second span (denoted beam M26 in the original design),
- the bridle beam of span 3,

shall be disassembled, cleaned, inspected and rehabilitated as described above in section 3.17.4.4.

The bearings shall be equipped with new bushings and seals made to the original specifications.

New protective covers made by nitrile rubber sheeting shall be furnished to protect the bearings against dirt and water splash.

The sheaves mounted upon the bridle beam of span 3 shall be disassembled, inspected and rehabilitated as described in section 3.17.4.4.

Sheave bearings shall at assembly be fitted with new seals to the original specification.

The four existing mooring steel wire ropes for connection of the ferry ramp span 2 to the ferry tensioning gear shall be discarded and replaced with new ones to the original specification.

3.17.4.9 Surface Protection

The surfaces of the machinery parts located inside the support towers may be given the same surface protection as specified for the steel structures cf. section 3.8.4.1.8.

If so preferred by the Contractor these parts may alternatively be given the paint system described below (machinery parts located outside the towers shall be given the treatment mentioned above):

The system is from J.C. Hempel A/S, and may be applied by spraying or brushing, rolling will not be allowed.

Acrylic System

1 coat Hempatex Hi-build 4641, min. dry film thickness: colour: Grey 12170	80 µm
1 coat Hempatex Hi-build 4641, min. dry film thickness: colour: Red 50630	80 µm
1 coat Hempatex Emaille 5636, min. dry film thickness: colour: To be decided	40 µm
Total minimum dry film thickness	200 µm

Remarks: The colour of the final coat to be decided upon by the Employer for the different structures.

If the acrylic system is used the specification in section 3.8.4.1.8 shall apply with the following exceptions:

Grit blasting shall be to degree Sa21/2 according to ISO 8501-1.

Roughness of blasted surface shall be according to RUGOTEST No. 3, BN9.

Pore testing shall be made after application of the final coat only. The entire surface shall be without pores.

3.17.4.10 Assembling of Machinery

When mounting the machinery's special care and attention should be paid to the following items:

The drive trains connected by elastic couplings shall be carefully aligned so as to avoid excessive and cyclic stresses when the machinery is operated.

The hoisting spindles must be in absolute vertical position, when the ferry spans are in horizontal position.

The counterweight ropes shall be adjusted so as to secure equal distribution of the forces in the ropes and a proper alignment of the equalising beams of span 1 and 2 as well as the bridle beam of span 3.

The procedure to obtain this could be to support the applicable span in horizontal position, where also the equaliser beams will be horizontal.

The counterweights are similarly supported in the pit in a position half way between min and max position.

In this position the nuts at the end of the rope fittings extending from beneath the equaliser beam are tightened by a torque wrench to a rather small and equal torque to reassure that all ropes are stretched.

Following this all nuts in both sides of the beam are successively turned the same number of revolutions, and this procedure is repeated until the counterweights are just elevated from their supports.

The weight of the counterweights shall be adjusted by placing an additional number of the existing hand weights upon top of the counterweights to obtain equal weight in both sides of the span and to obtain the required excess weight of the span.

The excess weight of the spans must be documented by measuring the force necessary to lift the spans at the end of the bridle beams with the ramp in horizontal position.

The forces shall be as given in the table below:

Row number	Force in kN
1	50 - 60
2	60 - 70
3	90 - 100

Brackets for limit switches shall be such as to allow for wide adjusting of the position of the switches cf. section 3.12.1.

3.17.4.11 Documentation

3.17.4.11.1 Drawings

The Contractor shall submit to the Employer for consideration, prior to commencement of manufacture, three copies of works drawings of general arrangements and fully dimensioned detail drawings for all new mechanical components of the machinery's.

Any alterations required during manufacture shall be advised to the Employer with appropriate revision drawings in triplicate.

The Contractor shall, not later than the date of handing over, provide one copy of all general arrangement and detail drawings for the mechanical design.

Drawings shall be in both English and Russian Language.

3.17.4.11.2 Operation and Maintenance Manuals

.1 General

The Contractor shall provide comprehensive manuals in English and Russian covering all aspects of operation and maintenance of the Machinery, in draft form, three months after the date of commencement. The Employer shall review the draft manuals and the Contractor shall make such modifications and additions as the Employer shall require and shall re-submit the manuals for final approval by the Employer. Following approval by the Employer, the Contractor shall provide three copies of the manuals, contained in good quality protective covers. The approved manuals shall be provided not later than the start of Tests on Completion on site.

.2 Operation Manual

The Operating Reference Manual shall be in A4 size which simply and clearly defines all aspects necessary to enable the operator to safely and efficiently operate the ferry ramp. The manual shall have separate sections where possible having numbered short paragraphs setting out instructions on a "do", "do not" format, indexed as follows:

1. General Description.
2. Performance, loads and working limits.
3. Safety.
4. Operator daily checks and end shift reports.
5. "Start up" procedure.
6. "Shut down" procedure.
7. Operator controls and operation/handling methods.
8. Interlocks and limit switches.
9. Fault identification and reporting.
10. Hazard warning and emergency stop.

The operating manual should include photographs or drawings to illustrate operating controls etc.

.3 Maintenance Manual

The Maintenance Reference Manual shall be in A4 size, in loose leaf folder format. The manual is to have main sections for each of the principle engineering disciplines, i.e. Structural, mechanical and electrical engineering.

Each main section shall have subsections as follows:

Data Section

- Condition monitoring and fault diagnosis
- Schedules of planned maintenance routines
- Detail description of operation and settings
- Component service procedure
- Method of components removal
- Method of repairs including use of special tools
- Method of component replacement
- Test procedures following maintenance and repairs
- Schedule of special tools required

Cross reference shall be made to relevant drawings where applicable in the maintenance manual text.

Where applicable, photographs should be used to illustrate maintenance procedures.

.4 Spare Parts Manuals

The Contractor shall provide a detailed parts manual in three copies to enable efficient positive identification of all parts and part numbers.

The manuals shall be in A4 size, in good quality loose leaf folder format.

3.17.4.12 Tests on Completion

The Contractor shall present the machinery for acceptance tests.

Before the Contractor offers the machinery for the following Acceptance Site Tests, all systems and installations are to be complete, checked adjusted and set up.

Final paint work must be complete and a complete lubrication service applied. These site tests are in addition to any tests the Contractor may need to carry out in order to set up the systems to his own satisfaction.

If any significant adjustments have to be carried out after the acceptance tests have been completed, the Contractor shall repeat the tests.

The ferry ramps shall be tested in the presence of, and to the satisfaction of the Employer to ensure that the ramps conform to the specification and is ready for commercial use.

Undertaking of the Acceptance Tests is to be the responsibility of the Contractor and all costs are to be included in the Tender.

The Contractor will be required to prepare a detailed Schedule and Programme of Tests on Completion in draft form two months before the commencement of testing.

The Employer shall review the Programme and the Contractor shall make such modifications and additions as the Employer may require and shall re-submit the Programme two weeks prior to the commencement of the Testing.

The Schedule shall comprise the following tests:

- Satisfy the correctness of all circuits, interlocks and limit switches.
- Prove satisfactory operation of each motion of the ferry ramp and in so doing ensure satisfactory operation of each controller, relay, switch, limit switches, etc.

Performance test by verification:

- a) Maximum and minimum operating speeds, synchronous operation of machinery's in first and in second rows.
- b) Duty ratings over a period of no less than one hour at noon time.
The machinery's in each row shall be operated continuously.

Throughout the Acceptance Tests readings will be required and recorded for all electrical machines together with operating times, where applicable.

All instruments needed for these tests and recordings shall be provided by the Contractor.

On completion of the Tests the Contractor shall provide three copies of the Test Schedules duly completed for all observed tests and data readings.

Any defects observed during the Acceptance Tests shall be listed by the Contractor and Employer and shall be duly rectified by the Contractor before final commissioning of the ferry ramps for commercial service.

3.17.4.13 Quality Assurance

3.17.4.13.1 Quality Assurance, General

The Contractor shall be responsible for and shall carry out the Quality Assurance as described in section 3.8.4.1.10.

3.17.4.13.2 Test Certificates

Works test certificates of the following items shall be supplied in copy to the Employer when received by the Contractor or at the latest one month prior to commencement of the Tests on Completion:

- Drive motors
- Hoisting spindles

- Gear reducers
- New equipment such as axles, gear shafts, bearings etc.
- Wire ropes and fittings