Tacis

Development of the Port of Baku
Port Master Plan
Civil Engineering Assessment

Phase III Report, Vol IV

21 March 1997

Volume IV:

Civil Engineering Assessment

Table of Content

Volume IV: Civil Engineering Assessment

Civil Engineering Assessment

1. Introduction - Former and ongoing studies and surveys

The bulk of the infrastructure of International Sea Port of Baku has been constructed between 1960 and 1970. Since 1970 virtually no new investment in infrastructure has been made in the port. As a result, many hydro-technical constructions show wear and tear.

In the period of design and construction of the facilities the sea level dropped year after year. This was going on since the beginning of the century. Since 1977 however, the sea level is rising every year. Due to this raised sea level part of the port facilities have been either abandoned, because they are flooded or are threatened seriously if the trend continues. The sea level measurements of the last year seem to indicate that the trend of rising is slowing down, if not reversing.

In the last years, several studies have been undertaken, aiming to trigger investments for improvement of the infrastructure.

Just before independence, in 1990 / 1991, the KASPMORNIIPROJECT institute of Baku assessed the rising of the sea level, produced a forecast for the development of the sea level for the next 20 years and made preliminary designs that corresponded to the then forecasted sea levels. The preliminary designs and budget estimates include phased renovation of all the hydro-technical constructions in the ports of Baku, Turkmenbashi, Makhachkala, Aktau, Oil terminal Apsheron, and the facilities at Bekdash, Alaja and Bautino. This programme is ambitious and includes at least for the Port of Baku the renovation of all existing facilities.

Within the TRACECA programme, Tacis financed a study on the Caspian Sea water level. This study was done by Sofremer, HPC and Deti, consulting engineers and was executed in 1994; It treated four aspects:

- Updating the forecast of sea level evolution
- A survey of the harbour installations in Baku and Turkmenbashi and the influence of the sea level rise on the operational fitness of these facilities
- Traffic prediction for both ports
- Phased action plan and rough budget estimate for the renovation works.

Two studies aiming at the preparation of tender documents for improvement works are ongoing at the moment. These studies are financed by Tacis within the TRACECA programme.

- The redesign of the ferry terminals in Baku and Turkmenbashi (Ramboll).
- The renovation of the general cargo facilities in Baku (The present addendum to the HPTI Management Assistance and Training Project).

The previous work done in the above mentioned studies has been used extensively for preparing this chapter. Field inspections, discussions with the port engineers as well as the screening of the port documentation have completed the data collection.

The need for an up to date overall mapping of the main port area was felt by the Ramboll team as well as by our team. For that purpose a topographical survey was set up jointly. This survey covers the area of the main complex, the ferry terminal and the adjacent areas. The survey has not been extended to other port areas because it seems at this moment unlikely that these other areas will be subject to renovation works in the short term.

2. Review of the existing structures

At the moment, the Baku Sea Port has three locations on the Apsheron peninsula:

- The main harbour location in the Baku bay, east of the town centre, near the government building
- The Timber Terminal, on the east side of Baku town and bay, in the industrial area
- The oil terminal, north-west of the town, on the north shore of the peninsula.

Fig.4.1 of the Apsheron peninsula and Baku bay shows these locations.

2.1 The main harbour location

Fig 4.2 gives an overview of this area. Hereafter, the waterfront structures are described from West to East. Most of the cross sections given hereafter have been copied from the Kaspmorniiproject plan for reconstruction of 1991, mentioned in 1. For that reason, most of the sketches show in dotted lines the rehabilitation proposed by Kaspmorniiproject.

2.1.1 Platforms on piles near the Sea Station (passengers terminal building) (A)

Fig 4.3 gives a typical cross section. It consists of a concrete platform on concrete piles. Under the platform, the slope is ballasted with stone. At the top of the slope, a grid of concrete beams, filled with stone, forms the barrier between shore and structure. According to the Kaspmorniiproject report, the structure was build in 1969. The waterfront beam has been raised by some 50cm over nearly the complete length. This was for coping with over topping water caused by sea set-up and wave generation basically from winds from the South. This structure consists of three perpendicular sections with a length of respectively 98m, 55m and 112m west and east of the passenger jetty and 40m. At the first section an old ferry boat is berthed on semi-permanent basis. The middle part is not used as berthing facility. The last part of 45m is sometimes used as berth for small harbour vessels. The fendering vanished and was replaced here and there by old tires. The surface is asphalted.

2.1.2 Passengers pier (B)

Fig 4.4 gives a typical cross section of this concrete platform on concrete piles. The pier is 16m wide and 128m long. The structure is reported to date from 1969. The fendering system has not survived and has been replaced mainly by old tires. The waterfront beam has been raised with different heights according to the local sea attack. The passenger vessels other than the mixed ferries berth at this pier. The pier is not equipped with handling gear and no crane rails are installed. The surface is asphalted.

The waterfront between the berth for harbour vessels and the main complex belongs to a company that processes fish products and that has cold stores. It is not part of the port.

2.1.3 The main complex, Western and Southern quays (C

Fig 4.5 gives a typical cross section of these quay walls. They consist of an old block wall construction, completely enveloped by an anchored sheet pile construction. The sheet piles are of the Larsen type. The block wall construction is reported to date from 1939. The upgrading with the sheet pile construction is, according to the Kaspmorniiproject report, from 1969-1970. The West side of the main complex is 403.5m long and the South side is some 200m long.
The topping beam has been raised at several places, mainly by placing on top concrete piles or other loose structures.

The apron is equipped with crane rails, train rails, a drainage system and culverts for water supply, power distribution, etc. Fig 4.6 shows typical cross sections of the quay top, as designed by Kaspmorniiproject. The drainage system and the waterside culvert for power distribution and water supply are not in good shape. The fendering system is not any more in good shape. At places old steel structures protrude at the waterfront. On the south side of the main complex, a Ro-Ro ramp has been installed later. Fig 4.7 has been copied from a renovation project of the East quay of the complex. It shows were the ramp is located, and that it is intended for Ro-Ro ships with side flaps.

The surface of the main complex consist partly of asphalted area, of covers of the culverts, of concrete pavement and of unpaved sections. In general the pavement is not in good shape.

2.1.4 The main complex, Eastern quay (D)

As shown on fig 4.8, the East side of the complex has not been rehabilitated but has simply been raised during the renovations of 1969-1970. This quay wall is some 360m long. The block wall is raised by masonry, executed with the local natural stone, a kind of porous limestone or coral stone. On top of the masonry is a concrete beam. The fendering system has vanished but its steel anchors protrude at the waterfront.

Kaspmorniiproject made the detailed design for the renovation of the first stretch of 150m of this quay. The location of this renovation project is indicated on fig. 4.9. Fig. 4.10 gives a cross section of this design. It consists of a concrete platform on concrete piles. Work started and a substantial amount of piles have been placed. Work stopped some time ago so that berth NR. 10 is out of use since. The design documents date from 1982. The design differs considerably from the pre-design shown in dotted lines on fig. 4.8. The latter dates from 1991.

2.1.5 Shore defence between the main complex and the ferry terminal (E)

This shore has been reinforced by the port at regular intervals as the water level went up year after year. No specific cross section is available. The rehabilitation of this shore protection, if needed, is part of the redesign of the ferry terminal, presently undertaken by Ramboll.

2.1.6 The mooring facility for water tankers (F)

This facility is mainly used for loading the tankers that supply the town of Turkmenbashi with fresh water. The facility consists of 5 concrete mooring blocks on steel piles. Metal bridges are placed between the blocks. According to the Kaspmorniiproject report, it was constructed in 1967. Fig 4.11 gives cross sections of the mooring points. The fendering system seems satisfactory.

2.1.7 The ferry terminal complex (G)

For this part of the port facilities is referred to the reporting done by Ramboll. Its construction was ready in 1963.

2.1.8 Shore defence between the ferry terminal and the port fleet terminal (H)

This shore has been reinforced by the port at regular intervals as the water level went up year after year. No specific cross section is available. The rehabilitation of this shore protection, if needed, is part of the redesign of the ferry terminal, presently undertaken by Ramboll.

2.1.9 Quay for the port fleet (I)

Fig 4.12 gives a typical cross section of this quay construction, as incorporated in the Kaspmorniiproject rehabilitation report of 1991. The quay is build in two straight sections. They are some 100m and 30m long. The earth platform between the berth and the sea is less wide than fig 4.12 might suggest. It is reported to be constructed in 1968. No cross section of the seawards slope protection could be traced. As elsewhere, the fendering has vanished and has been replaced by old tires. The earth platform and slope protection form a break-water structure that protects the enclosed water area against the waves coming from the South.

2.2 The Timber Terminal

The timber terminal consists of three different construction phases. Due to the high water level, the terminal was flooded until very recently. At the time of writing (October 1996), the water level had dropped so that the apron was just above the water. To the West of the terminal, a construction company has a quay with a platform 1m above that of the timber terminal.

The location of berths 1,2 and 3 are indicated on fig 4.13. The first berth is 97m long and was constructed in 1957. It consists of an anchored sheet pile construction. Fig 4.14 gives a typical cross section. At places, the topping beam is completely destroyed. Only the surface is visible now. It looks like that considerable repair works will be needed to restore this berth into operational condition.

The chief engineer's department reports that berth nr.2 was constructed in 1971. It consists of a concrete platform in piles. The slope under the platform is protected with stones. Fig 4.15 gives a cross-section of this berth 2 and of berth 3. Both are of the same design. Only the surface is visible now. It looks like that considerable repair works will be needed to restore nr.2 berth into operational condition.

Berth nr.3 has the same design as berth nr.2, but has for one or another raison been constructed about 1m further into the sea. According to the chief engineer's department, this last berth was constructed in 1982. Berths nr.2 and 3 are together 255m long.

2.3 Oil Termina

Fig. 4.16 gives an overview of the oil terminal area. It indicates also the position of the different piers.

The terminal consists of:

- The Northern breakwater
- The three identical jetties for crude oil imports (nr. 1, 2 and 5)
- One jetty for export of refined products (nr. 3)
- A quay for the service boats
- A Southern breakwater and causeway.

Only jetties nr. 1 and 3 belong to Baku Sea Port. It is nor clear who owns the breakwater and who is responsible for its maintenance. Only jetty 1 and 3 are operational today. Jetties 2 and 5 are abandoned by now.

The director of the oil terminal reports that no dredging is needed in this facility.

2.3.1 The Northern breakwater

Fig. 4.17, 4.18 and 4.19 give cross sections of the existing breakwater and of the reinforcements proposed by Kaspmorniiproject in 1991. It has been built in 1965. The deepest stretch was reinforced in 1989 with concrete blocks of 14.6 tons each (see fig. 4.19). The reinforced section runs from jetty 5 till the end of the breakwater.

According to the director of the oil terminal the present situation is satisfactory. Over topping of the Northerly waves is not excessive. At the non reinforced sections, the limited water depth moderates the waves sufficiently. During our site visit, the sea was to calm to judge the efficiency of the breakwater. Regular maintenance is needed by replacing moved blocks after stormy periods.

2.3.2 Jetties N°. 1, 2, 3 and 5

The jetties are of the same type. They have been constructed in 1970. They consist of three parts:

- The access bridges between the shore and the middle part of the jetty. One side houses the pipe bridge, the other side contains a ramp for cars and trucks.
- The middle part is used for berthing the vessels. This part houses the loading or unloading arms. For unloading, the ships> pumps are used. There is a facility at both sides of the jetty.
- The last part consists of mooring points and fender blocks.

Fig 4.20 gives a cross section of the middle part of the jetties and the proposed renovation proposed by Kaspmorniiproject in 1991.

The jetties are founded on concrete piles and covered with concrete decks. The fender system is still in place.

2.3.3 Quay for the service boats

This quay is not documented in the Kaspmorniiproject report of 1991. The level of the deck is not far above the sea level.

2.3.4 The Southern Breakwater and Causeway

This facility has not been inspected as it is not included in the Kaspmorniiproject list of facilities to be renovated. It is protected against wave attack from the North mainly by the Northern breakwater, from the East by the Artyom island and from the South by the Absheron peninsula and the causeway to the Artyom island.

2.4 Warehouses

Inspection of buildings has been limited to the warehouses on the main complex. These warehouses are the only ones that are fit for efficient cargo handling and storage. Fig 4.2 shows the location of these warehouses.

Warehouse 1,2 and 3 are of similar construction. These warehouses are located at the rear of the quay cranes of the Eastern quay. They consist of masonry walls. Warehouse 1 has a roof supported by a steel structure. The span is some 30m without any column in between. Warehouse 2 and 3 have the original wooden roof structure, resting on the walls and on columns in the middle of the warehouse. The warehouses are divided in sections by transversal separation walls in masonry.
Warehouse 1 is 108.6m long and is divided in three sections;
Warehouse 2 is 66m long and is divided in two sections;
Warehouse 3 is 72.6m long and is divided in two sections.

At the rear of these 3 warehouses, two warehouses have been build at the level of the rail wagon floors (i.e. 1.20m above the surrounding area. There are rail tracks on both sides of the warehouses. The two warehouses consist of a steel structure with light weight plated walls and roofs. They are of different design. There are no columns or division walls inside.
Warehouse 4 is 93.3m long and has a span of 21.7m.
Warehouse 5 is 62.3m long and has a span of 24.5m.

3. Engineering evaluation of the existing structures and facilities

Hereafter, the quay walls and warehouses as described under 2. are evaluated on their operational condition. For their general description is referred to 2.

3.1 The main harbour location

3.1.1 Platforms on piles near the Sea Station (passengers terminal building) (A)

Fig 4.3 gives a typical cross section. The level of the platform is at -26, which is only 65cm above the present water level. In the medium to long term, problems can arise when the sea level rises above the maximum level of 1995.

The concrete beam at the waterfront shows deteriorated concrete and uncovered reinforcing steel at several places. The fendering vanished and was replaced here and there by old tires at the places where ships are berthed.

The asphalted surface is satisfactory and has been repaired when needed.
There is no superstructure. The sea station building is spacious and has been designed for a much bigger passengers traffic than is the case today. The building is in good shape and can be adapted if needed when the passengers traffic grows.

As this part of the port is not used for the core activities, the only real threat can come from future sea level rising.

3.1.2 Passengers pier (B)

Fig 4.4 shows a typical cross section of this concrete platform on concrete piles. The surface of the pier is at level -26, hence some 65cm above the present water level.

The fendering system has not survived and has been replaced mainly by old tires.

The limited distance between the water level and the waterfront beam does not allow easy berthing. Some vessels that berth here have a ship's fender at the level of the main deck or just below. In normal berthing conditions, this beam should thrust against the fendering system of the pier. However, presently, the ship's fender is well above the platform of the pier and above its topping beam. As a result of the vessel=s movement the ship's fender collides with the top of the concrete beam, resulting in the deterioration of the latter. The concrete beam at the waterfront shows deteriorated concrete and unprotected reinforcing steel at several places.

The surface of the pier is in satisfactory condition. It consists of an asphalted cover above the concrete deck.

If used intensively, the passenger terminal should be equipped with a decent fendering system.

Future sea level rising is a constant threat, as there is only some 65cm between the sea level and the pier platform.

3.1.3 The main complex, Western and Southern quays (C)

Fig 4.5 gives a typical cross section of these quay walls.

An inspection of the water side of the quays showed that difficulties have been encountered in keeping the long stretches of sheet pile vertical during placing. This resulted in the need to insert at certain places wedge shaped piles or other devices for redressing the verticality. These places prove to be problematic. At these places backfill has washed out, creating craters in the apron. The port tries to repair these weak spots when they become visible. Also the connection of the sheet pile structure with the block wall has given problems and has given rise to mayor repairs.

Apart from these structural weaknesses, the port engineer reports that the unprotected sheet piles have corroded significantly over a height of several meters. During the last 20 years, the splash zone was situated over a height of several meters due to the variation of the water level. The splash zone is known to be the favoured zone for fast corrosion, especially when no protection devices are in place. The Chief engineer reports that at regular times, backfill has washed out through corrosion holes that are located well under the present water level. Regular interventions are needed to keep the quays operational.

The fendering system is not any more in good shape. At places old steel structures protrude at the waterfront.
The concrete beam above the sheet piles shows considerable deterioration and unprotected reinforcing steel. This can partly be explained by the absence of an adequate fendering system and partly by unsatisfactory quality of the reinforced concrete and care and quality control during execution.

The apron is equipped with crane rails, train rails, a drainage system and culverts for water supply, power distribution, etc. The drainage system and the culvert at the waterfront are not in very good condition. This can be explained by the weakness of the sheet pile structure and the regular repairs it needs. The apron level is at -23.87, the bottom of the culvert at -24.97 and the drainage system at -25.35. Hence, these facilities have not been below the sea level since there construction.

In general, the surface of the platform is too irregular to allow easy horizontal transport. The crane and train rails need to be at the same level as the surface, as was originally designed (fig. 4.6). This is not the case at the moment at many places where horizontal transport should be allowed.

The surface in the vicinity of the Ro-Ro ramp is satisfactory.

The surface of the main complex is some 2.80m above the present sea level. Hence this facility is not threatened by sea level rise (see also 5.).

The sheet pile structure is not in good condition. At regular intervals repairs are needed. A major renovation of the quays is needed in order to upgrade them to reliable berths. This renovation should include the construction of a good fendering system that can be adapted according to variations of the sea level.

Nearly the complete area of the main complex needs new surfacing.

3.1.4 The main complex, Eastern quay (D)

Fig 4.8 gives a cross-section of that quay construction.

Part of this quay cannot be used anymore due to the half finished renovation work.

The remaining part of the quay needs a decent fendering system that can be adapted according to the variation of the sea level.

The quay itself seems to be in better condition then the sheet pile quays. However, by raising the block wall quay, the overall stability is reduced. An analyses of the general stability of this raised quay will determine, if the present situation provides satisfactory stability or not. This analysis has been done in the past by Kaspmorniiproject and the stability found unsatisfactory. This would explain the renovation projects that the institute has prepared and the work that started along berth no.10.

3.1.5 Shore defence between the main complex and the ferry terminal (E)

P.M. This is part of the renovation project of the ferry terminal.

3.1.6 The mooring facility for water tankers (F)

Fig 4.11 gives cross sections of the mooring points.

The fendering system is satisfactory, as are the concrete blocks on top of the piles.
According to Kaspmorniiproject the top level of the mooring blocks is at -24;07. Hence well above the present sea level. The steel pipes of the mooring blocks might have corroded as the sheet piles of the main complex did. The splash zone was also here during two decades extended over a height of several meters.

3.1.7 The ferry terminal complex (G)

P.M. This is part of the renovation project of the ferry terminal.

3.1.8 Shore defence between the ferry terminal and the port fleet terminal (H)

P.M. This is part of the renovation project of the ferry terminal.

3.1.9 Quay for the port fleet (I)

Fig 4.12 gives a typical cross section of this quay construction.

This quay has been damaged at places by ship collisions. Some major repair work to the concrete structure is needed.
There is room for improving the fendering system.
The surface of the platform is asphalted and is in a reasonably good condition.

3.2 The Timber Terminal

The timber terminal can only be transformed into a facility that is reliable in the long term if the quays and the port area are raised by at least 2m. However, the location seems good for harbour activity, as rail access is available and as the main road is nearby. The access to the timber terminal is narrow and hardly paved.

3.3 The oil terminal

3.3.1 The Northern breakwater

Presently, the water level is at about -26.60 and the crest of the highest part of the breakwater is at about -22. Hence its crest is only some 3.40m above the sea. There is no road on this last stretch of the breakwater so that maintenance is only possible from the sea.

Today, only jetties 1 and 3 are operational. These two jetties are located near the shore. The breakwater is mainly needed for jetty 5 and 2, and to a lesser extend for jetty 3.

If jetties 5 and 2 are planned to become operational, a proper reinforcement of the breakwater must be included in any renovation project.

3.3.2 Jetties N/. 1, 2, 3 and 5

The main deck of the jetties is at -24.84, which is well above the present water level. There is no direct threat of the sea level.

The concrete parts of the jetties are in very poor condition, although it dates only from 1970. During construction, the basic rules of good workmanship have been neglected. No spacers between reinforcing bars and shuttering have been used. At places, it is visible that the reinforcement had no concrete cover from the very beginning. Some pile caps have not been placed vertically above the piles. Concrete quality is poor. At many places the concrete cracked and show the location of the reinforcement.

Apart from jetty 1, the pipes need de-rusting and painting. The pipe system of jetty 5 has been dismantled completely and the pipes of jetty 2 are partially dismantled.

If the oil terminal has a vocation for major activity over a longer period, it seem the best solution to dismantle the existing jetties and to construct new facilities.

3.3.3 Quay for the service boats

If the oil terminal has a vocation for major activity over a longer period, the quay should be raised and renovated.

3.4 Warehouses

The warehouses 1, 2 and 3 with masonry walls are generally in good condition. Minor repairs and regular maintenance can keep these warehouses in good condition.

The steel structures of warehouses 4 and 5 also seems to be in good condition. However, the sheeting needs some repair and doors need to be repaired.

4 Topographical survey

On October 8th the topographical surveyors started their work on the main complex and adjacent areas. They will cover the main complex, the entrance and yard to it, the ferry terminal the accesses to this terminal and adjacent areas to both harbour facilities.

The Ramboll team is taken care of the survey of the ferry terminal and related areas while our team sponsors the survey of the main complex and related areas.

The surveys will than be incorporated into one general map of the core area of the port. This map will be the basis for the master plan development in the second phase of this feasibility study.

The survey itself will take some two weeks and processing of the results will require about the same time. Hence, no results can be incorporated to this report as yet. They will be given in the second phase report.

5. Impact of the rising sea level

As the Caspian Sea has no outlet, the water level is established by the balance of the water inflow and the evaporation.
Hence, fluctuation of the sea level over longer periods is a normal natural phenomena. It causes problems with berthing facilities, as quays have fixed levels. Presently, the Sea Port of Baku is suffering from the high sea level in relation to the platform level of some of its facilities.

From 1900 till 1977, the Caspian Sea level dropped considerably. In that period, all existing infrastructures in Baku Port have been designed and constructed. Since 1977, the level raised by some 2.70m. Hence it is not surprising that problems are encountered today.

Table 5-1

Year	Sea Level
1900	-25.60
1977	-29.12
Nov. 1994	-26.64
1995	-26.45
Aug. 1996	-26.64

The Tacis study on the Caspian Sea Water level summarises the work done by Kaspmorniiproject and others on forecasting probable sea levels. Forecasts appear to be rather intelligent guess work than scientifically fully justified predictions. This is an element we have to live with.

However, major renovation works and for new developments, we cannot do without defining the maximum and minimum design level over the live period of the structure. Fig.4.16 has been borrowed from Sofremer and Co report and gives an overview of the available historical data. During the last 165 years the sea level remained between -25 and -29. This would be a first set of limits.

Sofremer and Co have analysed the predictions Kaspmorniiproject did since 1976 and concluded with the institute that predictions are nearly impossible as the factors involved are not fully understood. The prediction is as difficult as is the prediction of the climate in the large catchment basin of the Caspian Sea and the effect of regulation works on the Volga river.

In an attempt to increase the evaporation of the Sea, the Kara-Bogaz-Gol lagoon in Turkmenistan has been reconnected with the Caspian recently. This measure may partially explain the fall of the Sea level during the last year.

In the renovation study of Kaspmorniiproject of 1991, the following sea levels are used:

Table 5-2

Year	Sea Level
1995	-26.00
2000	-26.30
2005	-25.70
2010	-25.10

Taking into consideration many factors involved and having analysed the available studies of Kaspmorniiproject and of Moscow based scientists, Sofremer and Co Ahopes in 1995 that the level of the Caspian should lie in 2030/2040 between -24 if the level continues to rise and -28 if there should shortly be a reversal of the trend.

The EBRD study team for the renovation of the port of Aktau also deepened out the question of what should be the design sea levels for future investment projects. The present quay level is -26.25. The design top level for the new quay is fixed at -24 with allowance to raise the quay with another 2m if needed (i.e. level -22). The forecasted level range (in 1993) was -28 and up to 1m above the present level (about -26) over the period to 2010.

The project team for the renovation of the ferry terminals in Baku and Turkmenbashi (Ramboll team), proposes in their phase 1 report, for the time being, as design sea levels, -24 and -29. These design levels are those suggested on the TOR. However further investigation, based on statistical analysis, is ongoing and final design sea water levels will be proposed. The design levels should cover a period of 50 years.

The EBRD study team for the renovation of the port of Turkmenbashi (Louis Berger International) produced its Phase 1 Report in march 1996. The team takes into account the maximum level predicted for Aktau (-24) Sofremer's forecast for 2010 (between -25.30 and -25.70) and the forecast of the Turkmen Scientific-

Research Project Institute for 2015 (-24.45). They concluded that there is no need to raise the present quay level (-24.00)

Hence, the different forecasts give the following design levels:

Table 5-3

Forecaster	Period	Max. level	Min. level
Last 165 years		-25.00	-29.00
Kaspmorniiproject	1991 - 2010	-25.10	-26.30
Sofremer & Co	2030/2040	-24.00	-28.00
Aktau Team	1993 - 2010	-26.00	-28.00
Ramboll Team (first guess)	1996 - 2045	-24.00	-29.00
Turkmenbashi Team	1996 - 2015	-24.45	-25.70

It is proposed to adapt as maximum design level -25 and as minimum level -28. In the design of quay walls it should be taken into account that erosion from ships' propellers can deepen the bottom by one meter. If the level should drop under the proposed minimum level, the bottom can be stabilised by stone or mattresses, preventing erosion, at the design bottom level after erosion. This measure allows then for an extra meter of sea level drop.

The structures of the main harbour location, discussed in 2 and 3, have the following top levels and design sea bottom levels:

Table 5-4

Structure	Top Level	Bottom Level
Platforms - Sea Station	-26.02	-33.70
Passenger Pier	-26.02	-33.60
Main Complex West & South	-23.87	-32.57[1]
Main Complex East	-23.87	-32.57
Berth for Water Tankers	-24.07	-33.40
Quay for Port Fleet	-25.80	-32.80

The minimum distance between the water level and the quay level and the minimum draft, taking into consideration minimum and maximum design levels are the following:

[1] The Chief Engineer reports that these berths have been deepened during the seventies, when the sea level was reaching its minimum

Table 5-5

Structure	Min. to Quay Level (m)	Min. Draft (m)
Platforms - Sea Station	-1.02	5.70
Passenger Pier	-1.02	5.60
Main Complex West & South	1.13	4.57[2]
Main Complex East	1.13	4.57
Berth for Water Tankers	0.97	5.40
Quay for Port Fleet	-0.80	4.80

Under the above assumptions, the major port facilities remain operational with a minimum water depth of 4.5m. The auxiliary facilities however will be flooded when the maximum design level occurs.

6 Existing designs for the renovation of the water-front structures

Three types of designs for renovation works are discussed hereafter. They are all prepared by Kaspmorniiproject.

- Detailed designs of parts of the main complex, mainly of the Eastern quay.
- The general pre-design of all harbour quays and jetties prepared in 1991.
- The general pre-design of shore protection prepared in 1991.

6.1 Detailed designs of parts of the main complex, mainly of the Eastern quay

The chief engineer made the following documents, prepared by Kaspmorniiproject, available:

- Renovation of the Western and Southern quays of the main complex. This project has been completed in 1969-1970. Detailed description is given in 2.1.3 and 3.1.3. Fig. 4.6 has been borrowed from this document. The renovation brought the platform level to the present level of -23.87.

- A detailed design document dating from 1977. This project contains the complete renovation of the Eastern quay of the main complex. This design is basically the same as shown on fig. 4.10, except that the front plates and fendering system are designed according to the very low sea level of 1977. The designers wanted to extend the apron by .75m and shift the quay cranes and rail tracks onto the front platform on piles. The level of the quay platform is -23.87. The designed structure has not been built. Probably, the poor stability of the old block quay was the principal reason for preparing this design. Berths 2 and 3 of the timber terminal that have also been designed in the seventies have comparable design (fig.4.15).

---

[2] See note 1

- Detailed design documents for the first 150m of the Eastern quay of the main complex and of the shore protection near that area. These documents date from 1982. The design of the quay is the same as the design of 1977 except that the front plates and fendering have been adapted to the water level and their forecasts of that moment. Work started and was stopped later, as has been reported in 2.1.4. Fig 4.10 has been borrowed from this file.

- A last detailed design file dates from 1991. It equally concerns the renovation of the Eastern quay and adjacent shore. The design consists mainly of an anchored sheet pile construction. A vertical fendering system is foreseen. The sheet pile construction is also proposed for first 50m of shore, adjacent to the Eastern quay. Fig 4.22 gives the design cross section. Here also the design level of the quay platform is kept at -23.87. Part of the design file is the renovation of the water supply system of the main complex.

6.2 The general pre-design of all harbour quays and jetties prepared in 1991

Fig. 4.3, 4.4, 4.5, 4.8, 4.12, 4.14, 4.15 and 4.20 give cross sections of these pre-designs. The pre-design of all quays and jetties consist of anchored sheet piles. The platform level of most of the renovated structures is at
-23.10. The design water level for most structures is -25.10 (forecast 2010).

6.3 The general pre-design of shore protection prepared in 1991

Fig 4.17, 4.18 and 4.19 show cross sections of the pre-designs of the breakwater of the oil terminal. Fig. 4.23 gives the cross section of the pre-designed shore protection foreseen for the Baku port, main location. The designs take into account a sea level of -25.10 in the year 2010.

6.4 Comments about the designs

The detailed designs have been worked out in great detail. In concrete constructions prefabricated elements are used extensively. In the sixties, sheet pile constructions were used. In the seventies concrete platforms on piles were preferred while in the late eighties sheet pile constructions re-gained popularity. The design documents give a professional impression.

The proposed design levels (see 5 above) of the sea are -25 and -28. If needed, dredging of a extra meter and stabilisation of the bottom would allow a minimum sea level of -29. Most of the pre-designs of 1991 take into account a maximum level -25.10 which seems adequate.

The variations of the sea level, combined with the aggressive of a sea water environment makes the use of sheet piles troublesome if no measures against corrosion are incorporated in the design. However such measures are delicate and costly (coating in the splash zone and sacrificial anodes).

The sea environment requires a carefully designed concrete mix and the use of appropriate cement.

From the experiences of the past, the need for strict quality control of the contractor's work has proven overwhelmingly. Future tender documents and site control should focus on quality.

7. Utilities

The port is served with water, electrical power and waste water services by the municipality of Baku. These services are fairly reliable. Warm water for the central heating system is generated by the port ifself by means of 3 gas-powered boilers within the port's area. This heating system is generally sufficient, but in some workshops electrical heating elements are used in order to keep an adequate temperature in the cold season. Deteriorated insulation and poor maintenance of the warm water pipes are the main reasons for these insufficient temperatures. Air conditioning is generally no problem during the summer season, although some staff would like to have more units available in the office. In total 108 units of air conditioning exist in the port.

Water supply, as stated before, is adequate. However, in summer the municipality does occasionally have problems to provide the required quantities. There is an ongoing World Bank Project in Baku which deals with this problem.

The electrical power supply (220V - 380V, 50 Hz) 2 or 3 phases, occasionally does not meet all requirements. However, the situation is improving. Power cables and electrical installations within the port area are old and generally in bad condition. The renewal , the renewal of installations in the operations area should be included in rehabilitation time.

In the port no emergency stand-by generator is available. Such a facility should generally be available, at least in order to provide electric power to the port's hospital etc. in emergency cases, as electric power cuts did happen in the port. The service has improved to such an extend, that there is no interruption of cargo handling operation, though. Power failures that occur sometimes due to the poor condition of electric cable installations in the port are tackled by the port's staff.

The sanitary facilities must be improved. The garbage collecting system is adequate due to an agreement between the port and the municipality, i.e. the port provides the transport to the municipality's dumping areas.

8. Design Report

The items discussed in this report are mainly those recommended in the second phase report as first phase of developments and fine-tuned elsewhere in this third phase report. Meanwhile the discussion about the financing of the equipment and works for this first phase development got momentum. Guidelines that should govern the designs and procurements have been given by both, the Port Authority and the financiers.

- An initial development would be financed by TACIS - TRACECA funds. The equipment and works, subject to this source of finance, are planned to be realised prior to the bulk of the first phase developments. They should be in harmony with this first phase development.
- The bulk of the first phase of development would be financed by an EBRD loan. The works and procurements for this first phase should be part of and in harmony with the long term planning for the Port.

- Caution is needed in defining the works to be materialised and the procurements to be made. Indeed, uncertainties are inevitably connected to long term traffic forecast in an economic environment that has undergone drastic changes in the recent past and that is expected to undergo equally drastic changes in the next future.
- The development plan should allow flexibility so that the Port can cope with the traffic types and volumes as they develop.
- The immediate productivity of the proposed works and procurements should govern the choices made.

On overview of the first phase development is given on Fig.1, 2, 3 and 4. The subjects treated in this design report are the following:

8.1 Renovation of Western Quays

These quays are not in good condition. Reference is made to the first phase report, Volume IV, Civil Engineering Assessment for further details on this mater.

8.1.1 Design sea levels

For this topic, reference is made to the First Phase Report. It was recognised that predicting future sea levels is impossible, as many of the driving forces are not fully understood today. However, based on historical data, it was recommended to use as maximum design level -25 and as minimum design level -28 with the possibility to deepen the sea bottom next to the quay with an extra metre if this bottom is stabilised. Hence the proposed design levels were -25 and -28 with possibility of -29 if measures are taken.

During discussions with the Chief Engineer it was agreed to fix the lower design level at the minimum sea level reached in 1977, namely -29. Hence the agreed design levels are -25 and -29.

8.1.2 Design Water depth

Two approaches have been made to document the decision on the design water depth at quay.

A) Sea map of Baku bay, dating from 1989 (1/25000)

Outside the bay the bottom level is at -38 or deeper. This is at some 9km from the terminals. Inside the bay the water depth gradually decreases. Table below gives the approximate distances between the Main Harbour Location and the natural sea bottom level. Hence it gives an indication of needed length of channel to be dredged if such bottom levels need to be guaranteed.

Distance in km	9km	7.5km	5.5km	4.5km	3.5km
Natural sea bottom	-38	-37	-36	-35	-34

B) Draft of the fleet of the Caspian Shipping Company

The following ship dimensions have been taken from a brochure of the Caspian Shipping Company:

Table 8.1

Type of ship	Overall Length (m)	Loaded Draft (m)	Breadth(m)
Ro-Ro "Kompositor Kara Kavaev"	125.90	5.66	16.22
Rail Ferry "Dagastan"	154.47	4.50	13.45
Dry Cargo "Kishinyov"	123.50	4.50	15.00
Dry Cargo "Geroj Mekhti"	114.00	3.73	13.00
Dry Cargo "Buniat Sardarov"	118.10	3.95	13.40
Tanker "Nikifor Rogov"	146.64	8.00	17.38
Tanker "Apsheron"	146.88	5.30	17.40
Tanker "General Shikhlinskiy"	124.97	4.15	16.63
Ice breaker "Capitan M. Izmaylov"	56.19	4.20	16.03
Salvage tug "Svetlomor"	61.00	4.50	14.00

In discussions with the Chief Engineer, the above data were checked with the Port's experience and expectations for the future. It was decided to foresee future quays for ships with a draft of 5.5m.

In order to define the design water depth at quay the design draft must be increased by the following factors (source EAU 1990).

Keel clearance	minimum 0.5m
Minimum dredging tolerance	0.4m (water depth > 6m)
Layer for maintenance dredging	0.3m
Hence the design water depth should be	minimum 6.7m

In another approach, the Chief Engineer calculated a necessary design water depth of 6.8m.

By mutual agreement it was decided to adopt 7m as design water depth. Hence the design bottom level is at -36.

8.1.3 Design Quay Levels

According to design documents of Kaspmorniiproject Institute of Baku, the following wave intensity should be taken into account at Baku Main Harbour Location:

Table 8.2

Waves between 0.00 and 0.1m	59.57% of the time
Waves between 0.11 and 0.3m	32.80% of the time
Waves between 0.31 and 0.6m	6.40% of the time
Waves between 0.61 and 1.0m	1.18% of the time
Waves between 1.01 and 1.5m	0.04% of the time
Waves higher than 1.5m	0.01% of the time

The Chief Engineer of the Port proposes to foresee the new quay level 2m above the maximum design sea level, i.e. at -23 which is adequate for reflecting 1m wave without over topping.

The quays of the Main Complex in the Main Location are at present approximately at level -23.70 till -23.85 which is some 2.80m above the present water level. Raising the apron level up to level -23 is in conflict with the need for immediate productivity of financing funds on the one hand, but it is on the other hand raising the quay level is the best justifiable solution on the long term as it safeguards the port for future high design sea levels. It is proposed to foresee the waterside wall of the quay at level -23 and the apron at level -23.40 (see later in this chapter).

8.1.4 Condition of sub soil

Available geotechnical data

Some data about the sub soil condition in the Port of Baku have been made available by the Port Authority. They originate mainly from documents produced by the Kaspmorniiproject design institute of Baku. The following documents have been used:

1) A note summarising the basic physical conditions in the ports of Baku and Krasnovodsk (now Turkmenbashi). This note in its original Russian version is given in annex 1.

   From this document the following subsoil conditions have been deducted:
   On top, sand and silt over a thickness of 7 to 10m.

   φ = 28 to 30°
   C = 0 t/m²
   Pore volume = 0.60 to 0.75
   γ = 1.7 t/m^3

   A consolidated clay layer

   φ = 20°
   C = 4.3 t/m²
   Pore volume = 0.05 (?)
   Water content = 0.50 (?)
   γ = 2.04 t/m^3

2) Design documents of existing or projected quays of the main complex.

   - A geotechnical cross section along the Eastern Quay of the main complex (from 1982). This profile is given in annex 2. The levels given are related to the "Caspian Sea Datum", i.e. -28 below the Baltic Sea Datum, that is more generally used in the area. According to the document the profile is based on the results of one core drilling made in 1941 and two made in 1977.

   - A profile, probably of the West Quays, probably produced in 1960, gives three core drilling of 1941 (annex 3). On this profile, the soil characteristics are indicated.

   - A cross section from 1982 of the Eastern quay giving two drillings, one of 1941 and one of 1977 (annex 4).

   - The available core drillings are summarised on Fig.5 Levels are given according to the Caspian Sea Datum reference (-28 Baltic Sea Level).

Provisional geotechnical design profile

From the above given geotechnical data the following design has been deducted:

Layer	Type	Top B.S.D	Top C.S.D	φ °	C t/m²	γ dry	γ wed
A	Consol. clay	-39.50	-11.50	21°	4.96	2.00	n.a.
B	Sand	-37.50	-9.50	30°	0.00	2.00	n.a.
C	Silty sand (*)	Surface or sea bottom		28°	0.00	2.00	1.60

(*) A silty layer deposit is probably present on the sea bottom, as maintenance dredging was not needed for many years due to the rising sea level. In the design, this layer is to be treated as water on the sea side. If present, the layer must be removed in those parts of sea that are reclaimed by future works.

Layer A, the consolidated clay layer, that probably dates from the tertiary era, has proven to be highly compacted and very resistant. This is probably the main raison for the bad condition of the placing of the sheet piles of the Western and Southern quays. Also the pile tops of the piles placed at berth nr. 10 (Western quay) show heavy pile driving conditions (see photos in the annex to the first phase report). Hence driving conditions of sheet piles and concrete or steel piles are a topic of concern.

Seismic conditions

The Kaspmorniiproject report (annex 1) indicates a "seismic gradient force 8" according to the Soviet Standard SNIP 11 - A, 12 - 69. Force 8 corresponds to Richter scale 8. This grade 8 corresponds to richter grade 8.

8.1.5 Layout of quay platform - loading conditions of the quay

Crane rails - train rail arrangement

Fig.6 gives typical cross sections of the existing quay platforms.

The renovated quays will be used as multi purpose quays, equipped, at least in the first phase development period with the existing (partially renovated) quay cranes. It is foreseen when appropriate that direct loading from ship to train and vice versa will take place in the future, as was the case in the past. For that raisons, the present configuration of rail tracks and crane rails is to be foreseen on the renovated quays. The present heavy quay cranes are judged to be fit for container handling. However, especially when equipped with a sophisticated spreader, their capacity margin is not big. It would be indicated to reduce the distance between the water front and the first crane rail. However, the Chief Engineer indicated that the type of ships calling at Baku have difficulty in mooring in windy conditions and have on occasions collided with the cranes. It is recommended to apply the standardised distance (Soviet Standard) of 2.25m between first rail and water front for the renovation.

However, it is not impossible that the port considers to install in a remote future a container gantry crane on a part of the renovated quays. For that raison one of the loading conditions of the water front crane rail should be the loading condition of such a gantry crane.

a) Water front crane rail:

<u>Portal quay crane</u> - rail spacing 10.5m
design cranes:

TAKRAF/KONDOR cap. 40t outreach 32/25 - 8m = 1000tm

TAKRAF/SOKOL cap. 16/32t outreach 32/20 - 8m = 640tm

The table 10.3 below gives the loading cases recommended by the EAU 1990 (German Recommendations) for high capacity portal quay cranes:

The capacity of the 40 tons TAKRAF/KONDOR crane is 16.7% less important than the 30tx50m crane on rails, spaced by 10.5m. Hence, the following loading per support are to be used in the quay design:

	support loading in kN	íüþòííàõ
Jib position	Crane in operation	Crane out of operation
I	2300kN	-------
II	2900kN	2000kN

The crane is supported by 8 wheels of 45cm diameter, spread over a distance of 6.75m for each support.

Table 8.3 Crane corner load table for heavy general cargo cranes with different track widths

Maximum crane corner loads in kN (including wind and inertia forces)			
Lifting capacity Length of jib	Jib position	Crane in operation	Crane out of operation
	I	2300	
	II	2900	2000
	I	2600	
	II	3200	2300
	I	3000	
	II	3300	2600

Container gantry crane:

The water depth in Baku Port and the other ports of the Caspian Sea is limited resulting in the use of smaller ships (see 1.4 above). Hence, a container gantry crane needs an outreach of some 15m beyond the line of the fenders. A loaded 40' container can weight some 30 tons. Hence the capacity of the gantry should be some 35 tons under the spreader, resulting in a maximum outreach capacity of some 20mx35t = 700tm.

The EAU 1990 gives no standardised loading cases for such a gantry. The models given have an outreach of 38 till 46.5m, intended to service Panamax and Post-Panamax container vessels. The loads given for the crane supports are the following:

Table 8.4

Rail spacing	Outreach	Max. support loads
18m	38m	4200kN
18m	44.5m	5000kN
30m	46.5m	6000kN

For a heavy quay crane, basis 10.5x10.5m and a capacity of 30tx40m (1200tm), the loading cases are given in the table 10.3 above. These loads are used for the design loads of the gantry in order to count for its heavier outreach construction. Indeed:

- Estimated weight of trolley and spreader: 20tons
- Comparable capacity: 35+20)tx20m = 1100tm

The space between the crane supports on the front rail is supposed to be 16m. The supports are supposed to rest on 8 wheels each, with a spacing between the wheels of 1m (loading case II is not applicable for a gantry, 30tons/wheel).

b) Train rail loading:

A wagon weighting 80tons with a length of 10m and supported on two bogies is considered.
Wheel spacing and wheel loads are supposed to be the following:

1.5m 20t axle 1.5m 20t axle 4m 20t axle 1.5m 20t axle 1.5m

Hence 40 tons for each boggy and 10 tons for each wheel.

c) Loading on the rear crane rail:

The loads of the water front rail for the portal quay crane and for the container gantry are to be used.

d) Yard loading behind the rear crane rail:

4 tons/m²

e) Bollard load:

One bollard, capacity 20 tons every 25m.

f) Water level behind the quay:

In the short term, variations of the sea level are limited as nearly no tide occurs. Variations are mainly due to wind uprising. On the other hand, the climate in Baku is rather dry and nearly the complete harbour area is paved. For both raisons, the design difference in water level between the sea and the ground water can limited to one metre. No extensive drainage of the subsoil is needed for equalising the water levels.

g) Fendering system:

This issue is to be detailed in the phase four of the project as the implication of its loading on the quay wall design is limited. However, the design should allow for adjustment of the fendering level on the long term, according to the sea level evolution. Fendering with minimum and with maximum sea levels conditions should be possible. The thickness of the fender construction should be kept to the minimum.

8.1.6 Proposed design

Given the design sea bottom of -36 (-8), it is compulsory to create the foundation of the renewed quay structures on or in the consolidated clay layer (layer A).

If sheet piling or pile driving is foreseen, it should be a major consideration is for the general concept of the renovation works to propose a design that allows pile driving under good quality conditions into that hard consolidated clay.

The existing sheet pile wall can hardly be incorporated into the new design as structural element because of its bad condition. This bad condition is the main raison for the need of a major renovation. The lower adopted design sea bottom (based on the lower minimum design sea level, experienced in the seventies) compared to the design of the present quays results any way in a heavier quay construction.

Taking into consideration the above discussion, a preliminary design for the renovation of the quays have been prepared.

Preliminary design of the quay renovation (Fig 7)
In this design, the waterfront is shifted by some 8m towards the sea and a new wall is constructed. The area between the old and the new wall is backfilled. For facilitating sheet pile driving and for economising the amount of steel needed, the front wall is composed of deeper founded steel tube piles with normal sheet piles in between (combi wall structure). The sheet piles do not need to be founded at the same depth as the tubes. Slots are welded on the tubes in order to guarantee soil tightness of the wall. If driving home of the tubes becomes troublesome, the tube can be excavated inside, which results in easier driving. An other measure to facilitate driving can be to equip the tubes with an outside rim at its bottom in order to eliminate most of the friction forces in the consolidated clay.

The existing anchor rods are incorporated into the design and reused as structural elements. A platform plate is foreseen for bringing the crane, train and quay loads onto the sheet pile wall and onto the old block wall structure, thus limiting the horizontal soil pressure on the top section of the sheet piles. The plate also functions as anchor between the new front wall and the fixing point of the anchor.

The front wall of the quay is at level -23 while the apron level is -23.40 and slopes up in the land wards direction (see 8.5 below).

Surface water is drained behind the front wall of the quay. A connections pit for power supply to the cranes and one for fresh water distribution for bunkering is foreseen to be installed in the front beam of the quay wall every 50m. For cooling purposes electrical cables are foreseen to be placed in the bacfilling, above the quay plate, while the water pipes are to be placed in cast in PVC tubes in the quay beam.

Every 25 m, a bollard with capacity 20tons is foreseen.

8.2 Adapt the Southern quay as a reliable shore protection facility

Table 8.2 of §8.1 gives the wave attack to be taken into account. The shore protection should reach at least level -23, subject to detailed calculation.

The shore protection should be constructed so that possible erosion of ground material through the holes in the existing sheet pile wall is avoided. Hence a filtering construction is needed.

The West and East quays have to remain operational over their full length. At the extremities of the Southern face of the Main Complex, corner constructions are needed over the length of the ending slope of the future shore protection. At the West side this implies an extension of some 25m of the renovated Western quay. On the Eastern extremity, a detailed check of the (partially repaired) existing sheet piles is needed in order to determine whether repairs are needed prior to the construction of the shore protection.

In the fourth phase a design will be made of the shore protection and cost will be compared with the quay wall renovation. For the time being, budget cost of the shore protection is estimated at 50% of the quay wall renovation per unit of length.

8.3 Foundation of gantry cranes

The general layout at the end of the first phase of renovation of the cargo port is given on Fig.4. The beams for the rail mounted gantry cranes are indicated on this figure. Fig.8 gives a cross section, showing the proposed container stacking system and indicating the crane beams. The present rail tracks in the middle of the harbour area are supposed to be reinstalled at their present place, but at the new level. For the construction of the Eastern crane beam, the platforms are intended to be shortened by 1.5m in order to create the necessary space. The beams would then be implanted starting from the edge of the shortened platforms.

For the purpose of preparing a bill of quantities and for budgeting, the foundation beams have been given dimensions based on the following supposed loading cases.

Big gantry

- 120tons for each support - four wheels spaced by 1m
- Distance between supports 16m
-

Small gantry

- 80tons for each support - three wheels spaced by 1m

- Distance between supports 16m

Two gantries can be placed one next to the other.

The foundations need to be equipped with a device for fixing the gantries under heavy storm conditions. This device should be designed together with the design of the gantries.

The elasticity of the soil is pessimistically estimated at 0.02N/mm^3.

The preliminary design calculation gives the following T cross section:

Top section:	0.5x1m
Beam section	0.5x2m

8.4 Adapt warehouse no 5 as CFS

The existing warehouse nr 5 is intended to be used as CFS. For that purpose the CFS must be accessible for yard tractors and trailers and for road trucks and tractors with semi-trailers.

Fig.9 shows the parking and manoeuvring area. The space between warehouses 4 and 5 proves to be sufficiently large to allow for manoeuvring space and for parking place for five vehicles loaded with containers. Turning radii of 15m have been allowed for.

The surface between the two warehouses needs renovation. Reference is made to §8.5 hereafter for detailed description.

The warehouse itself is in reasonably good condition. The steel structure needs de-rusting and painting. The roof and wall plating needs repair or replacement at certain places, but in general it is in good shape. On the North side the building and platform needs to be adapted for the CFS services. A platform depth of 5m is required so that two loaded fork lift trucks can pass. Two gates of 8m separated by 3m should be accommodated in the Northern wall. The present floor pavement consists of asphalt based covering. However, its level is at about -22.40 to -22.60 while the manoeuvring area for tucks is at -23.50 to -23.60. A standardised ramp level is 1.20m above the parking area. The Northern platform should be raised to level -22.35 and sloped towards the present level in the first 5m inside the warehouse. The existing doors on the long sides of the building need to be repaired or to be replaced by new ones.

8.5 Surfacing of parts of the apron and the yard

8.5.1 General information about the pavement system

Fig. 10 indicates the areas where the surfacing is to be renewed in the first phase development and at what level these surfaces should be constructed. It equally indicates the run off system proposed. In general the slopes are limited to less then 1%, which is allowable for the stacking areas. Four types of surfaces are foreseen (see Fig.12):

- Pavement of the operational area

- Pavement of the traffic areas in the port
- Pavement of the CFS warehouse and platform
- Pavement of the new workshop area
- Pavement of the gate area

Fig.11 gives cross-sections of the present levels at the places where the new flood light tower are projected (see Fig.4). As discussed later in this chapter, the complete pavement thickness in the operational area should be some 43cm. The new pavement system in this area is supposed to be placed on top of the existing pavement, thus eliminating demolition of the latter. Fig.11 gives also a cross section of the new pavement. One can see that earth movement and demolition is kept to a minimum by adapting the levels proposed.

A good pavement in the operation area must meet the following requirements:

- The surface should be even so that swift operation with modern equipment is possible.
- The surface should be strong enough to resist the friction forces of manoeuvring and braking equipment and it should have a sufficiently rough surface in order to allow these forces to occur.
- the surface should allow sufficiently quick evacuation of rain water.
- The surface should withstand the corrosive effects of spilled oils and fuel and of chemically aggressive cargoes.
- The pavement system should be adequate for spreading the surface forces and for transferring them to the subsoil.

The wheel loads of mobile equipment has increased over the years. Static axle and wheel loads of some mobile container equipment is given below.

Kind of equipment	Max. axle load	Max. wheel load
Truck	30 t	10t
Straddle Carrier	---	13 t
Reach Stacker (full cont.)	92 t	23 t
Reach Stacker (empty cont.)	39 t	10 t
Forklift Truck (full cont.)	90 t	15 t
Forklift Truck (empty cont.)	20 t	5t
Transtainer	---	29 t

The wheel loads of today's equipment are so high that it is un-payable to construct in ports a pavement that is designed to resist without maintenance these loads during its economic life period. Such maintenance free pavement would be comparable with the runways of airports.

A good design of pavement should try to compromise between cost, cost of maintenance and flexibility during the economic life time.

The asphalt based type of hard standing is not indicated for future surfacing for the following reasons:

a) On hot sunny summer days the top layer softens, resulting in easy damage.

b) The use of cargo handling equipment does not combine well with asphalted surfaces.

- Asphalt, and especially asphalt originated from crude oil dissolves in diesel and in hydraulic oil. These types of oil are inevitably spilled from time to time by mobile equipment, thus softening the surface.
- Manoeuvring forklift trucks and the like generates high friction forces between wheel and surface. Asphalt based pavements, especially in summer time and/or after having been softened by oil or diesel resist less such friction than concrete based surfaces.

Surfaces made of concrete resist better the surface forces as well as corrosive effects of hydrocarbons and other chemicals. In most harbours new pavements have therefore concrete surfaces.

There is another conflicting parameter in determining the type of pavement system to be adopted. A good even surface can be made with cast in situ concrete slabs of large dimensions. However, they prove little flexible and give rise to high costs when broken parts need repairing or if cables, pipes and the like are to be installed underneath afterwards. The tendency is therefore to use prefabricated concrete elements placed upon in situ prepared foundation layers.

Mainly two types of prefabricated concrete elements are presently used for pavement of operation areas:

- Prefabricated reinforced concrete slabs (for example 2x2m) with steel angles as borders have been introduced some 20 years ago. The slabs are between 14cm thick for normal use and 18cm thick in extremely loaded places. Although produced in mass in the factory, these elements are expensive because of the reinforcement and the steel border profiles they require. This is partly compensated by the advantage of easy and speedy placement. The foundation layers can be less thick than for small concrete elements as pavement.
- Small concrete blocks, 10x10x20 or 12x12x24cm. The blocks are placed in an ordinary brickwork pattern. The low tolerances of individual bricks allow compact placement of the surface without loosely placed elements in between. The water cement factor of the concrete mixture is kept very low and the bricks are vibrated vigorously during casting, resulting in a very dense product that can withstand the surface friction forces. The placing of the blocks has been highly mechanised over the years, resulting in a good pavement for a reasonable price. However, the block pavement need a good foundation.

In the Belgium sea ports as well as in other European ports, the standardised hard standing consists of concrete block pavement, placed on a fairly thick foundation layer. The blocks measure often 10x10x20cm. The block layer is placed on a foundation of some 40 to 50 cm thick. Several systems are used:
In the port of Gent (Belgium), the standard foundation is as follows:

- Pavement of concrete blocks, 10cm thick.
- Levelling layer, 3cm of coarse sand stabilised by 150 kg cement/m^3 of mixture.
- 20cm of lean concrete (120 to 150 kg cement/m^3 of mixture).
- 20cm of compacted gravel.

Sometimes the foundation layer is made by mixing the soil in situ with cement or chalk (depending on the type of soil).

A Dutch recommendation for road and yard areas in ports give two possible pavement systems.

a)

- Pavement of concrete blocks, 12cm thick.
- Levelling layer of coarse sand, 5cm.
- One layer of 30cm of sand stabilised with cement.

b)

- Un-reinforced concrete layer, 30cm thick.
- One layer of 30 to 40cm of sand stabilised with cement.

In Hamburg, the major cargo handling company has standardised its pavement system in the following way:

1) Surfaces for container stacking.

- A layer of 22cm of high resistant concrete, poured in situ (B35).
- A layer of 15cm of in place mixed with some 30kg of cement/m².

2) Traffic lanes

- 3cm of asphalt based surface 0/11.
- 4cm of asphalt based layer 0/18.
- A layer of 15cm lean concrete (B10).
- A layer of 15cm in situ mixed cement (B5 - B10).

Alternatively, the surfacing is made with a top layer of concrete blocks, as specified hereafter.

1) Surfaces for container stacking.

- A layer of concrete blocks of 10cm.
- Levelling layer, 3cm of coarse sand stabilised by 150 kg cement/m^3 of mixture.
- A layer of 30 cm of sand mixed with concrete.
- A layer of recycling material (broken stone, bricks or concrete) with variable thickness depending of the local circumstances.

2) Traffic lanes

- A layer of concrete blocks of 10cm.
- Levelling layer, 3cm of coarse sand stabilised by 150 kg cement/m^3 of mixture.
- A layer of 40 cm of sand mixed with concrete.
- A layer of recycling material (broken stone, bricks or concrete) with variable thickness depending of the local circumstances.

8.5.2 Proposed pavement system

Given the general purpose of the quay and apron area, the renewed surface should be able to resist container handling equipment. The same goes for the stacking area of containers. Hence, it is proposed to use a pavement system as specified hereafter.

- A layer of concrete blocks of 10cm.
- Levelling layer, 3cm of coarse sand stabilised by 100 kg cement/m^3 of mixture.
- A layer of 30 cm of lean concrete (120 to 150 kg cement/m^3 of mixture).
- If pockets of mud or soil with low resistance is encountered, they are to be replaced by thoroughly compacted sandy backfill.

In this system, the blocks can be recuperated when cable sewers etc. are to be installed later.

The new pavement is proposed to be installed on top of the existing one.

In the traffic area the reach stackers, heavy lift trucks and other heavy handling equipment are only coming occasionally. These areas can be paved with a regular, asphalt based system which is supposed to be cheaper in Baku area. The proposed system is as follows:

- A top layer of asphalt based surface 0/11, 3cm
- A layer of 4cm of asphalt layer 0/18
- A base of 15 cm of lean concrete (B10)

For the CFS warehouse and platform the same type of surfacing foreseen for the traffic areas is proposed. However, no foundation layer is needed.

The gate area can be surfaced as proposed hereafter.

- A layer of concrete blocks of 10cm.
- Levelling layer, 3cm of coarse sand stabilised by 100 kg cement/m^3 of mixture).
- A layer of 20 cm of lean concrete (120 to 150 kg cement/m^3 of mixture).
- If pockets of mud or soil with low resistance is encountered, they are to be replaced by thoroughly compacted sandy backfill.

8.5.3 Surface drainage of rain water

Given the growing consideration for environmental protection, the rain water should be collected and hydrocarbons and solids, contained in the runoff water should be extracted before discharging into the sea. The separation device can be a simple one as complete separation of solids and hydrocarbons is not needed. The collection of the run off water is to be foreseen in the areas with renewed pavement, except in the areas running off to the East side. The slopes detailed on Fig.10 and 11 are designed to allow easy collection of rain water along the borders of the pavement. The new pavements in the Eastern part are to be considered provisional until the complete renovation and possible extension of the Eastern half of the main complex is materialised (reference is made to the long term planning discussed in the phase II report).

8.6 Electrical installation

8.6.1 Present Situation

High Voltage

The port gets its electrical supply from the city net sub station nr.220, North of the Nobel street fly over located near the main administrative port building.. Two feeders are coming from this sub station to sub station nr4 in the port. 1 comes directly from station nr220 to the port (3X185 mm2). The other feeder comes from sub station nr275 located in a building complex of the Caspian Shipping Co., just North of the access rail track to the ferry terminal and at the Western side of the access road to the ferry terminal (3X185 mm2). This sub station nr275 is fed from station 220. Of both feeders one is used while the other is kept for security as failure have proven to happen in the past. It is understood that both feeder lines are owned by the port.

Voltage is 6kV. The cables are reported to be in bad condition and have been repaired several times. The main high voltage switch gear is situated in the building of the operation centre (station N°. 4).
From this switch gear, current is supplied (high voltage) to a city client (before metering) and to the installations of the port and of the Caspian Shipping Company consisting i.e.:

- high voltage substation N° 7(located at the end of the main complex)(1X800kVA)

- high voltage substation N° 2(located halfway the main complex).(1X640kVA)
- the calculation centre (Caspian Shipping Company)
- the transformers of station N° 4 (2X560kVA, 1X300kVA)

Station N° 4 contains 3 transformers 6kV/380V :

- 300 kVA : in use
- 560 kVA : in use
- 560 kVA : spare

Substation N° 2 contains 1 transformer of 640 kVA and is used mainly to supply the port cranes.
Substation N° 7 contains 1 transformer of 800 kVA and is used mainly to supply the port cranes.

Although the installations are in working order, the material is old and not complying to nowadays standards. It is impossible to make changes to the configuration of the existing switch gear.

The transformers are oil filled types and can be re-used. The control of the dielectric oil takes place every year (dicit chief electrician of the port).

It is recommended that the main high voltage switch gear is rebuilt (existing transformers can be reused). The location should be in the neighbourhood of the existing switch gear, because the transformers are situated there. It is equally recommended to renew the high tension cables situated in the harbour area and of the feeder cable coming from substation nr.220

.

One transformer of 560kVA in station N° 4 will be used to supply the utilities of the port.
The other transformer of 560kVA will be used to supply the building equipment of all the buildings in the port (except workshops).
The transformer of 300kVA will be used to supply the workshops.

Substations 2 and 7 which are in the operation area of the main complex will be taken out.
The transformers that are now in substations 2 (640kVA) and 7 (800kVA) will be placed in station N° 4.

The calculation centre will be supplied by high voltage as it is now. Metering has to be installed (by preference in the building itself). The general protection of the high voltage installation of the calculation building should be checked and adapted if necessary.

Low 'Voltage

The low voltage distribution net seems to have grown over the years, hence it is not well structured. There is no reliable protection for the installations. Therefore a new low voltage distribution panel has to be constructed in station N° 4 to connect the installations with proper protection. Because there is enough room in the present station N° 4, the main distribution panel (low voltage) can be located here, as close to the transformers as possible.

All of the existing installations :e.g. the power supply of the cranes etc. have to be replaced. The existing installations in the buildings can be left as they are. A proper protection has to be installed at the level of the in coming supply cable. However, if the buildings are renovated, it is recommendable to adapt the electrical installations as well.

Protective earth has to be replaced. It is recommendable in this situation that the high voltage earth and the low voltage distribution earth are insulated from each other.

All of the connections (supply cables) of the harbour cranes should be replaced (50m rubber cable 4x120 mm2 per crane). The cable drums of the cranes should be repaired (part of crane rehabilitation program). For easy harbour operation, and for limiting the damage to the crane supply cables during operation, supply of the cranes should be installed on their waterside. However care should be taken that the cable drums are placed at least 2m out of the waterfront in order to prevent collisions with berthing ships.

8.6.2. Electrical Installation New Situation

High Voltage (See schematic)

The direct high voltage feeder cable from station nr220 to the port area should be renewed as it is old and has been repaired several times and has become unreliable. An extra 2000kVA of power supply will be required when the projected four gantry cranes will be installed and operational. The new feeder cable should have sufficient capacity for this future development. It is reported that the voltage of the electricity supply can not be higher than the present 6000Volts. The schematic does not jet take into consideration this future demand.

Construction of a new main high voltage main switch gear is indicated. The switch gear can be of the open kind, using power switches of the reduced oil volume type, or the gas-filled type. Sufficient extra cells are to be foreseen for future requirements. The renewed switch gear and adjacent transformers are planned to be installed in the present sub station nr.4.

The power needed for the existing equipment can be supplied by the existing transformers. However, their capacity is not sufficient to supply the new gantries (two of 600KVA and two of 300 KVA each to be installed at different periods, when the container cargo has reached certain levels). For that raison, two new transformers, 1000kVA each are planned and should be installed when needed.

Low Voltage

Power Distribution

The low voltage schematics joint to this design report describe only the power distribution to the present facilities, hence the immediate needed investment. The description hereafter treats this immediate investment programme. The distribution system for the gantries has to be designed when details of the electrical system of the cranes to be purchased are available.

In order to get an economic, risk free and reliable power distribution, the net should be of the type with grounded Neutral. Using this type of net, we can limit the number of earth-leak switches to install.

The main distribution panel should be situated nearby the transformers. Protection by use of power switches instead of fuses is proposed. In case of failure or short circuit, a power switch just has to be turned on again. When a fuse blows, it has to be replaced, which can create spare parts problems.

Existing Buildings

The existing buildings will have to get a new supply from the main distribution panel.
It is recommendable to replace the present underground supply cables.

Because infrastructure will change, roads and pavements will be constructed etc., the underground cables pipes and sewers should be brought in a good and reliable condition beforehand.
The new supply cables can be connected to the existing installations in the buildings without making changes to the distribution system in the buildings themselves.
Between the new in coming supply cable and the existing distribution system, a new reliable protection device has to be installed.

Buildings to be adapted

Some buildings have to be adapted due to a change of function.
A complete review of the electrical installation in these buildings is necessary.
A layout of these buildings is not available as yet.

Port Equipment

A. Exterior Lightning

The lighting of the container terminal and the driveways should have :

- illumination level of 30-50 lux for normal operation light.
- illumination level of 5-10 lux for security (port inoperative).
-

As light source, sodium high pressure is recommendable because of the efficiency and the power consumption.
The loading, unloading and stacking area can be illuminated by 4 light towers with a height of 25m to 30m. The distance between the towers is approximately 100m.
The driveways can be illuminated by light poles with a height of 6m, each of them equipped with 1 light fixture of 125W. The distance between the poles is approximately 30m.

B. Crane Power Supply

The power supply of the cranes has to be designed not to exceed a voltage drop of 5% at full load. Therefore the best solution is to install different circuits along the renovated quay. The used material should be water-tight and protected against intrusion of dust.
As the cranes are momentarily supplied by a transformer of 8OOkVA (1200A), and a transformer of 640kVA (1000A) these same transformers will again be used to supply electricity to the cranes through different low voltage circuits.
Each crane can be connected through a switch panel with protection switch. The switch panels should be either inside pits, covered by a device that can support the payload of the zone they are placed in. In this way the operation area will be free of obstacles.

C. Supply for Refrigeratin Containers

Only the standard connection is provided.
A zone on the container yard will be reserved for this purpose.
The number of power points needs still to be decided upon.
- standard net 380V 3P+N+PE 50Hz 32 A

D. Supply for Gate Cabins

Every gate cabin (total of 7) needs a connection mono phase 220V-20A to connect lighting, utility, heating and conditioner.
Connection can be made immediately to the switch panel in the gate building.

E. Supply for Maintenance

Throughout operation yard and area of warehouses (places yet to determine) there will be placed maintenance switch panels containing :

- 2 power point 2P+PE 16A
- 1 power point 3P+N+PE 32A
-

The switch panel to supply them can be put in one of the warehouses (4 or 5) which are in the middle of operation area (in order to keep cables short).

Workshop Building

This new building will be situated in the open area North of the present entrance gate.
Supply will be taken from the 300kVA transformer in station nr 4.
The internal power distribution of the workshop, as well as lighting etc. will be designed according to the needs when the finalised layout is available

8.6.3 Power Generator

In order to be able to have the fire pump working, even if electric power has dropped, a generator has to be installed.

This can be in substation N° 4, and near to the fire pump.
The generator will be of the standby-type an will have a capacity of approximately 50 to 70 kVA.
The generator can also be used to supply electric power to the operation building in case of city power failure. This than allows to save data, and even keep working, only using a small UPS (additional to the generator) to cover the time the generator starts on power drop. (app. 30 sec.)

8.7 Water distribution

8.7.1 Present Situation

The present water supply to the quays and to the buildings is made in steel pipes. The pipes are rusty and in many cases the valves are leaking.
Also in many cases the valves are not well placed, regarding the new layout of the main operation area.

8.7.2 New Situation

A new line will be placed from the main city tap point to all the existing buildings on the main operation area. The material will consist of poly-ethylene, resisting to a pressure of 10BAR. This material can be provided on drums, so it is possible to pull it into pipes. This type of material is free of oxidation and can be used for drinking water supply. Tap points will be made with the same type of connections as placed on the present water circuit.

The circuit will be a 70 mm pipe, with connection of 50mm.
Each tap point will consist of a valve and a standardised tap connection.
The existing buildings will get a new connection through an anti-reverse device and an valve, but the installations in the buildings will be untouched.
Same as for the electrical installations, buildings that are renovated should also get an new water distribution net that is free of corrosion, and new valves to get it reliable and maintenance free.
Along the quays, there will be put a tap point every 50m. The tap point will be put in a pit with a cover complying to the payload of the zone it is put in. So there will be no obstacles in the main operation area.

Warehouses will get one connection of 50mm each. In these warehouses that already are provided with water in the present situation, the present installation will be connected through a anti-reverse device and a valve.

The anti-reverse device is used to prevent stagnating (unused, dead) water to come into the fresh water circuit and so spoil it. (stagnating water fosters bacteria growth very easily).
The installation also will have devices preventing damage by water hammer. They will be next to the principal tap and along the circuit at some of the tap points according to the calculation of the final design.

8.8 Fire combat

8.8.1 Present Situation

The present fire combat system mainly consists of extinguishers an sand reserve on the main operation area. Also the existing water taps can be used to put out a fire.
This is not enough capacity to put out a fire on a ship, or cargo burning (e.g. a stack of containers).

8.8.2 New Situation

A fire combat net will be constructed that provides taps near to the light towers (4 pieces.) Main connection will be 100mm so that 4 fire hoses of 50mm can be put at work at each tap point.
The distance between the connection points (taps) is about 100m.
Therefore, also a number of fire hoses will have to be provided.

In order to supply sufficient water to the fire combat net, a motor pump will be put in place.
Capacity of the pump has to be 50m3/hour (pressure is 7BAR). The pump always keeps the net under pressure. When a tap is opened, pressure drops and the pump starts.
The power (electrical) to the pump is supplied by the electrical net, or when the net dies, it is supplied by the standby generator (see section 5 : electricity).
The water used is sea water.

The pump has to be mounted as close to the water as possible.
There also has to be checked with the local authorities what demands are specified for the harbour (e.g. smoke detectors, sprinkling, mobile fire combat equipment etc.).

8.9 Sewage

8.9.1 Present Situation

Along the quays there are no sewage points to take the waste water of ships.
The sewage circuit of the buildings connects to the city net, from where the water is transported to an existing pump station.
The circuit functions but has to be cleaned very often.

8.9.2 New Situation

The sewage connection to the buildings should be replaced before the infrastructure is changed. Mainly bigger pipes have to be used, to prevent blocking.
Connection to the city net can be made at the central collector nearby the entrance gate of the harbour.
Material will be PVC or concrete ducts, taking care that the joints are tight.
Inspection chambers will be made were necessary.

8.10 Reefer zone - Dangerous goods zone

8.10.1 Reefer zone

10 places have to be foreseen for reefer containers. On Fig.4 the proposed location of this reefer zone is indicated. It is arranged in such a way that handling can be done with a reach stacker or a big lift truck. The zone is located near the sub station nr4. The installation consist of two consoles, placed on from the surface and correctly protected against damage of circulating vehicles. Each console is fit with 5 connection plugs. The reefer containers are connected with the console with connection cables.

8.10.2 Dangerous goods

Dangerous goods in containers

These containers are grouped in a special area in the stack. If the containers are in good shape, no further measures are to be taken.

However, if a container is leaking or danger of spilling occurs by other reason, it should be separated from the stack and leaking or spilling cargo should be collected. There is no need for a fixed facility to deal with problematic containers. A mobile trailer adapted for this purpose is sufficient. The trailer should have a collecting basin that is big enough to contain the volume of a full tanker container.
The leaked cargo can than be treated as needed.

Conventional dangerous goods

It is not expected that bulk cargoes, categorised as dangerous goods will be handled in the port in the next future. However, if such cargoes are handled or stored, special measures will be indicated (for example dust prevention).

Other cargoes, categorised as dangerous goods (on pallets or in drums), should be placed in a separate area in the warehouse, where fire fighting equipment is nearby.

It can be concluded that no special civil works are needed for the time in the first stage development to cope with dangerous goods except the fire fighting facilities discussed in 10.8.

8.11 Adapt an existing building for container operation centre

The operation centre for container operation can be housed in the operation centre located in the main complex (see Fig.4). No special civil works are needed for this purpose. However, some refurbishing of presently unused offices will be needed.

8.12 Re installation of crane rails and rail tracks

8.12.1 On the quay

As indicated on Fig.7, the crane rails on the quay are foreseen to be placed directly on the concrete of the quay plate. The rails are foreseen to be placed on a rubber strip and fixed by special clips, fixed to the concrete by cast in anchor bolds. The present rails can be reused, be it that some straitening of rails will be needed.

It is anticipated that the rail tracks are replaced on the backfill foreseen on top of the quay plate. The present sleepers are in bad condition and should be replaced by the standard concrete sleepers for railways. The rails can be reused, be it that some straitening of rails will be needed. As the renovated quay will be moved 8m to the sea in relation to the present situation, the access lines will have to be replaced over the distance indicated on Fig.4 (darker lines).

8.12.2 in the yard

It is foreseen to remove the second line of rail tracks and crane rails (see Fig.4). The middle bundle of tracks (third line) on the main complex need to be replaced at a higher level in order to be at the same level as the surrounding pavement. The present sleepers are in bad condition and should be replaced by the standard concrete for railways. The rails can be reused, be it that some straitening of rails will be needed.

8.13 Gate complex flood light system, drainage, fencing

8.13.1 General

The layout of the entry gate complex is detailed on Fig. 4. It also indicates the borders of the area and the present constructions that need to be removed. The gate consists of two parts. The Eastern part is the parking facility for trucks during pre-clearing. The Western part is foreseen for the car park, office building and entrance gates.

The parking areas and the office building are accessible from the street and are as such not part of the future free port zone. The West facade of the office building and gate form the limit of this free zone area. The West facade of the building should not have doors to the outside so that all entering and outgoing persons and vehicles to and from the free port zone have to pass the gate control. This includes trucks of the catering services of the Caspian Shipping Company and all personnel of the Port. The present office building of the workshops will be used as gate office in the future.

The gate consists of three entrances for normal trucks and cars and one entrance for oversized trucks.

The truck entrances are separated one from another by islands, raised some 40cm above the road level, thus forcing the trucks into the gate lane. When not functioning, a gate lane can be fenced. The watchmen and gate officers have office/shelters (2x3m) at both sides of the intermediate islands, on the left-hand side of the incoming and of the outgoing trucks. The offices/shelters have a sash-window at the level of the truck cabin window. The floor level inside the offices/shelters are raised to the adequate level as to allow the sitting officer to communicate easily with the truck drivers.

Stairs on each platform lead to a gangway for inspection of the top of the trucks and of the containers. The gangway spans over the normal tree truck lanes. Over the lane for oversized trucks no gangway is foreseen as the high can be as well oversized This gangway can also be used to fix mirrors or cameras on it, allowing inspection of the top from the ground level. The gangway and suspended equipment should leave a free height of 5.5m above the lanes. The three normal truck lanes are covered by a roof avers weather conditions and for shade in the summer.

The pavement system is described in §8.5.

8.13.2 Drainage

The area has been given slopes that correspond with the present levels. Rain water runs off to the South East extremity of the gate area, where it is collected in the drainage system of the renovated ferry terminal.

8.13.3 Lighting

The parking area will be equipped with two towers for flood lights, similar to those foreseen for the operation area. The gate itself will be equipped with a local lighting system, allowing operation at night.

8.14 Gate complex building - adapt an existing building

The present office building of the workshops is located next to the gate and can be used as gate office. The building has two floors and measures some 10x20m. Some renovation works inside the building will be needed, but the structure itself does not need major repairs.

8.15 Workshops

The workshops North of the parking area of the gate area will also be used in the future. However, new equipment will be brought in and installed. This will implement smaller works inside the workshops. As the office building will be freed for the gate office purposes, some office facilities will have to be foreseen in the workshop complex, involving minor works.

8.16 Budget estimate

Bill of Quantities and Budget Estimate for Baku Sea Port Master Plan, phase one development, Civil Works

nr.	Item	Type	Amount	Un. pr. (USD)	Total (USD)
A	**Phase I Development** **Main Harbour Location**				
1	Renovation of West Quays	m	405.00	15,000	6,075,000
2	Adapt South Quay as shore protection	m	206.00	7,500	1,545,000
3	Foundation of stack gantries	m	720.00	750	540,000
4	Foundation of railway gantries	m	612.00	750	459,000
5	Adapt Warehouse nr. 5 as CFS	F. C.	1.00	100,000	100,000
6	Surfacing of apron and yard	m2	48,329.00	40	1,933,160
7	Surfacing of traffic areas	m2	14,233.00	25	355,825
8	Surfacing of gate area	m2	5,891.00	30	176,730
9	Renovation of electrical installation	F. C.	1.00	1,200,000	1,200,000
10	Data distribution lines	F. C.	1.00	80,000	80,000
11	New water dist. for West quay and buildings	F. C.	1.00	65,000	65,000
12	Fire fighting system	F. C.	1.00	70,000	70,000
13	General drainage of the port area	F. C.	1.00	100,000	100,000
14	Adapt existing building for cont. operation	F.C.	1.00	50,000	50,000
15	Reinstall rail tracks	m track	1,130.00	70	79,100
16	Entrance gate, office building	F. C.	1.00	10,000	10,000
17	Entrance gate, gate complex	m2	540.00	150	81,000
18	Entrance gate, lighting and drainage	F. C.	1.00	80,000	80,000
19	Workshop - Civil works	F. C.	1.00	10,000	10,000
	total				13,009,815
20	Unforeseen at this stage	%	10.00	13,009,815	1,300,982
	Grand Total Phase I Development				**14,310,797**

Figures and Annexes

Figure Section 1

Figure Section 2

Annex 1: Topographical Survey

Annex 2: Basic Building Solutions

Annex 3: Electricity Supply

Figure Section 1:

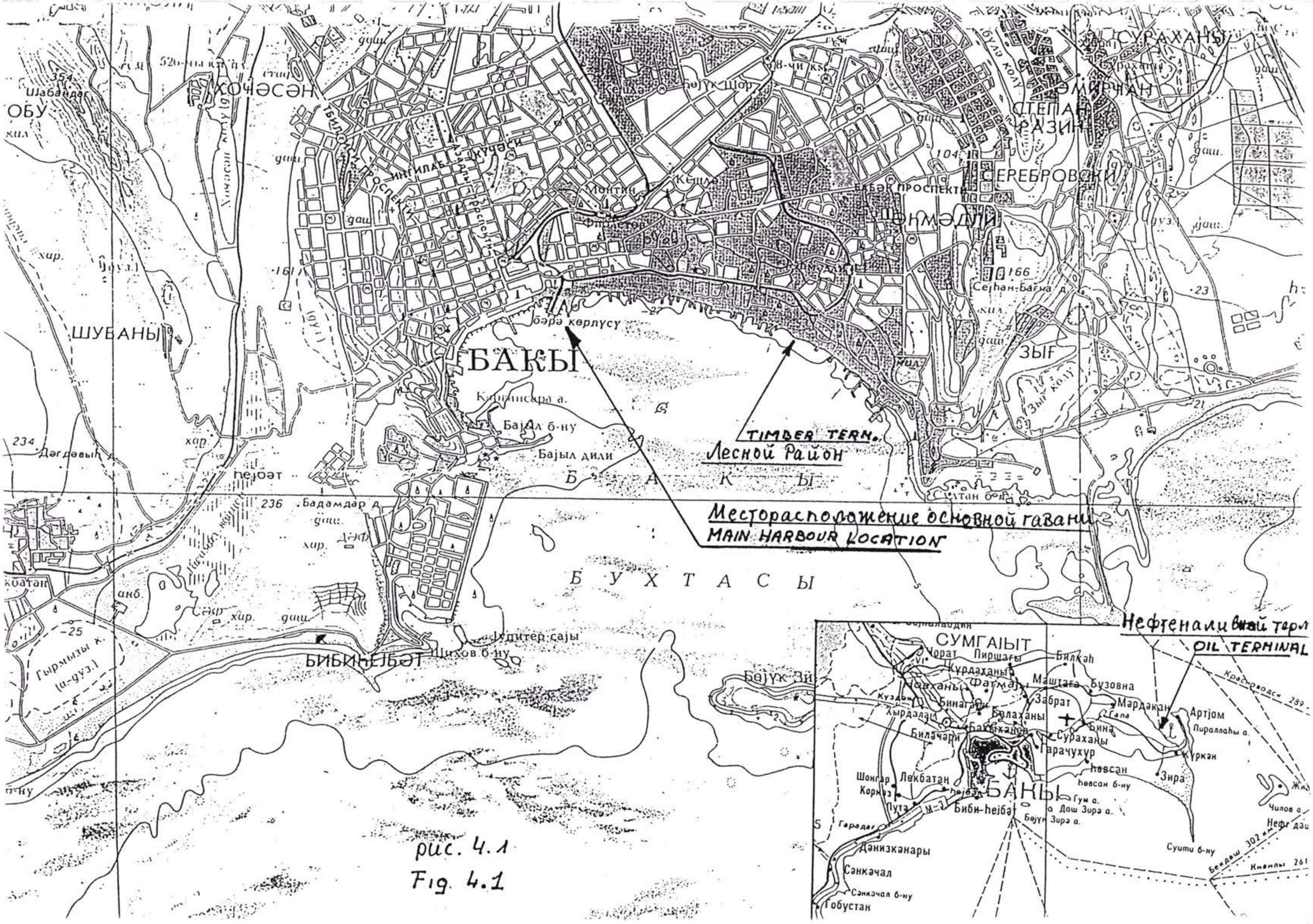

БАКЫ
Б А К Ы
Б У Х Т А С Ы
TIMBER TERM.
Лесной Район
Месторасположение основной гавани
MAIN HARBOUR LOCATION
Нефтеналивной терм
OIL TERMINAL
ХОЧӘСӘН
ШУБАНЫ
БИБИҺЕЈБӘТ
СУРАХАНЫ
ӘМИРҸАН
СТЕПАН РАЗИН
СЕРЕБРОВСКИ
ӘҺМӘДЛИ
ЗЫҒ
ИНГИЛАБ КҮЧӘСИ
БАБӘК ПРОСПЕКТИ
Бајыл дили
Бадамдар
Шабандар
ОБУ
СУМГАІЫТ
Пиршағы
Билкәһ
Маштаға
Бузовна
Мәрдәкан
Артјом
Забрат
Балаханы
Сураханы
Бина
Гарачухур
Һөвсән
Зира
Күркән
Хырдалан
Билачәри
Бинагади
Лөкбатан
Шонгар
Кормәз
Пута
Биби-Һејбәт
Гарадаг
Данизканары
Санкачал
Гобустан
Суити б-ну
Красноводск 289

рис. 4.1
Fig. 4.1

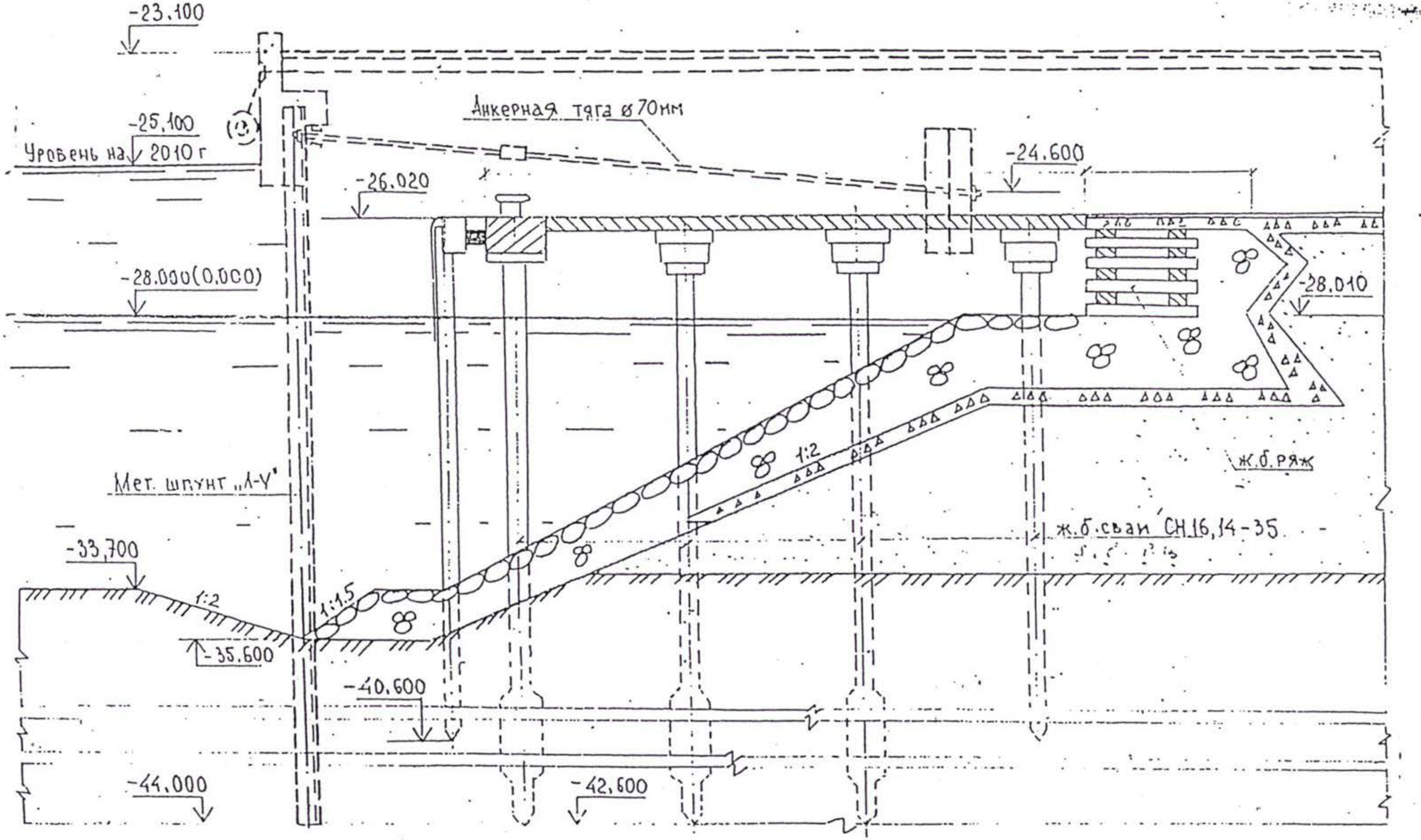


Рис. 4.3 Платформы у морского вокзала

Fig 4.3 PLATFORMS NEAR SEA STATION

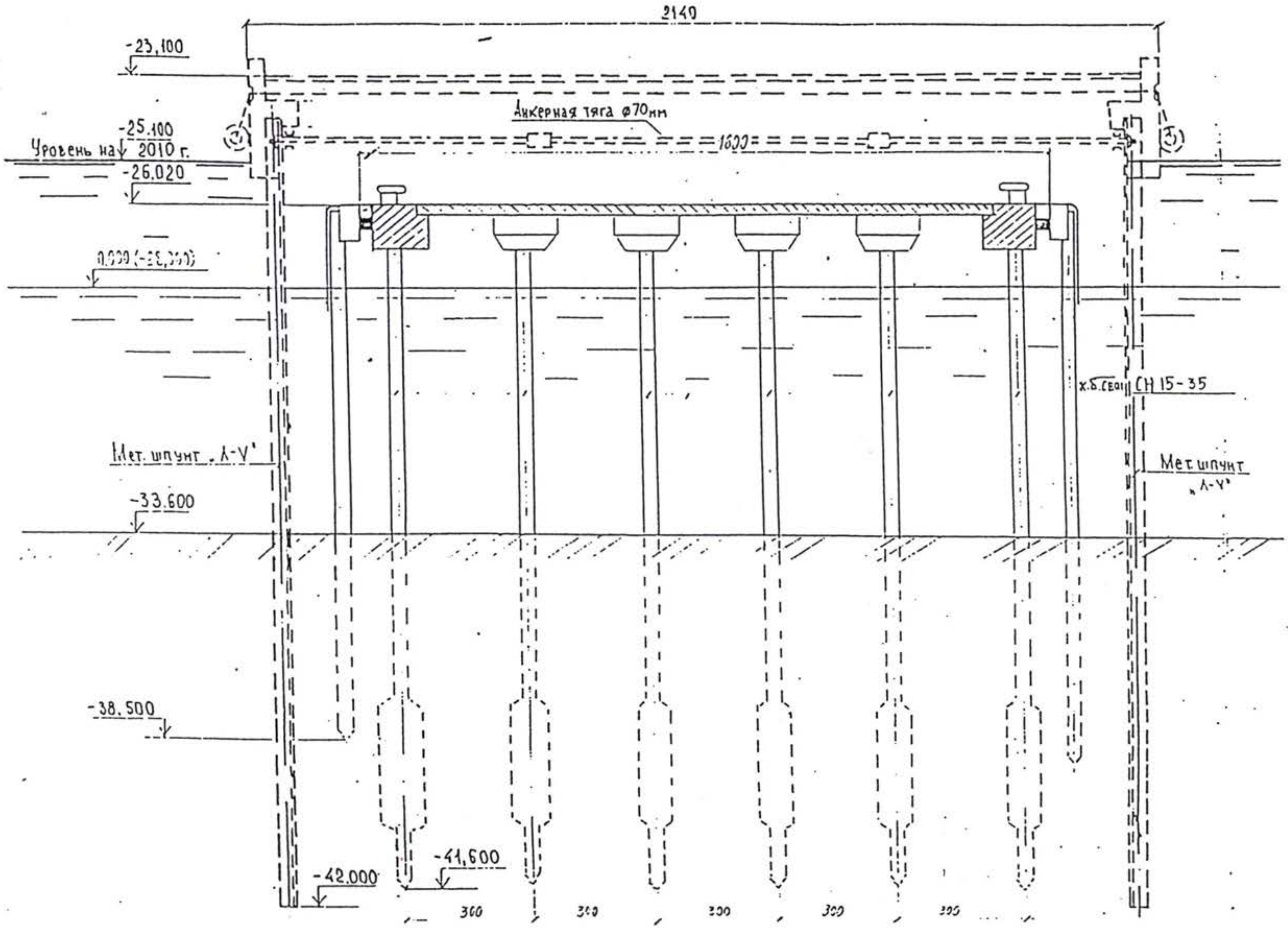


Рис. 4.4 Пассажирский пирс

Fig 4.4 PASSENGERS PIER

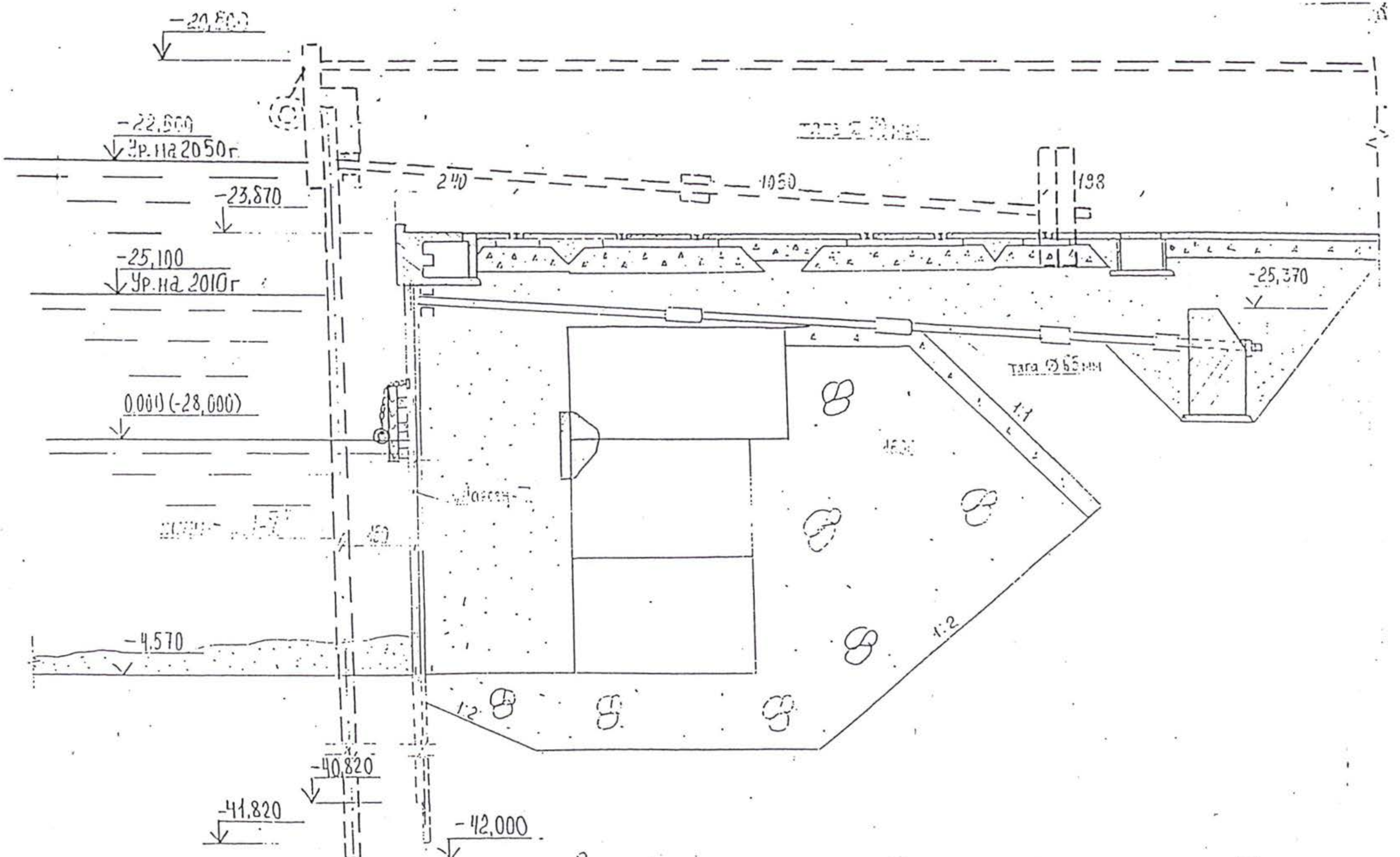


Рис. 4.5 Основной комплекс Западный и Южный Причалы

Fig 4.5 MAIN COMPLEX WESTERN AND SOUTHERN QUAYS

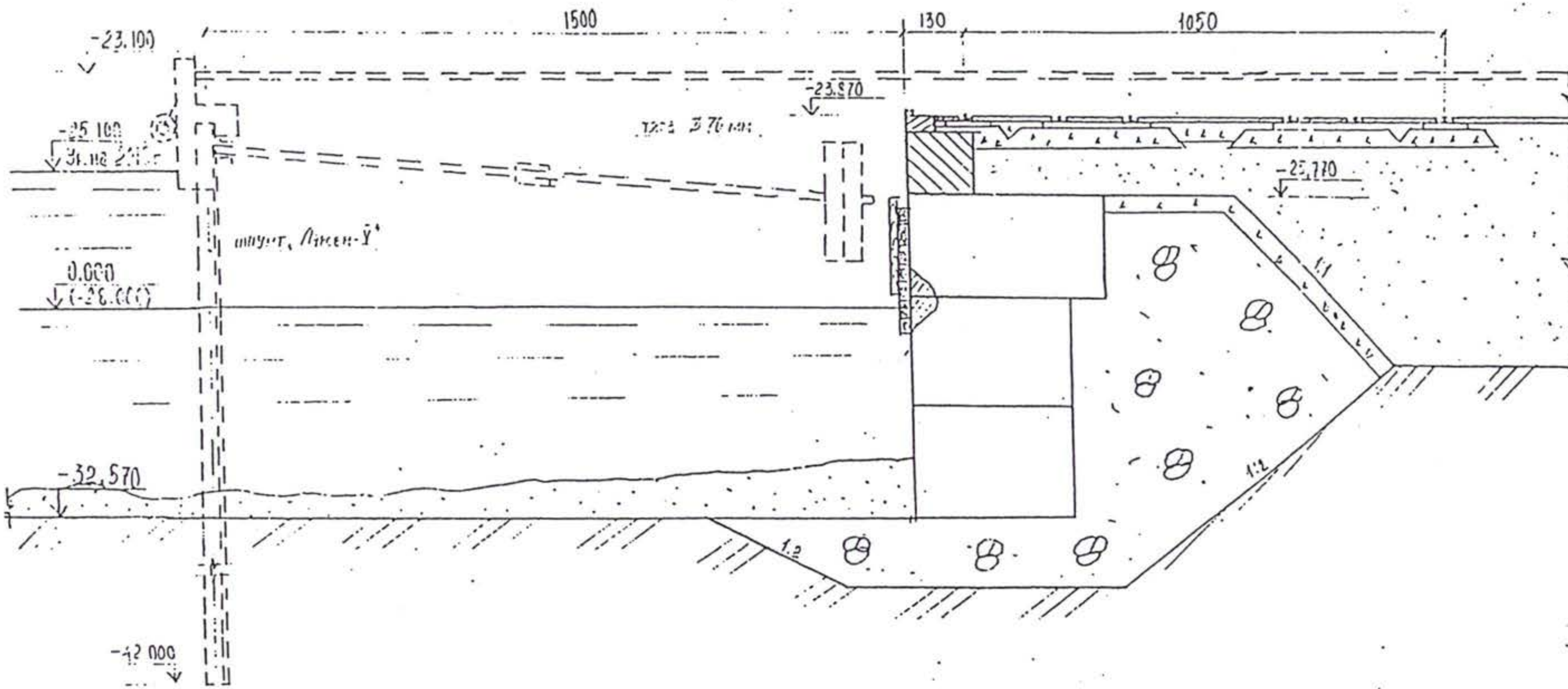


Рис. 4.8 Основной комплекс, Восточный причал

Fig 4.8 MAIN COMPLEX EASTERN QUAY

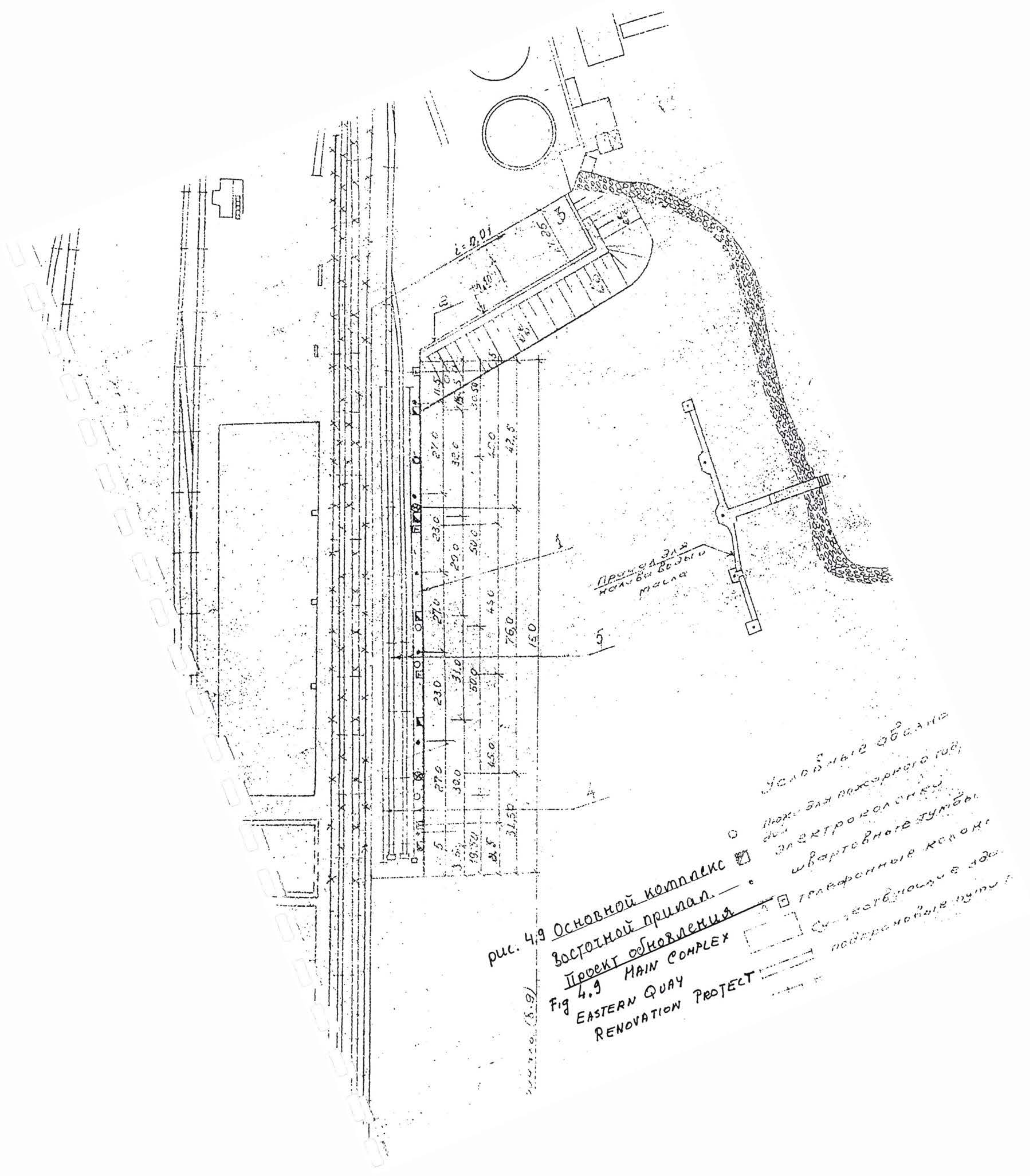


рис. 4.9 Основной комплекс Восточный причал. Проект обновления

Fig 4.9 Main Complex Eastern Quay Renovation Project

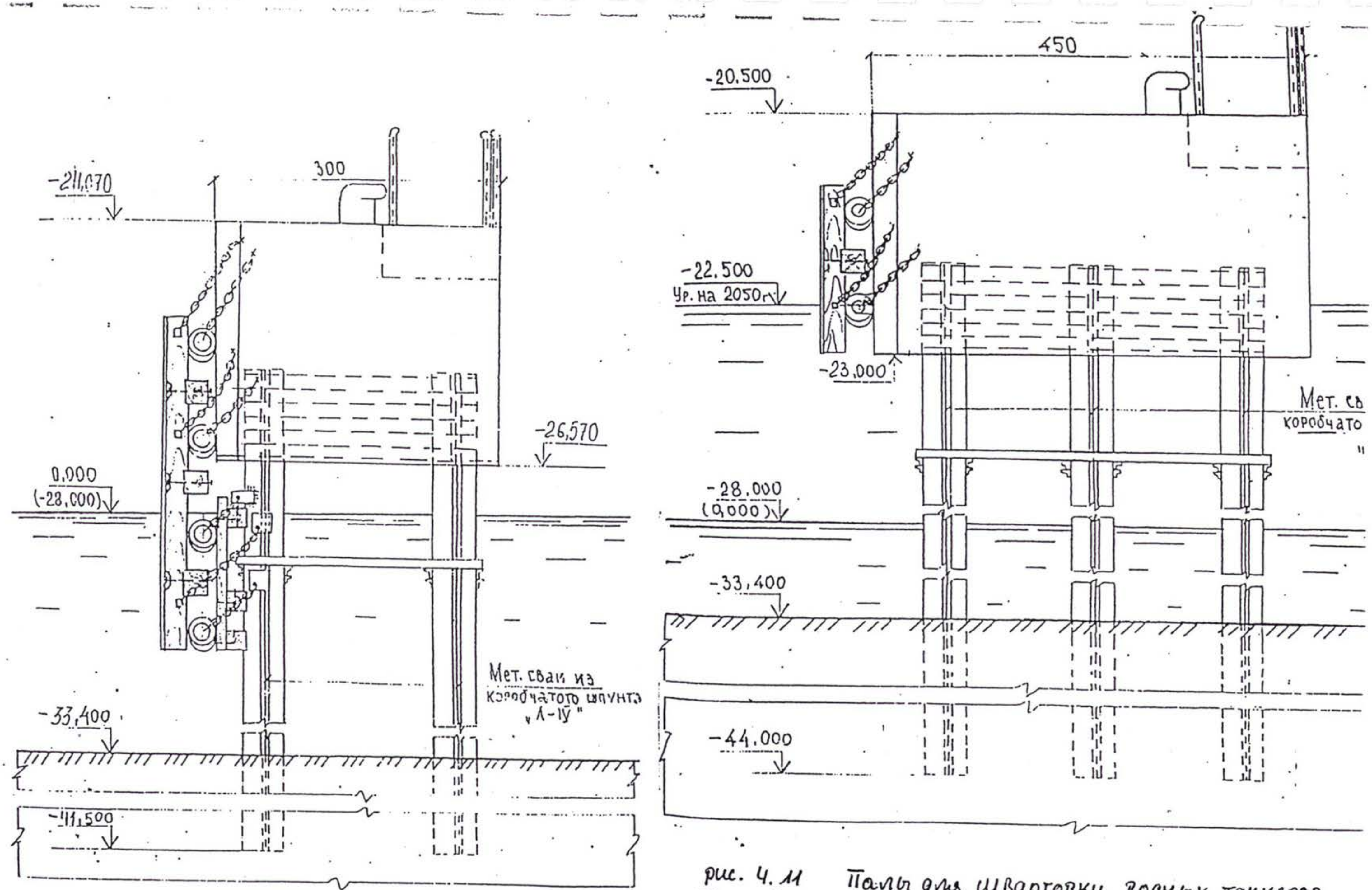


рис. 4.11 Палы для швартовки водных танкеров
Fig 4.11 MOORING BLOCKS FOR WATER TANKERS

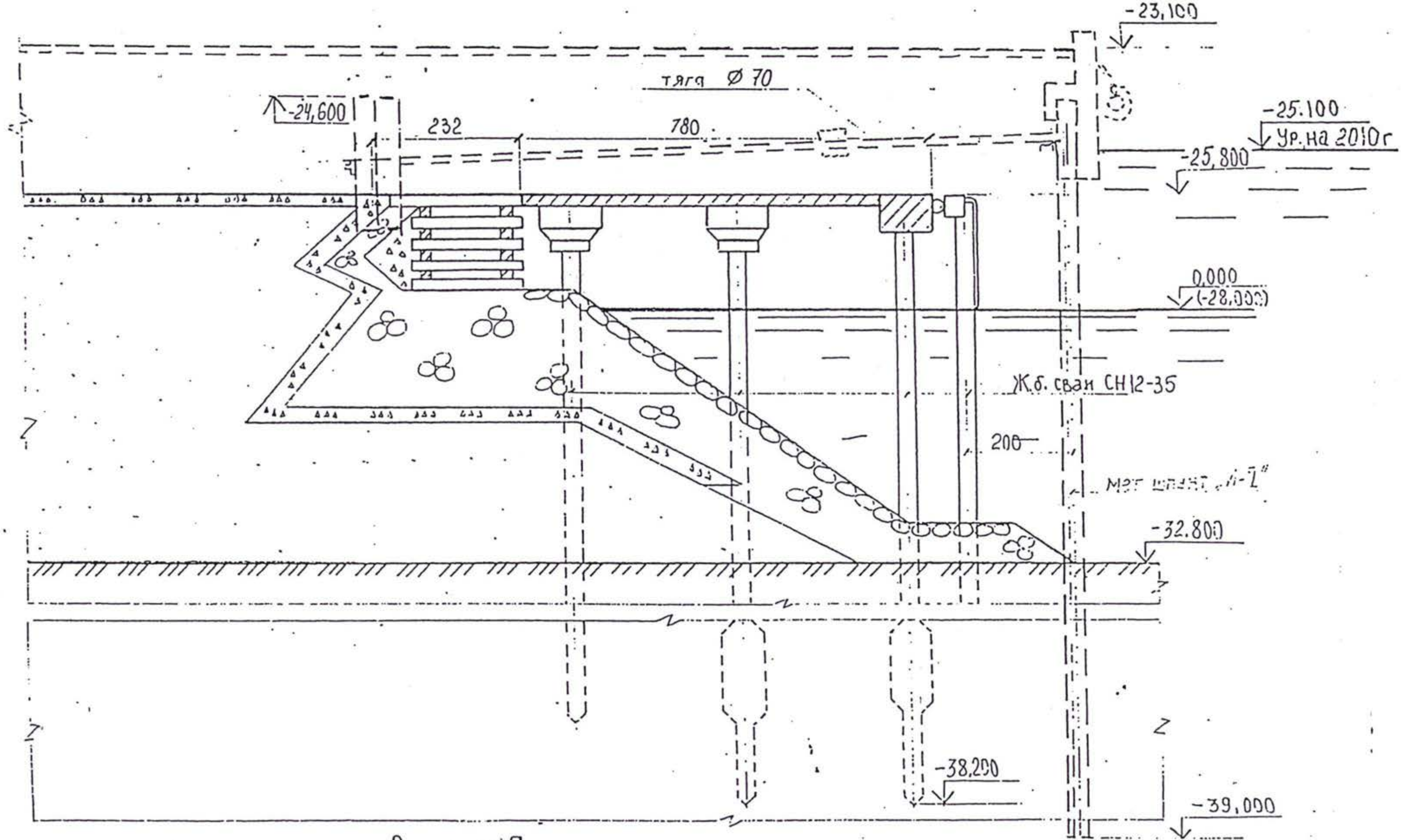


Рис. 4.12 Причал портофлота

Fig 4.12 QUAY FOR PORT FLEET

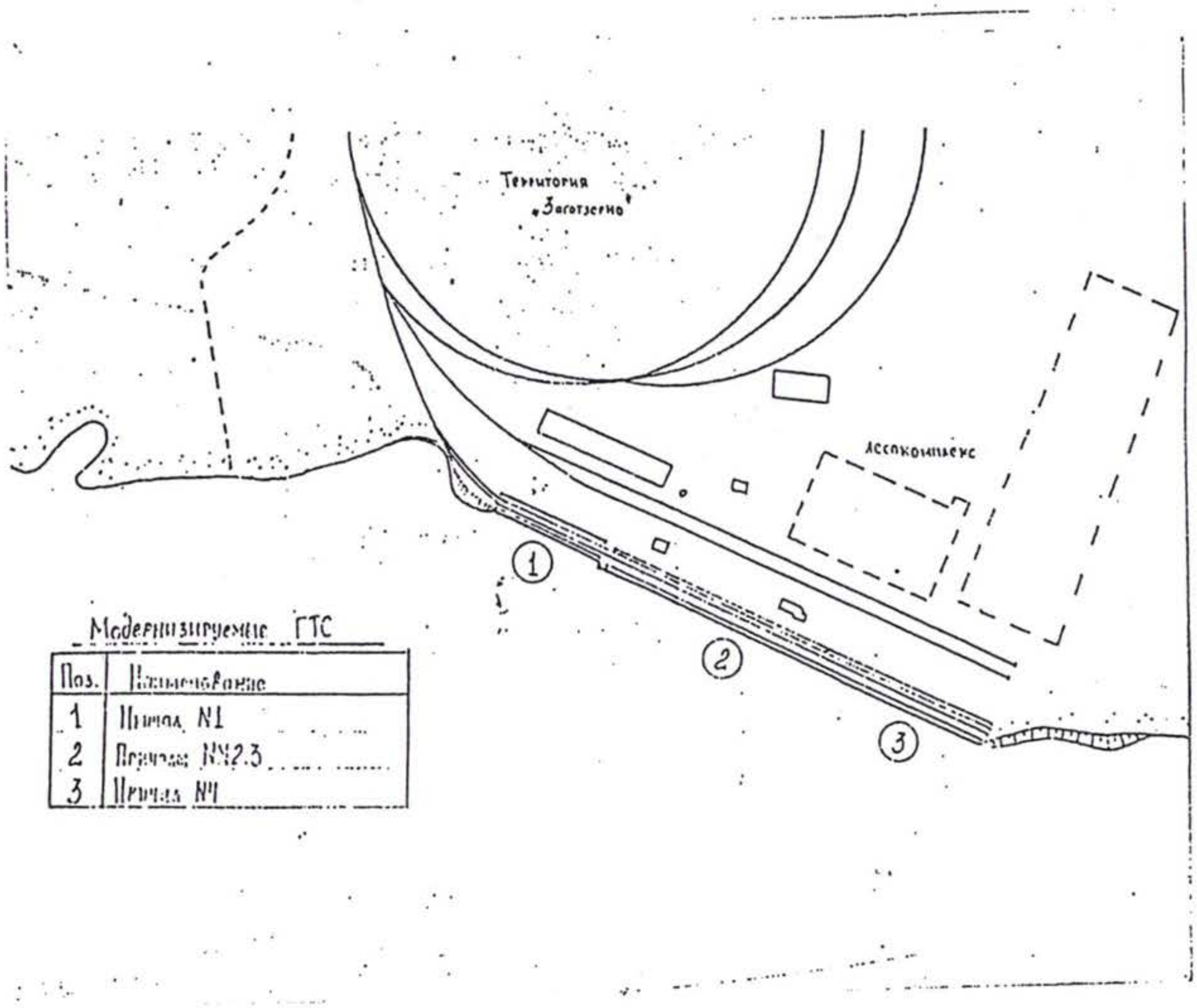


рис. 4.13 Лесной участок.
Fig. 4.13 TIMBER TERMINAL

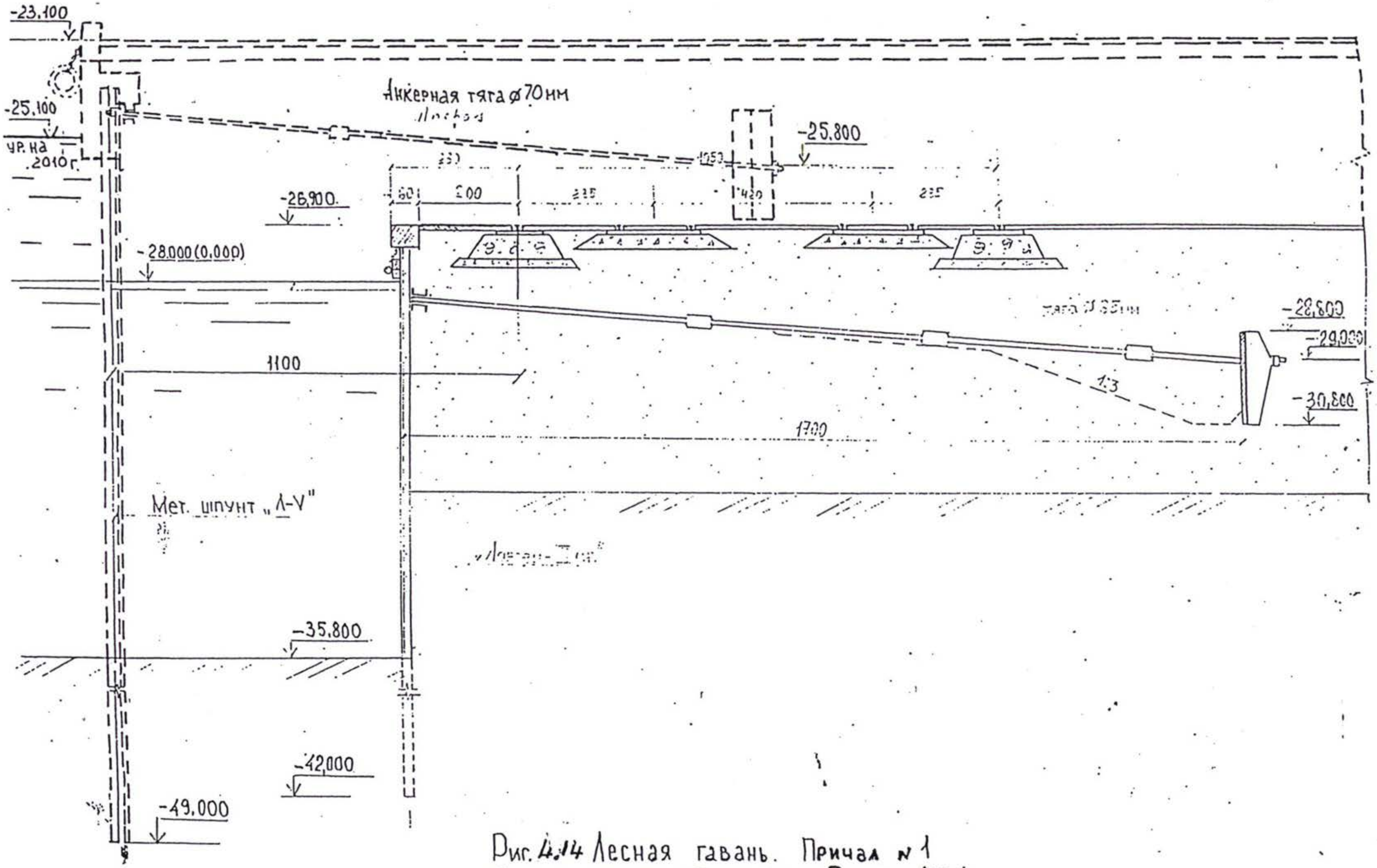


Рис. 4.14 Лесная гавань. Причал № 1
Fig 4.14 TIMBER TERMINAL BERTH NR 1

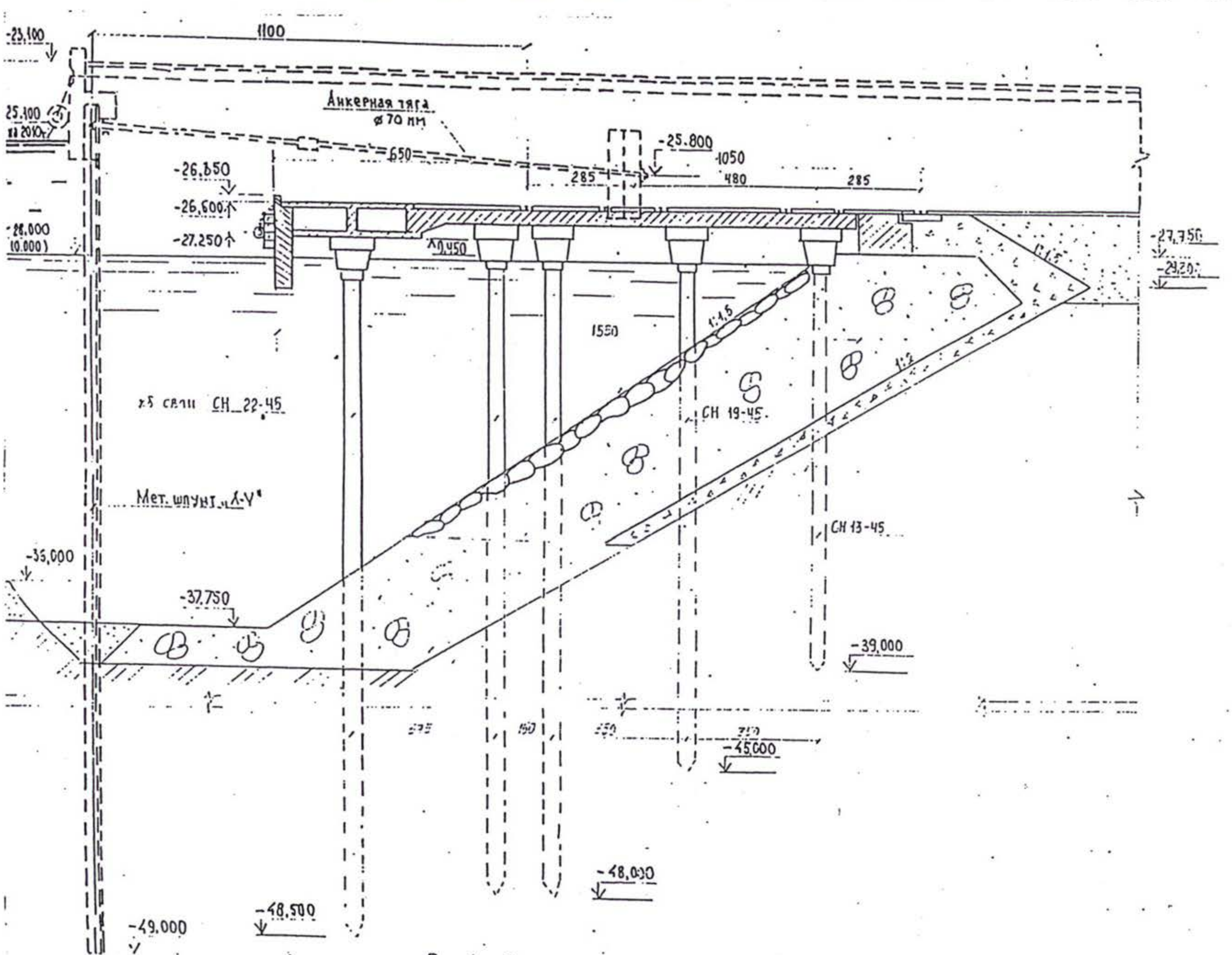
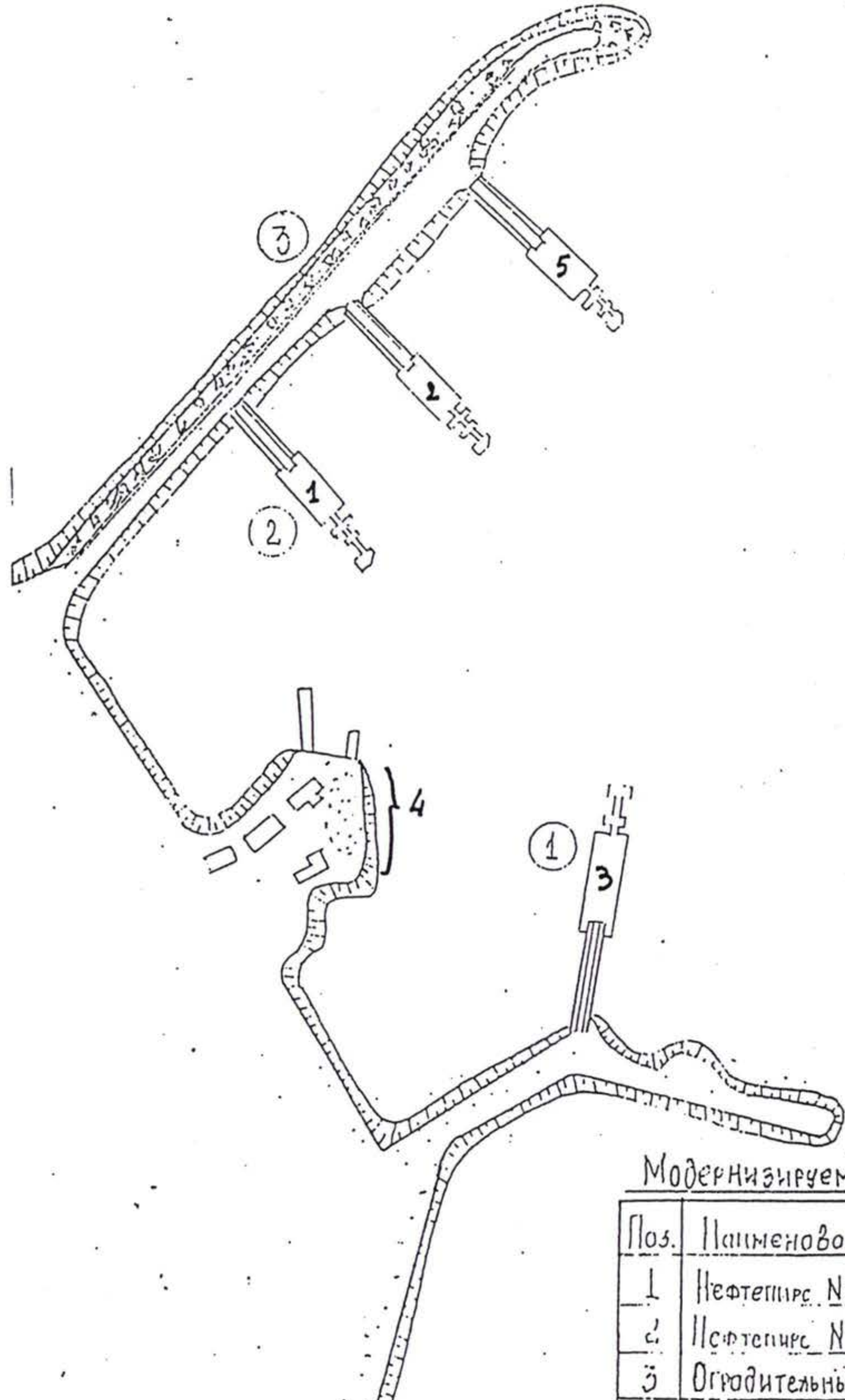


Рис. 4.15 Лесная гавань. Причалы № 2, 3

Fig 4.15 TIMBER TERMINAL BERTHS 2 and 3



Модернизируемые ГТС

Поз.	Наименование
1	Нефтепирс N3
2	Нефтепирс N1
3	Оградительный мол
	"

Fig. 4.16 Oil Terminal Area 1/2000

Рис. 4.16 П/о Апшерон. М 1:2000

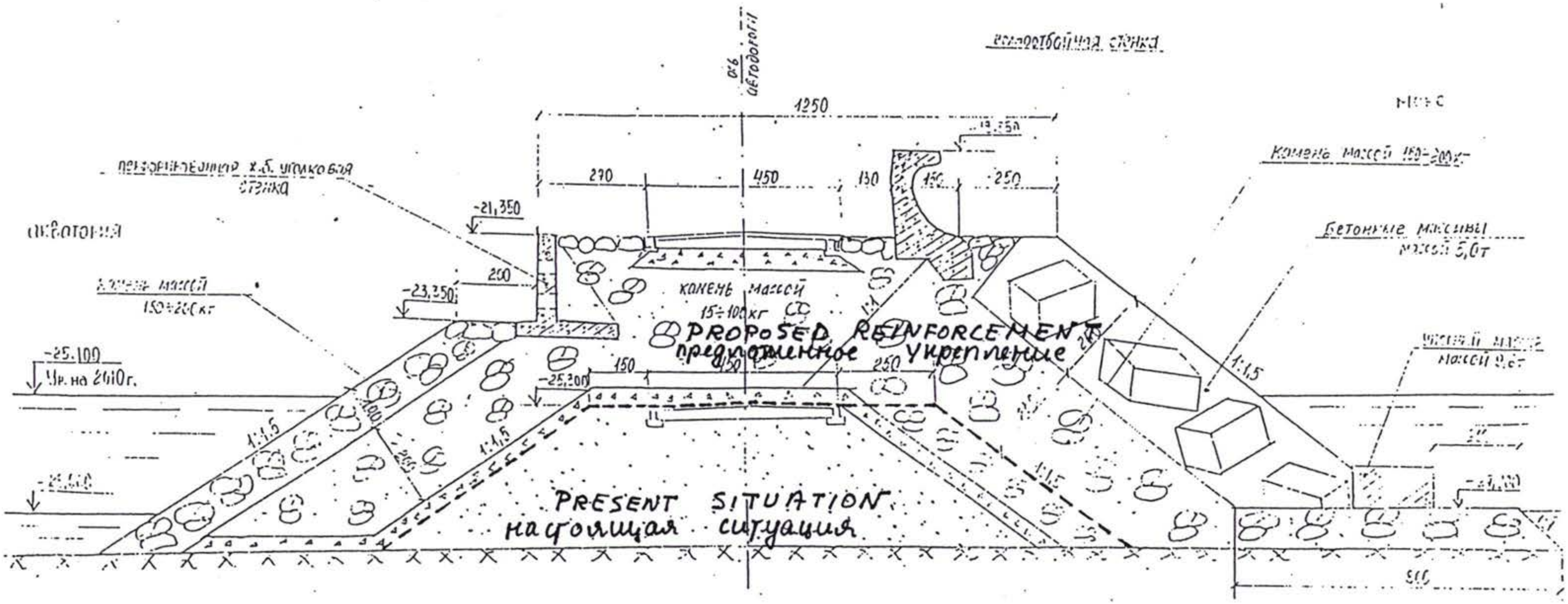


рис. 4.17 Мол у набережной

Fig. 4.17 BREAKWATER NEAR THE SHORE

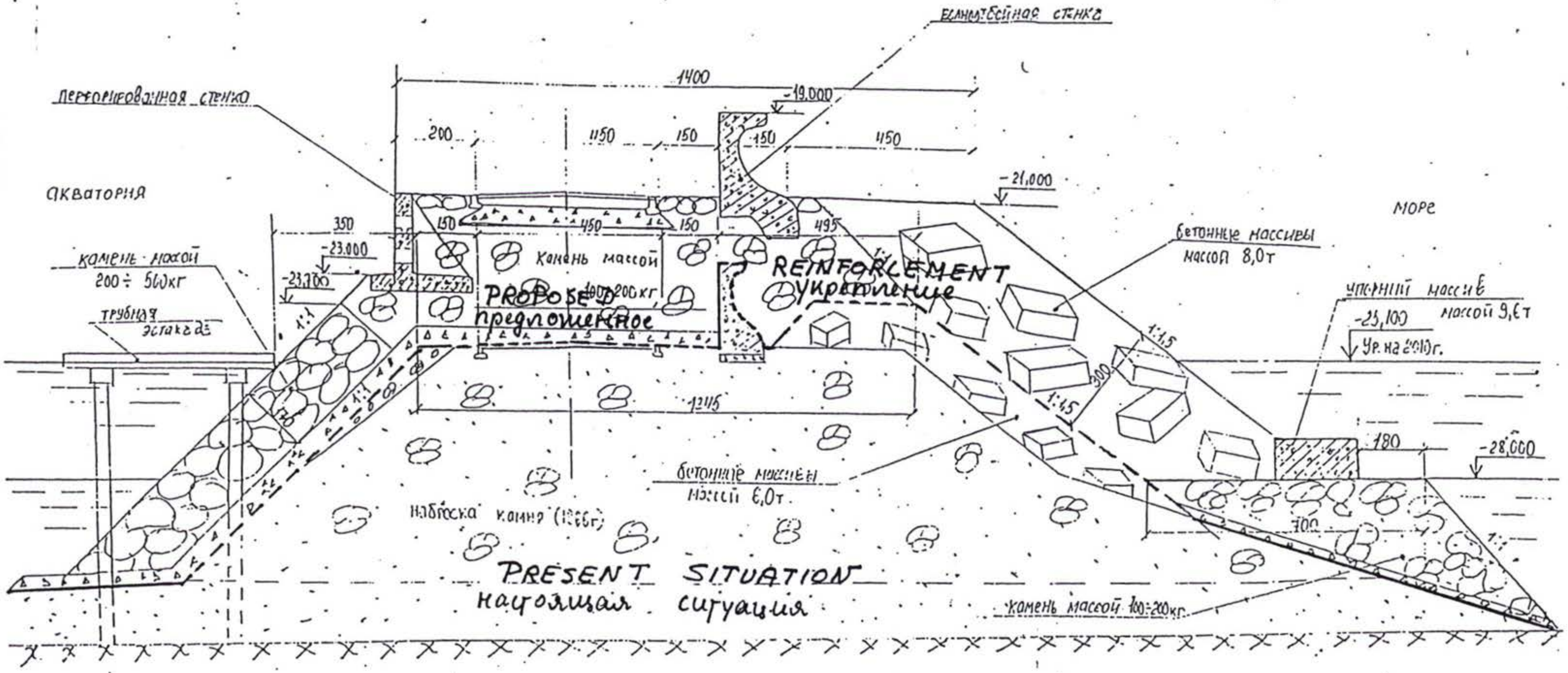


рис. 4.18 Мол, средняя секция

Fig. 4.18 BREAKWATER MIDDLE SECTION

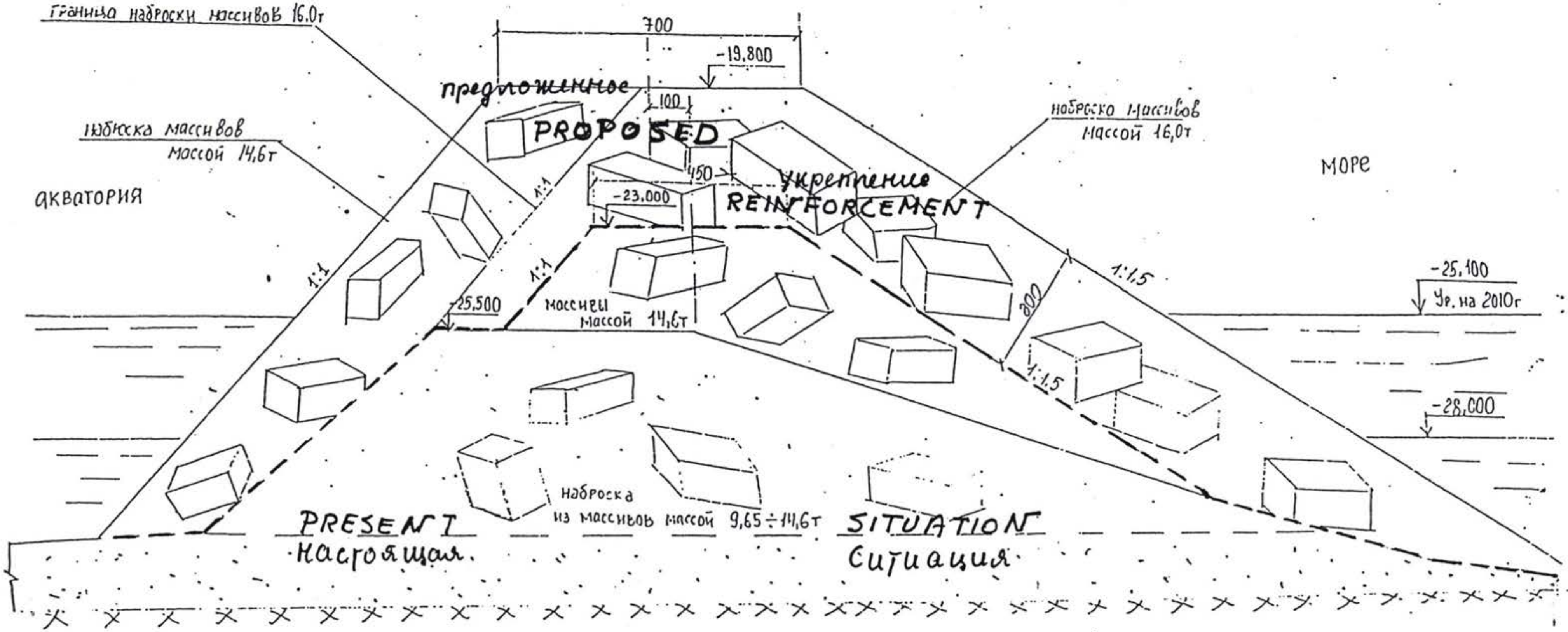
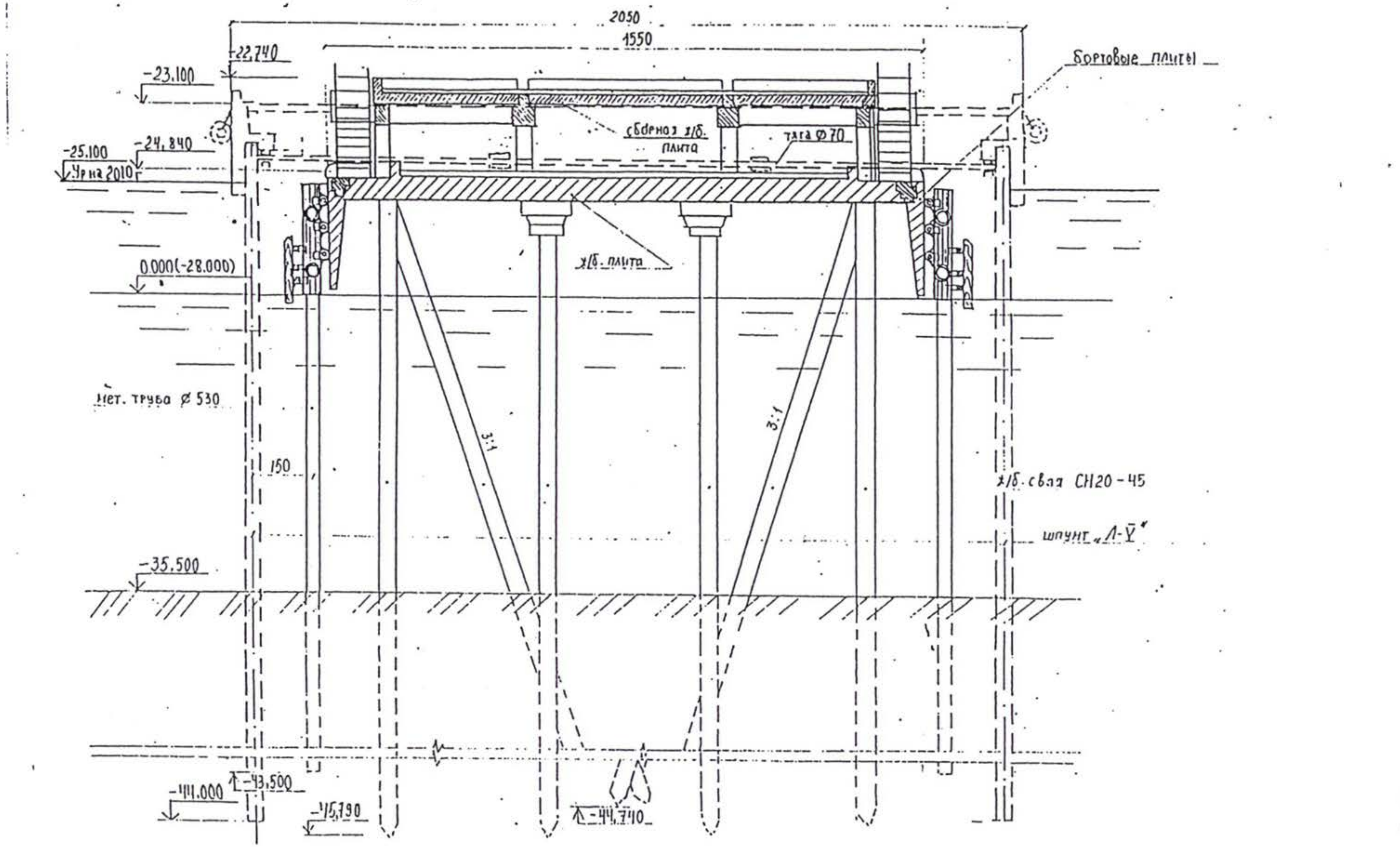


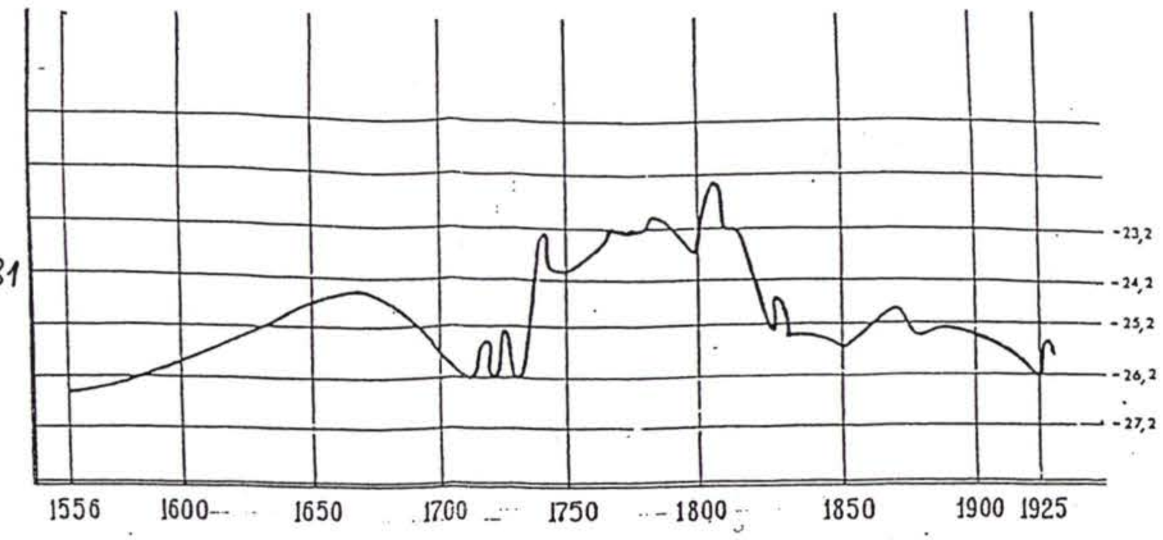
Рис. 4.19 Мол - последняя секция
Fig 4.19 BREAKWATER LAST SECTION

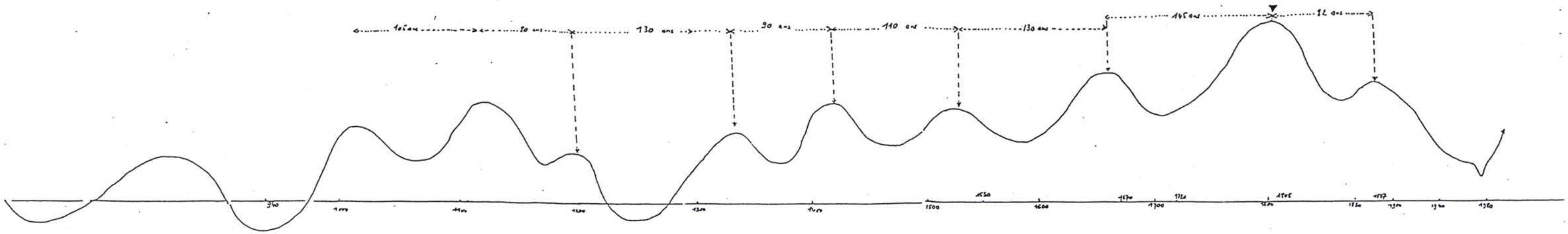


Поперечный разрез средней части пирсов 1, 2, 3 и 5

Fig. 4.20 CROSS SECTION OF THE MIDDLE PART OF JETTIES 1, 2, 3 and 5

VARIATION OF THE CASPIAN SEA LEVEL FROM 1958 TO 1931
Колебание уровня воды Каспийского моря 1958-1931





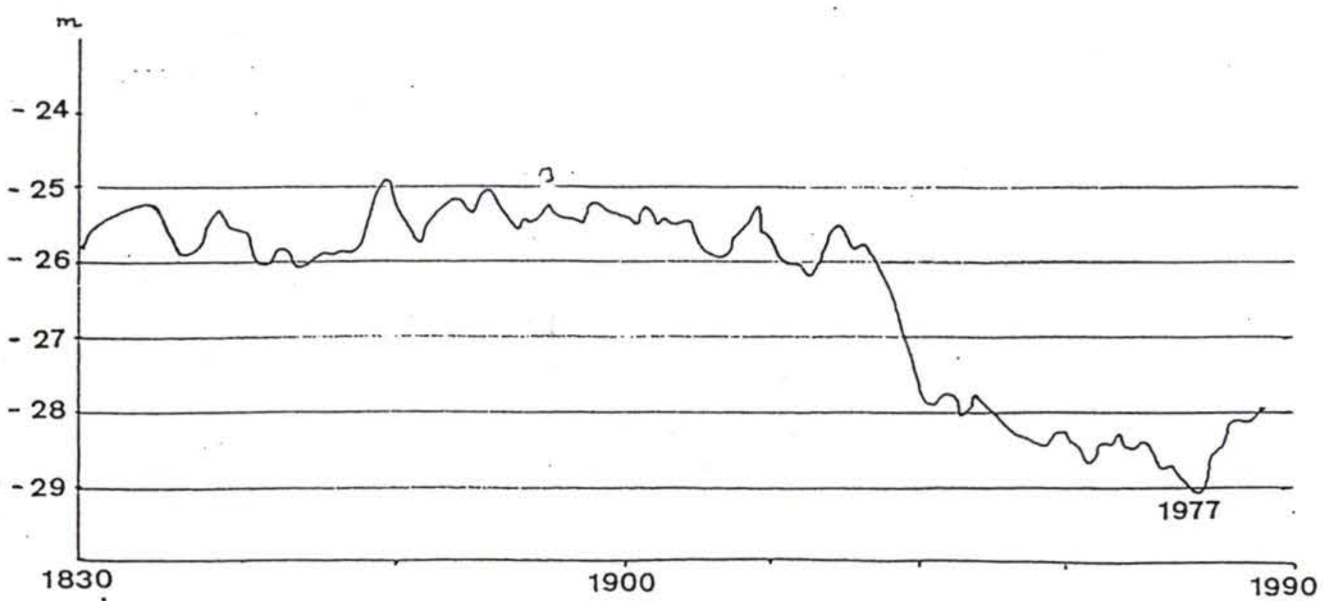


рис. / Fig. 4.21

VARIATION OF THE CASPIAN SEA LEVEL SINCE THE MIDDLE AGE
Колебания уровня воды Каспийского Моря с средних веков

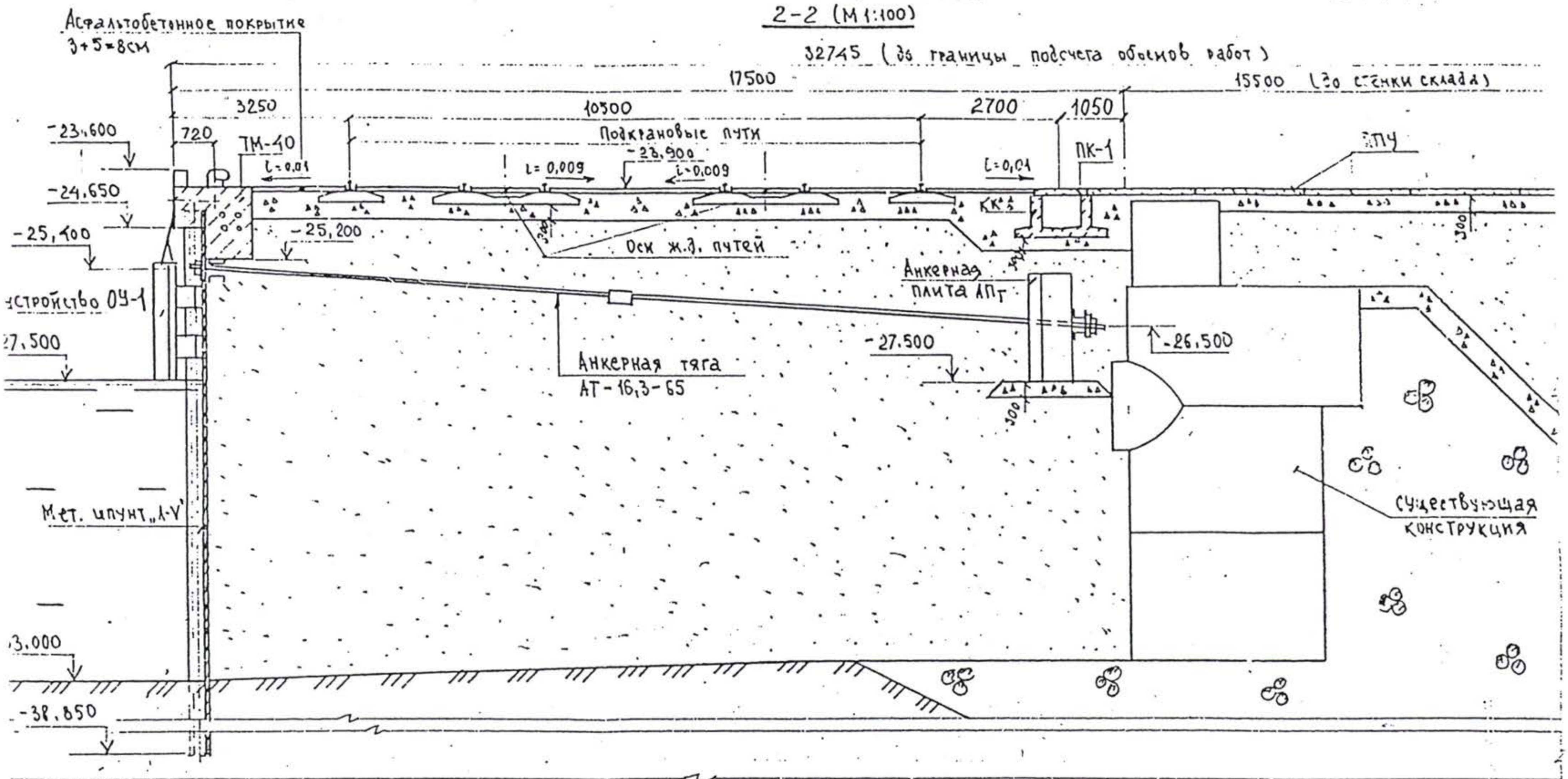


рис. 4.22 Основной комплекс, Восточный причал - подробный дизайн 1991

Fig. 4.22 MAIN COMPLEX EASTERN QUAY - DETAILED DESIGN 1991

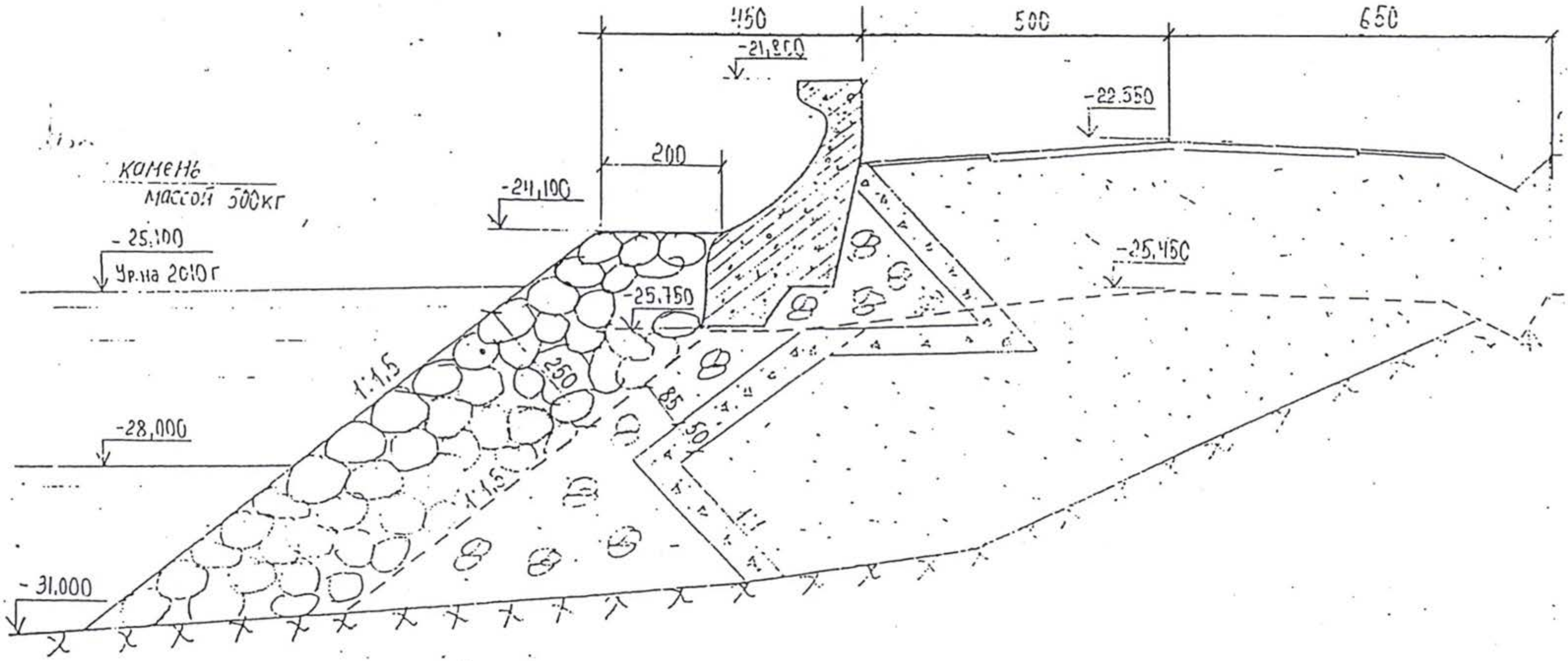
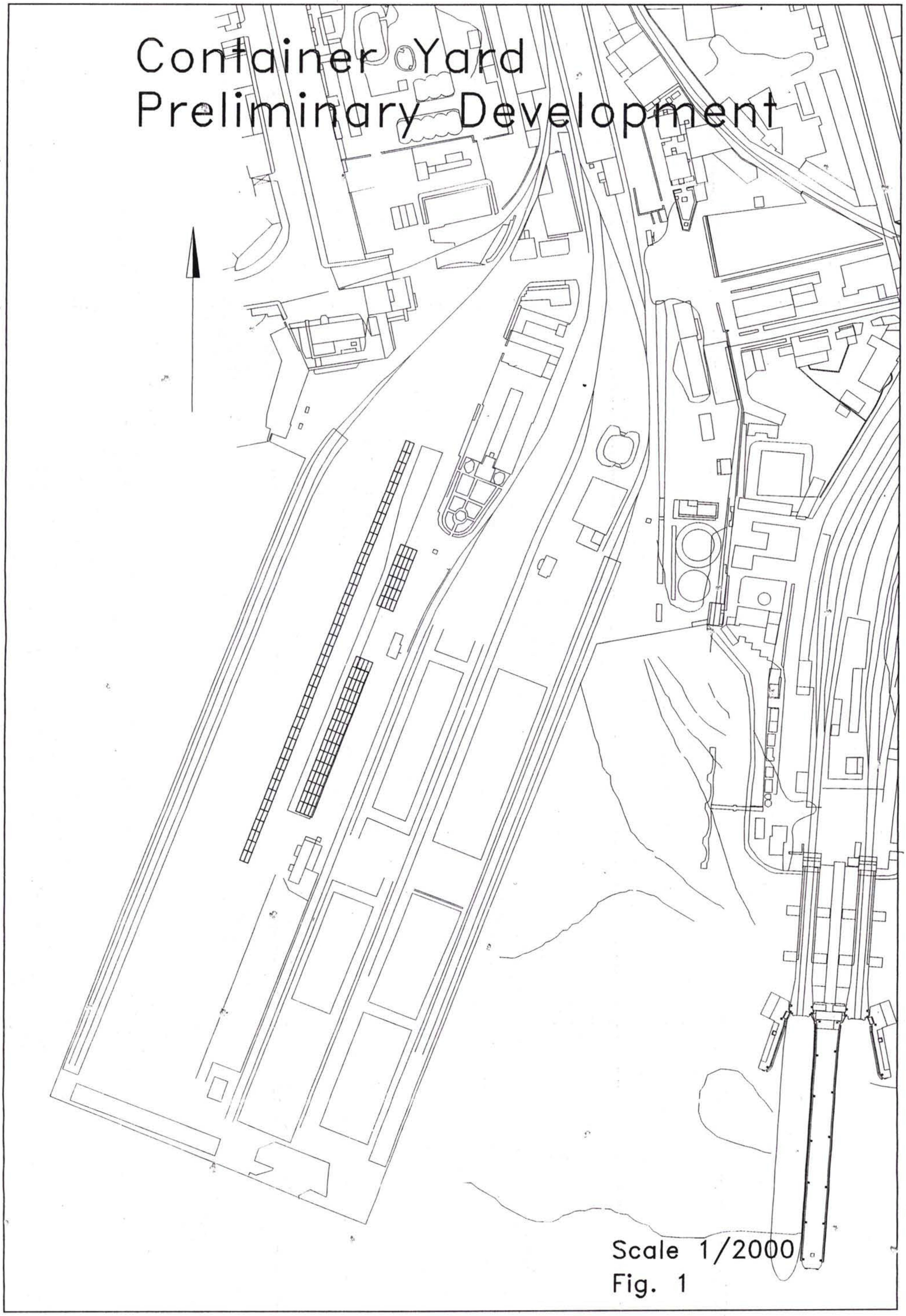


рис. 4.23 Основное местоположение порта. Предварительный дизайн защиты набереной.

Fig 4.23 MAIN LOCATION OF THE PORT PRE-DESIGN OF SHORE PROTECTION

Figure Section


Container Yard
Preliminary Development
Scale 1/2000
Fig. 1

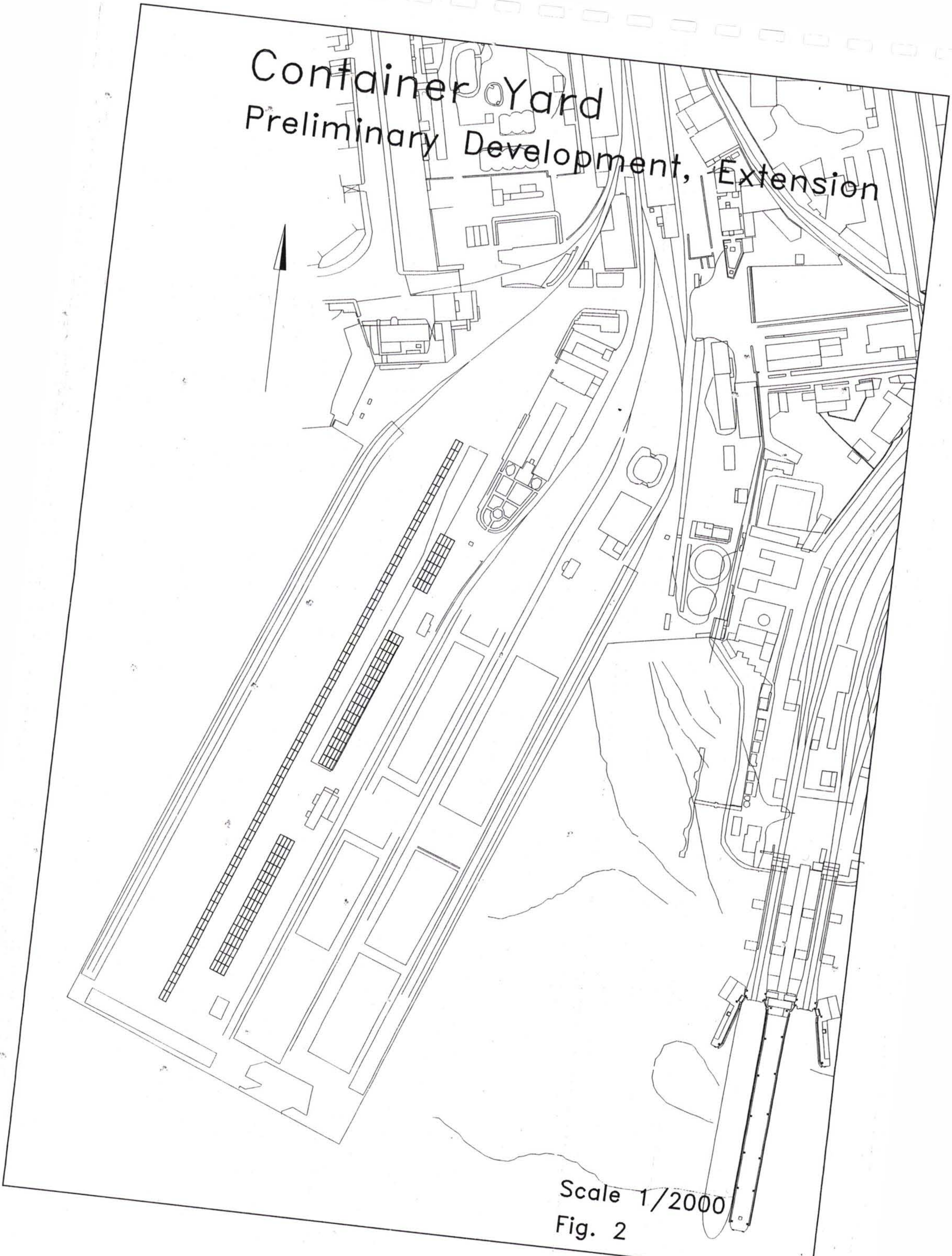

Container Yard
Preliminary Development, Extension
Scale 1/2000

Fig. 2

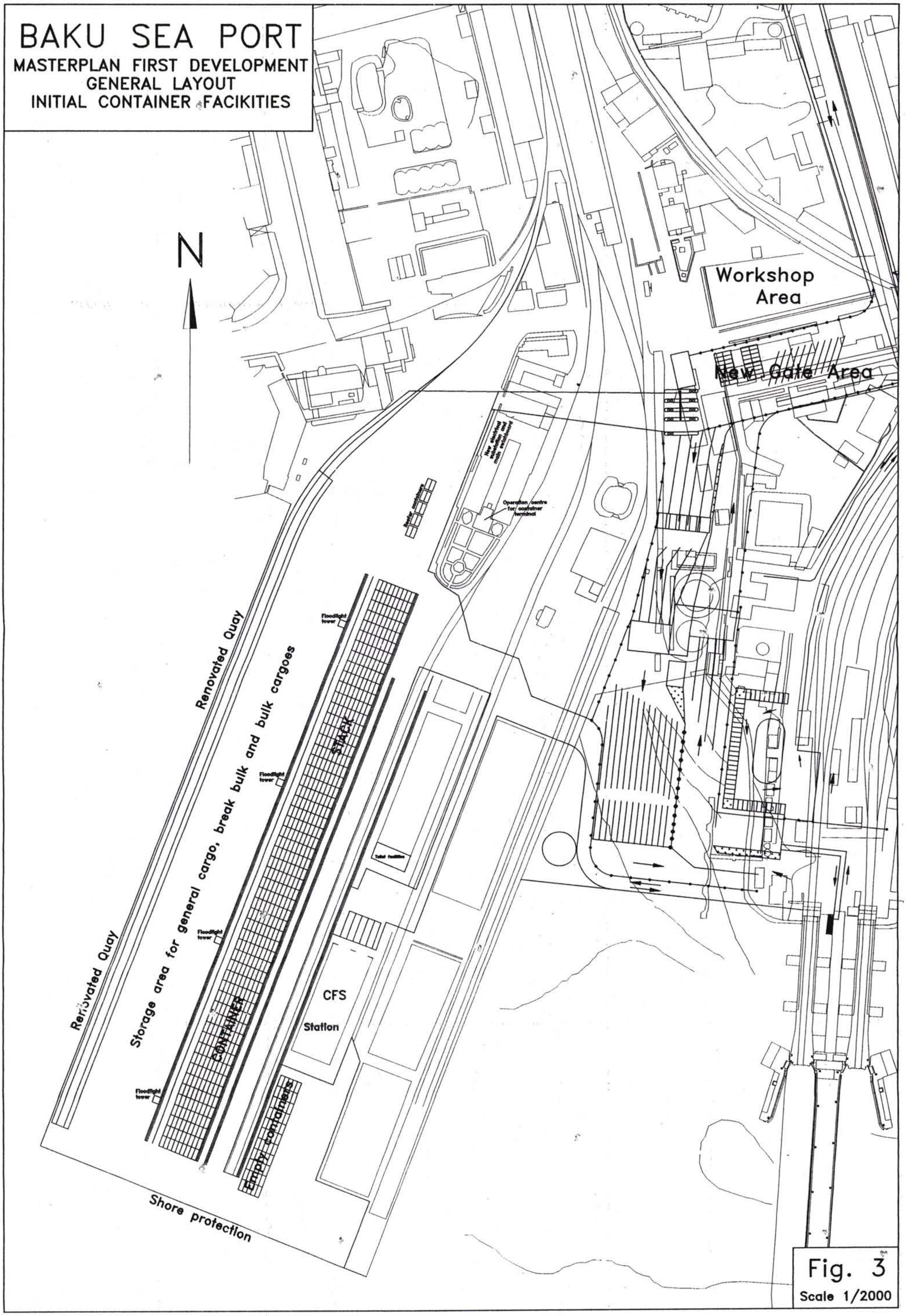


Fig. 3
Scale 1/2000

BAKU SEA PORT
MASTERPLAN FIRST DEVELOPMENT
GENERAL LAYOUT
AND CIRCULATION PLAN

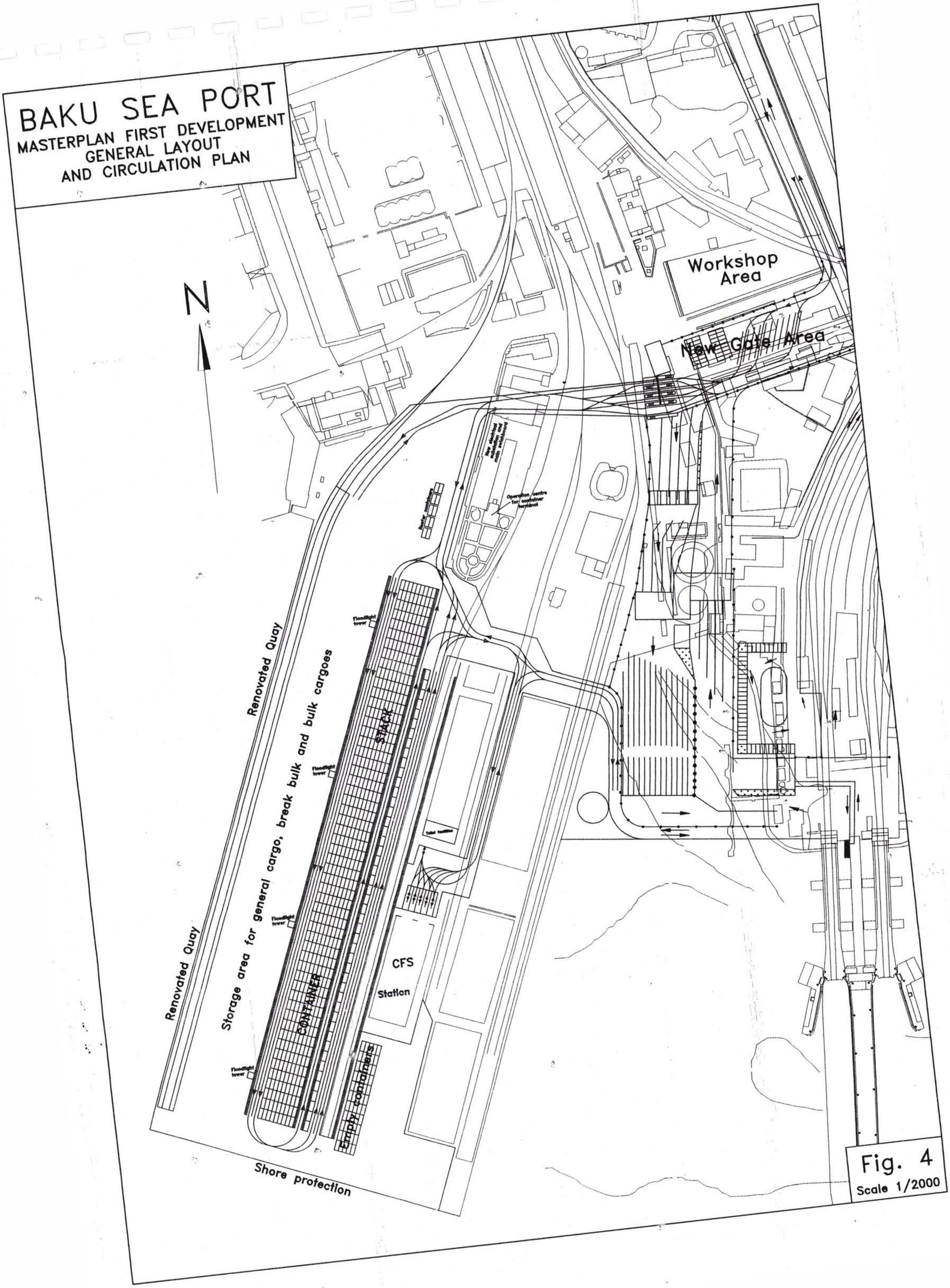
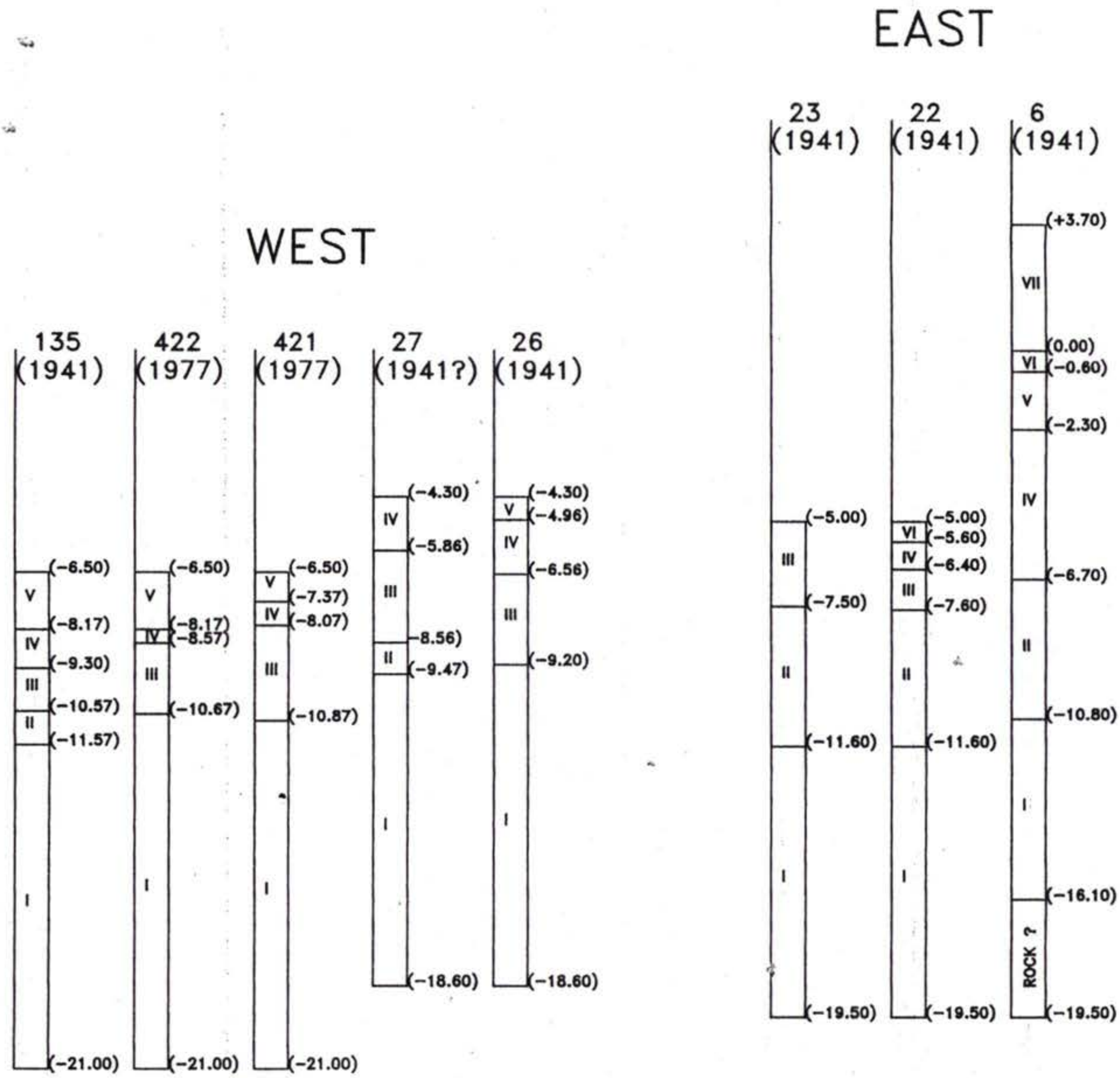


Fig. 4
Scale 1/2000

AVAILABLE GEOTECHNICAL DATA

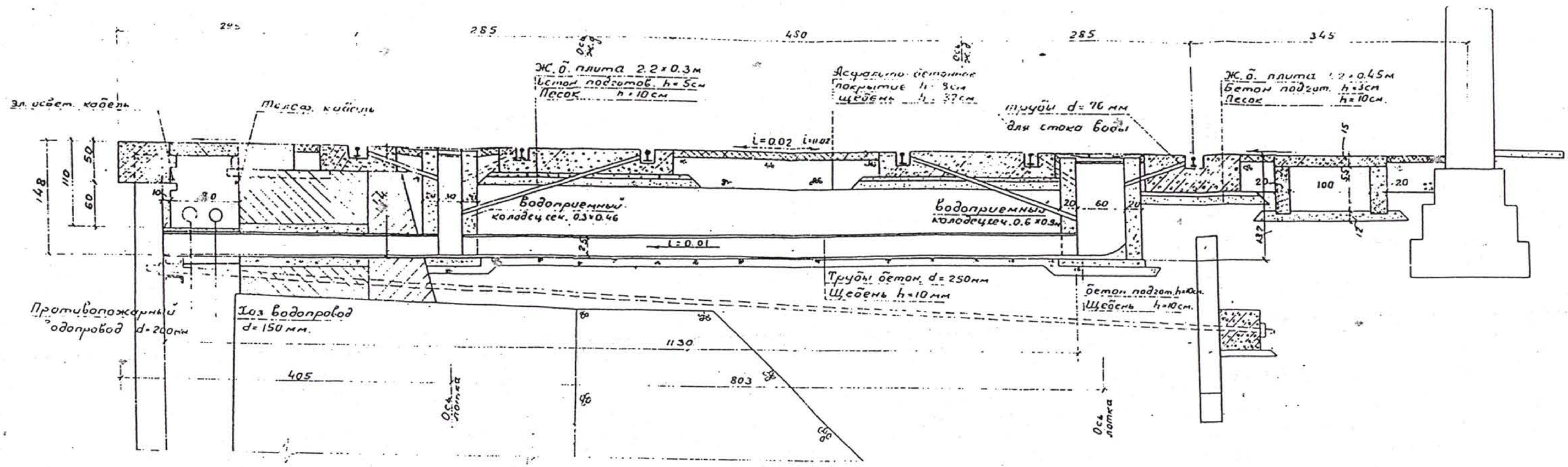


LAYERS :

VII–SAND
VI–CLAY
V–SAND
IV–CLAY
III–SAND
II–SILTY SAND
I–CONSOLIDATED CLAY

FIG. 5

Разрез Б-Б (I вариант) М-1:50



Разрез Б-Б (II вариант - принятый) М-1:50

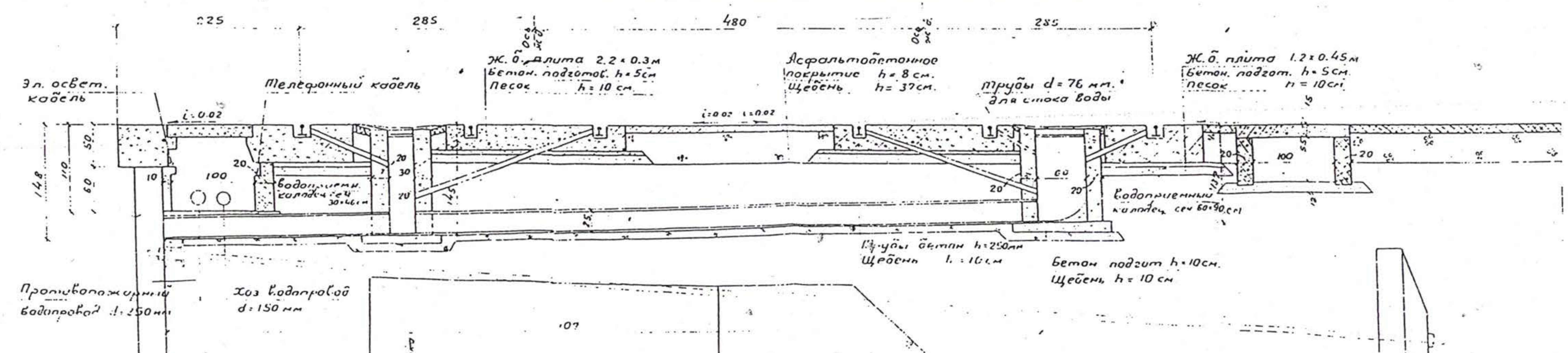
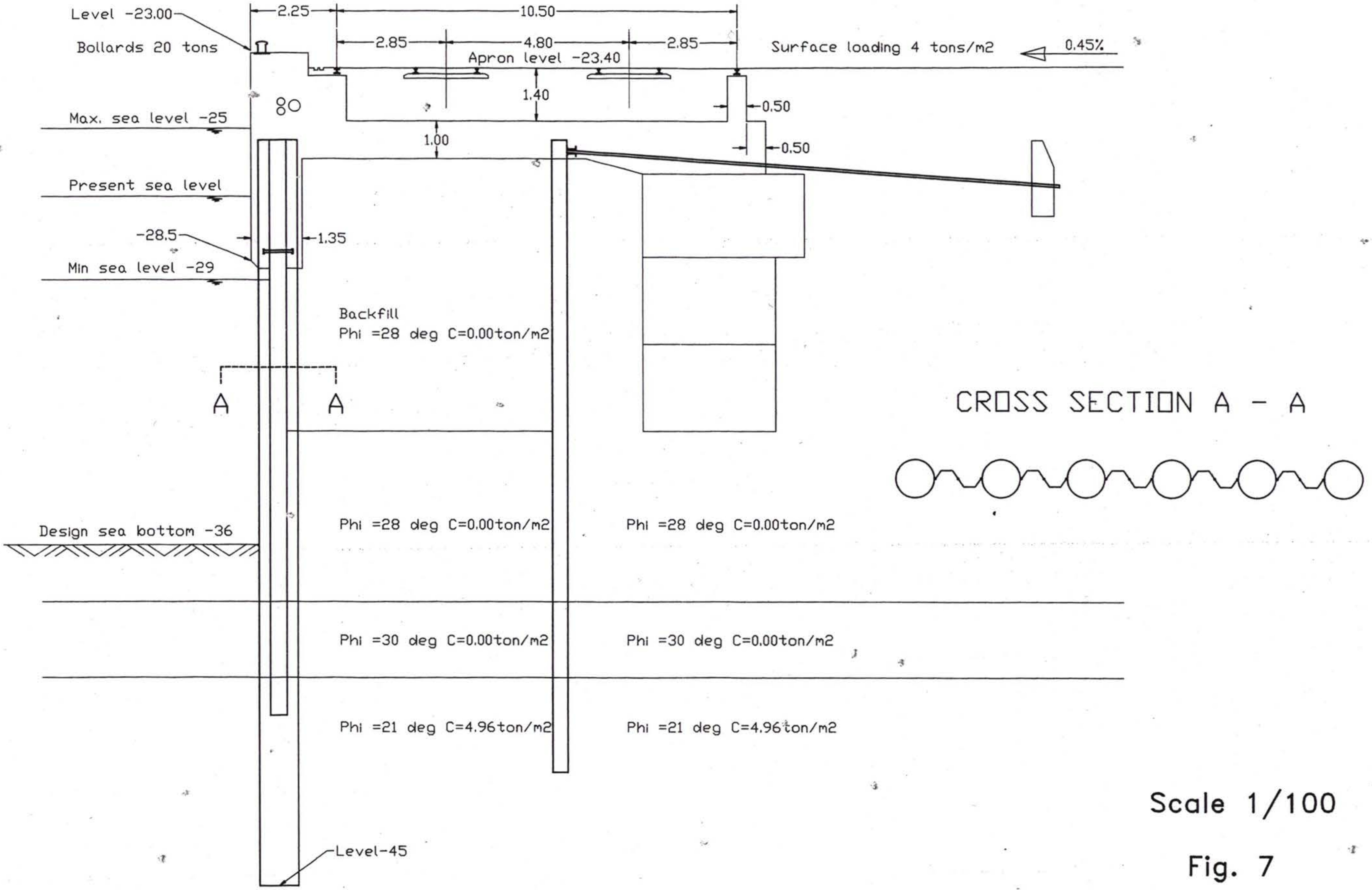


рис. 4.6 Основной комплекс Запад и Юг, Дренаж и траншея инженерных коммуникаций
Fig 4.6 MAIN COMPLEX WEST AND SOUTH, DRAINAGE AND UTILITY CULVERTS

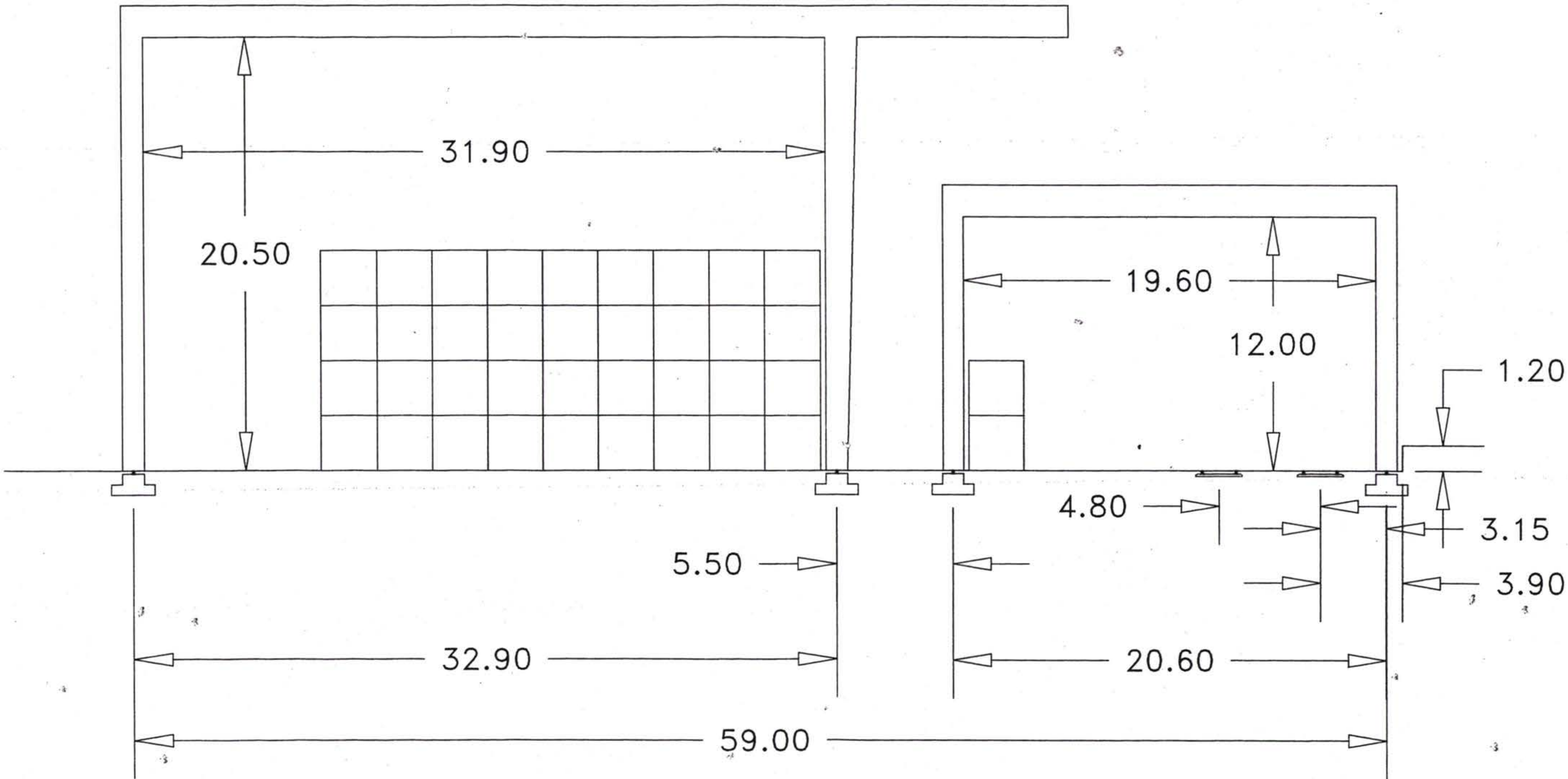
Renovation of the quays of the main complex
Solution with a combined sheet pile wall



Scale 1/100

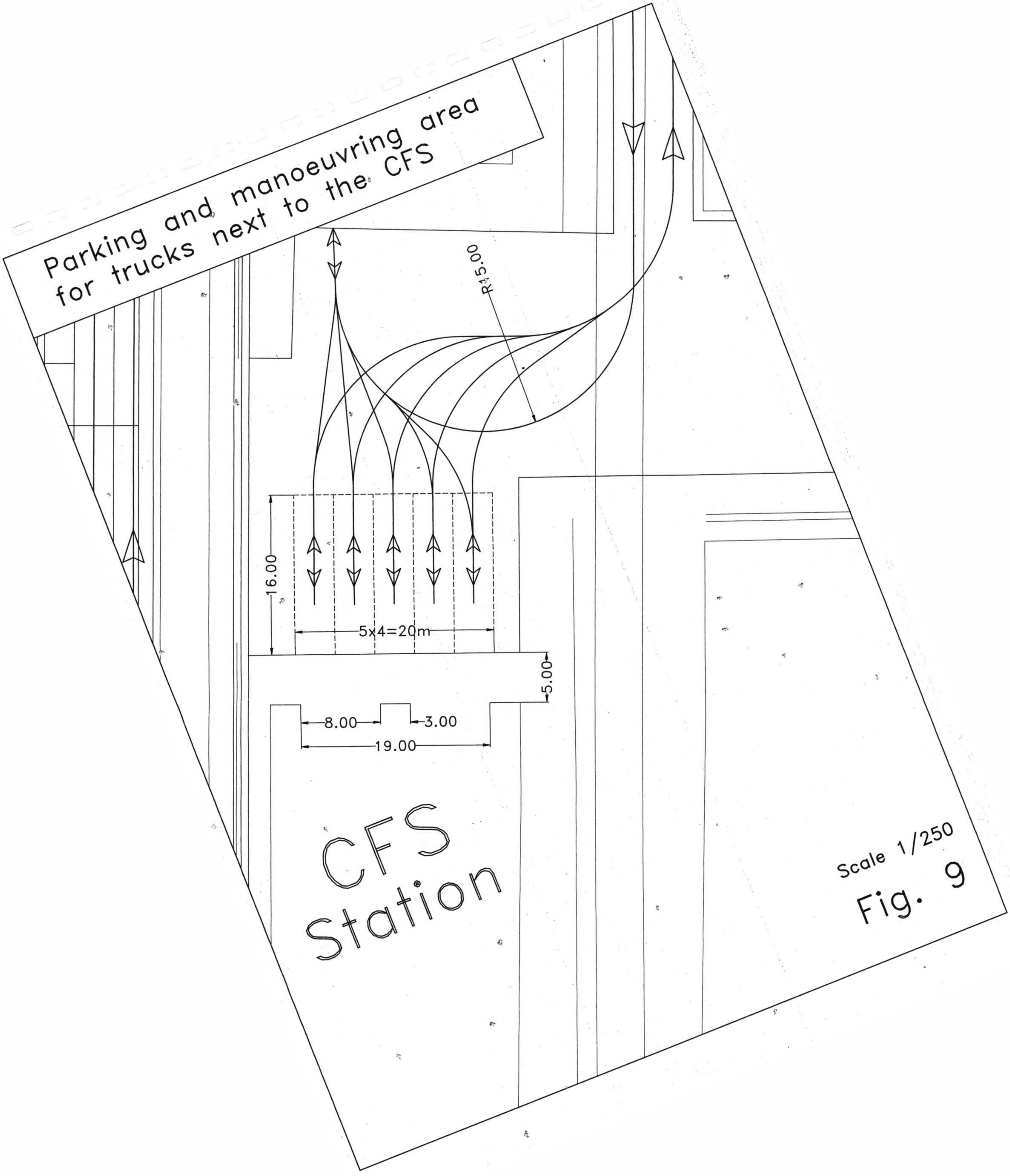
Fig. 7

CONTAINER STACKING SYSTEM



Scale 1/200

Fig. 8


Parking and manoeuvring area for trucks next to the CFS
R15.00
16.00
5x4=20m
5.00
8.00
3.00
19.00
CFS Station
Scale 1/250
Fig. 9

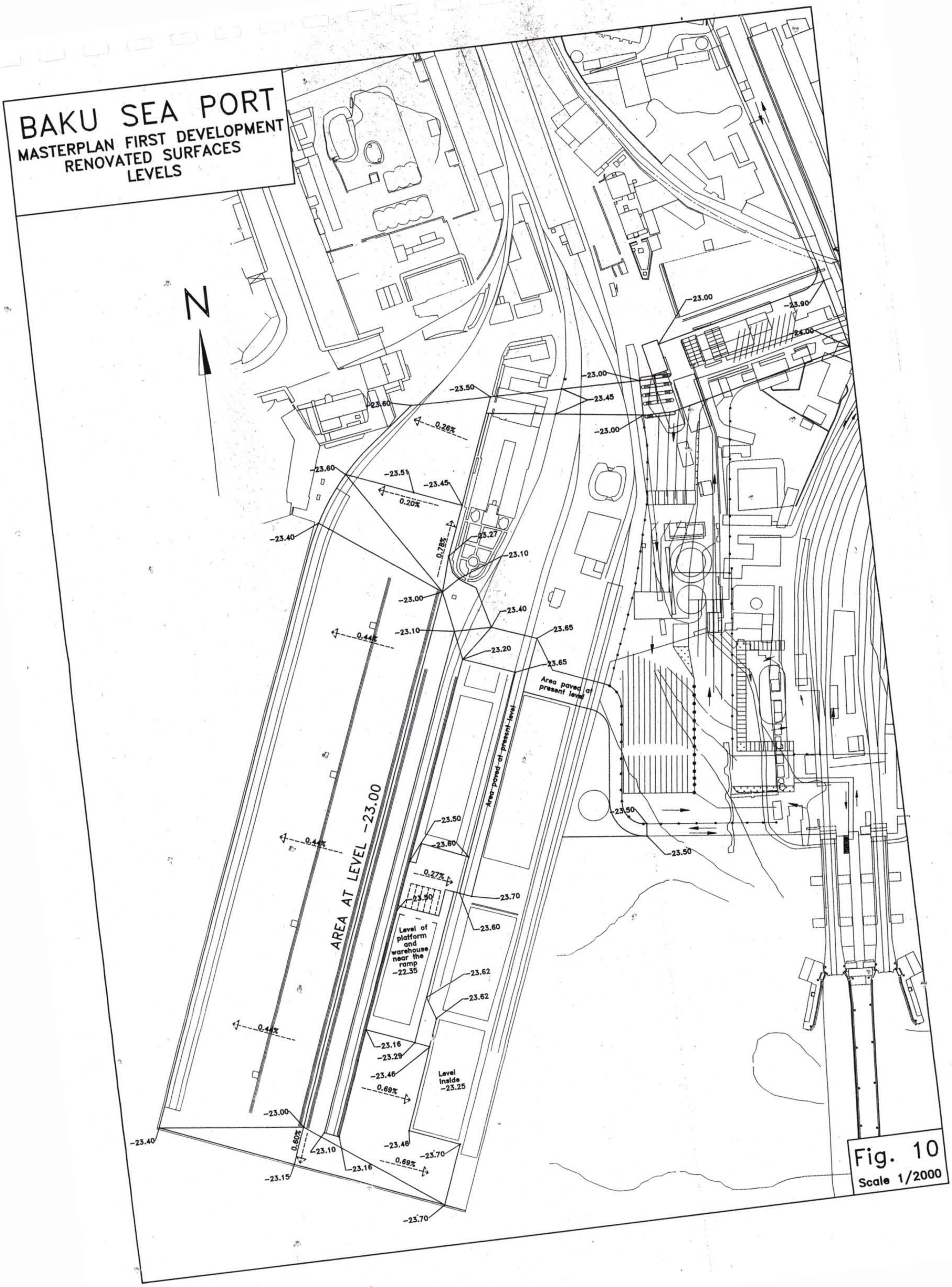
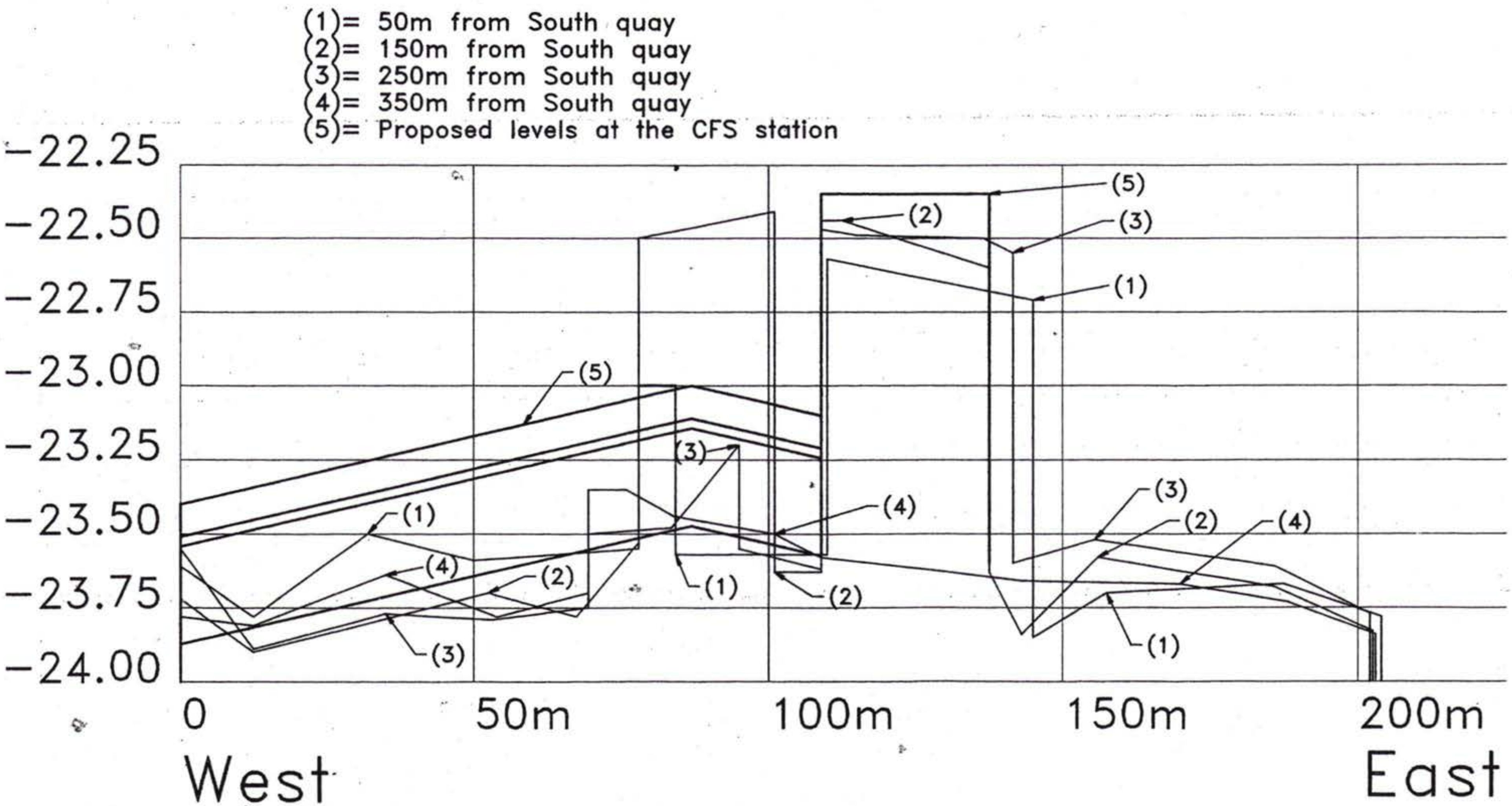


Fig. 10
Scale 1/2000

Present levels and proposed levels



Scale in X direction 1/1000
Scale in Y direction 1/20

Fig. 11

BAKU SEA PORT

MASTERPLAN FIRST DEVELOPMENT
RENOVATED SURFACES
Type of pavement

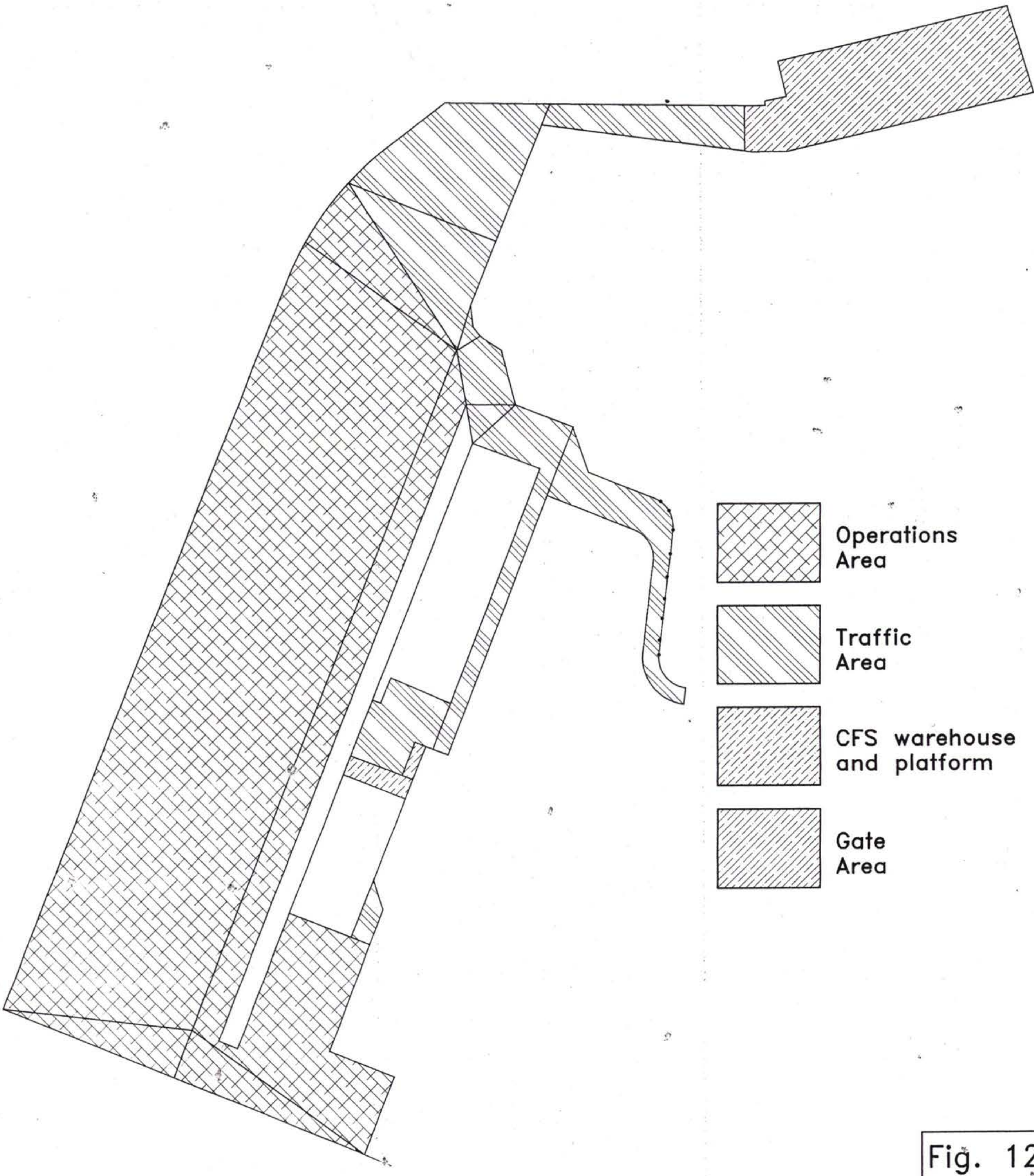


Fig. 12
Scale 1/2000

Annex 1

Topographical Survey

Topographical Survey - Maps

Drawing N° 1/4 - 4/4 (Reduced Scale)

<u>Qeydlər:</u>

1. Koordinat sistemi: yerli
2. Yüksəklik sistemi: Baltik
Başlanğıc yüksəklik qəbul olunmuşdur: Pn 9870, H=-22.860 (bax plana: vərəq №2)

2-ci vərəqlə birləşir

Rəhbər	Hənifəyev	[signature]	Bakı dəniz limanının genişləndirilməsi.
İ.S.M.			
İcraçı	Həşimov	[signature]	
Yoxladı	Hənifəyev	[signature]	
Norma-nəz.	Hənifəyev	[signature]	
	M 1:500		
	dm² = 80		

Topoqrafik-geodeziya axtarışları	Sahə	Vərəq	Vərəqlər
	İ.L.	1	4
Sahənin planı	„Azdövlətaqrarsənayelayihə"		

3-cü vərəqlə birləşir

Rəhbər	Xanifəyev		
İ.B.M.			
İcraçı	Haşımov		
Yoxladı	Xanifəyev		
Norma-nəz	Xanifəyev		
	M1:500		

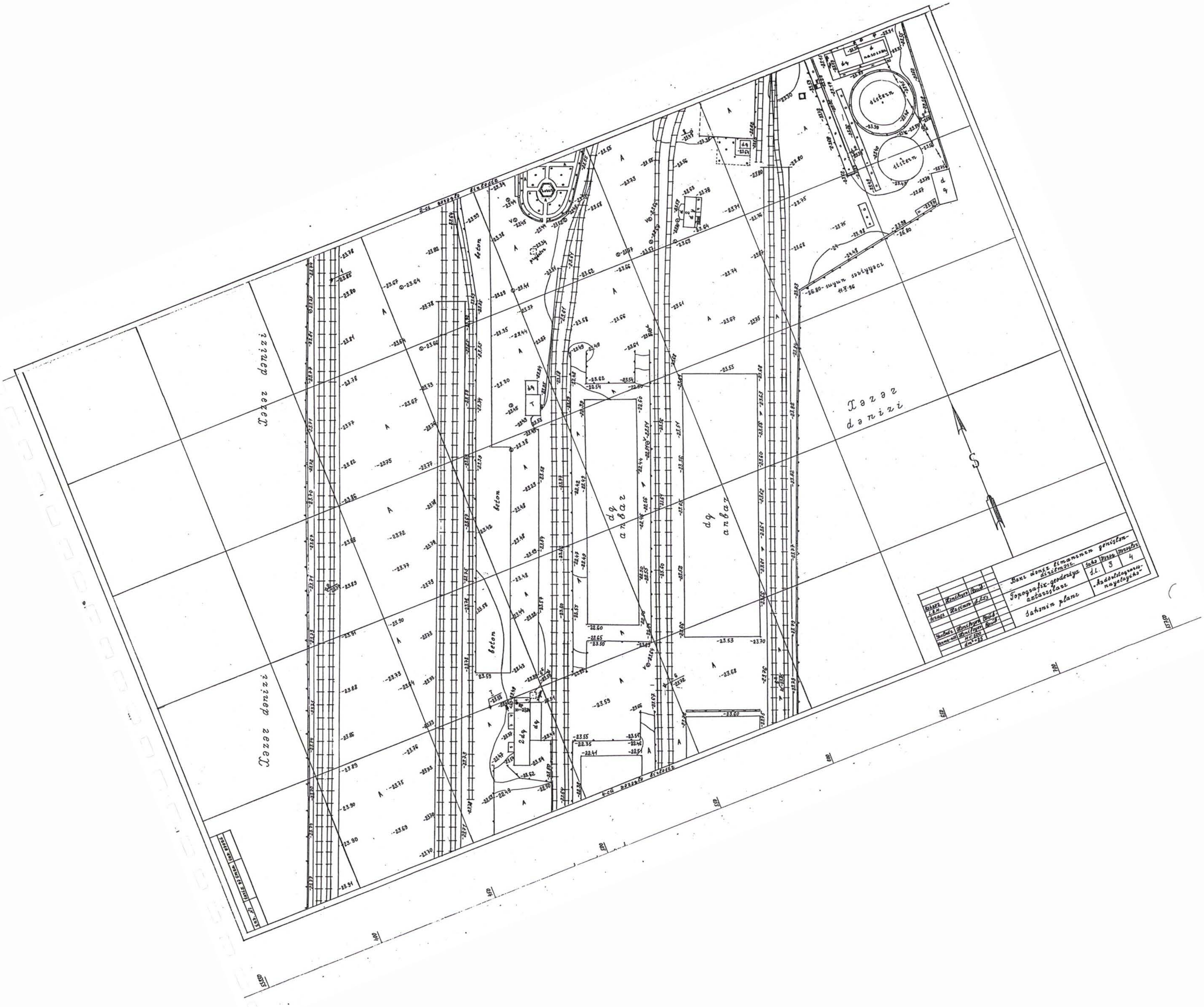
Bakı dəniz limanının genişləndirilməsi.

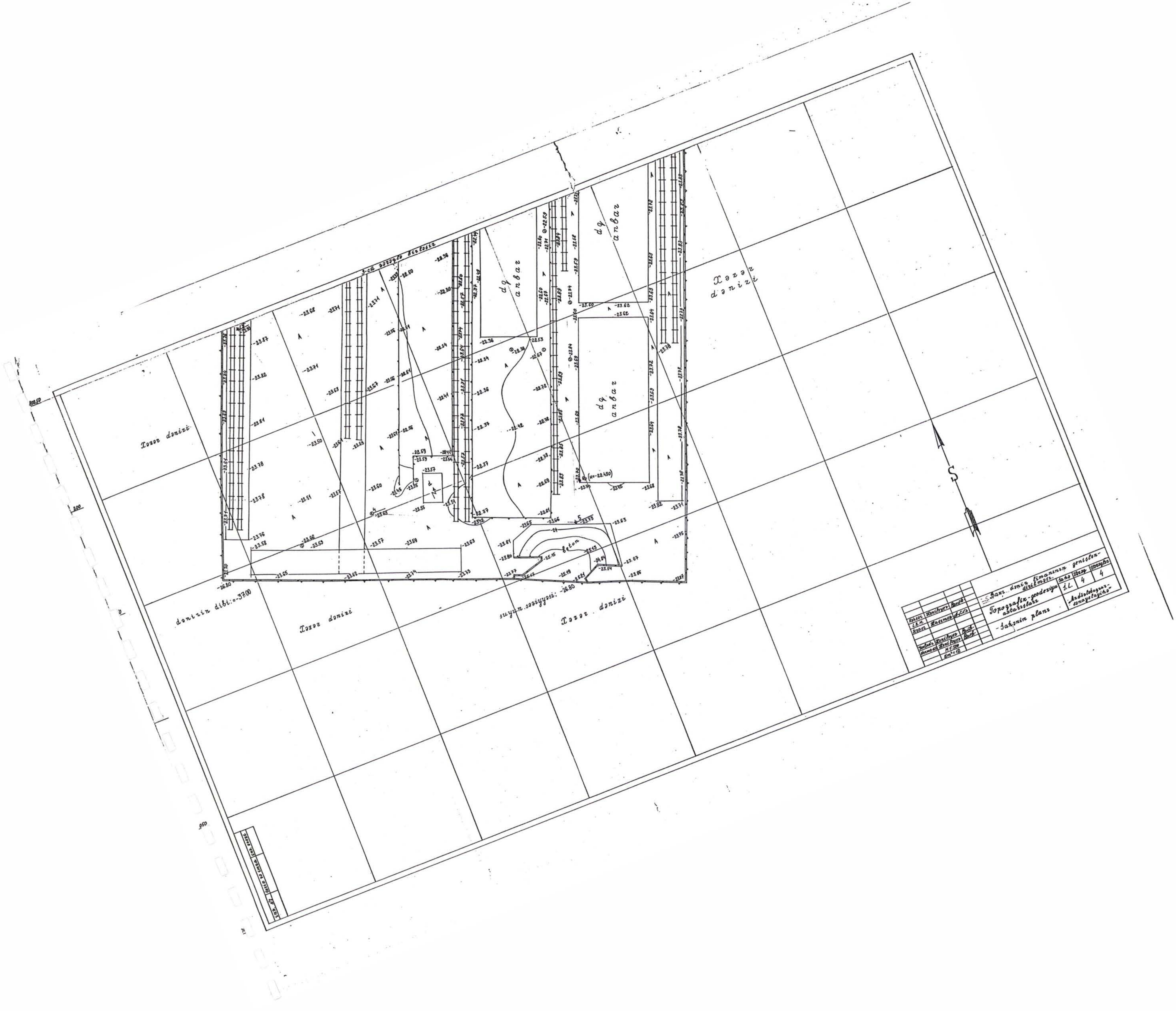
Topoqrafik-geodeziya axtarışları

Səhə	Vərəq	Vərəqlər
İ.L.	2	4

Sahənin planı

„Azdövlətlayihə-sənayelayihə"


Xəzər dənizi
Xəzər dənizi
Xəzər dənizi
beton
beton
beton
dq anbar
dq anbar
sistern
sistern
S
Bakı dəniz limanının genişləndirilməsi.
Topoqrafik-geodeziya axtarışları
Sahənin planı
Səhə
Vərəq
Vərəqlər
İ.L.
3
4
"Azdövlətqurğulayihə"
M 1:500


Xəzər dənizi
dənizin dibi: -37.00
suyun səviyyəsi: -26.80
anbar
beton
S
Bakı dəniz limanının genişləndirilməsi.
Topoqrafik-geodeziya axtarışları
Sahənin planı
Səhə
Vərəq
Vərəqlər
İ.L.
4
4
"Azdövlətdəniz-sənayelayihə"
M 1:500

Annex 2

Basic Building Solutions

From dok. 3

annex 1

5. ОСНОВНЫЕ СТРОИТЕЛЬНЫЕ РЕШЕНИЯ.

5.I. Краткие сведения о естественных условиях.

Ниже приводятся краткие сведения о природных условиях районов расположения паромных комплексов, учитываемые при обосновании принятых проектных решений.

5.I.I. Бакинский морской порт.

Участок железнодорожной паромной переправы расположен в северной части Бакинской бухты, ограниченной мысом Шихово на западе и мысом Султан на востоке.

С моря бухта прикрыта островами Нарген, Вульф, Песчаный и Плита.

Глубины в центральной части бухты достигают 6-8 метров, а к берегам они уменьшаются.

Глубины на фарватерах и у причалов порта поддерживаются дноуглубительными работами.

5.I.I.I Гидрометеорологические условия.

Климат характеризуется сухим умеренно-жарким летом, теплой зимой, короткой весной и солнечной осенью. Средняя годовая температура воздуха +14,4° Абсолютный максимум + 40° в июле, минимум-минус 13° в январе. Среднее число дней с морозами - 8.

Среднегодовое количество осадков 204 мм.

Средняя дата появления снежного покрова 7 января, льда 27 февраля

Среднегодовая величина относительной влажности - 72%, абсолютной -12,5м.

Туманы чаще всего наблюдаются в период с февраля по апрель преимущественно в утренние часы. Среднее число дней с туманами-9. Их продолжительность достигает 12 часов.

Ветровой режим- характеризуетмя преобладаением в течение
го года: северных -40,5% и южных -18,4% ветров. По градациям
оростей преобладают ветры до 8 м/сек (80,8%), повторяемость
тров более 14 м/сек - 7,2 % из которых 5,5% приходится на
верное направление. Повторяемость штилей 7,8% в году.

Максимальная скорость ветра северного направления достигла
м/сек, а южного- 28 м/сек.

лнение - в Бакинской бухте обусловлено мелководьем ее кон-
турацией береговой черты и господством волнения от ветров
ных румбов. Здесь преобладает ветровое волнение. Зыбь
блюдается редко. Максимально наблюденная высота волн от вет-
южных румбов на глубине 4-5 м достигает 1,5 м, Наибольшую
вторяемость- до 88% имеет волнение до 0,5 м. Повторяемость
лн высотой более 1,1 м - 8%.

чения - Обусловлены действующими ветрами. Постоянных
чений в бухте нет.

едняя скорость ветровых течений составляет 20-30 см/сек.
ксимальная достигает 60-80 см/сек.

еднегодовая температура воды + 16°, максимальная достигает
,8° в июле минимальная - минус 14° в феврале.

хта не замерзает. Исключение составляет узкая прибрежная
лоса, которая в суровые зимы может кратновременно замерзать.

Среднегодовая соленость воды - 12,7‰ максимально 14,5‰,
нимальная - 11,1‰ .

Морская вода в данном районе согласно СНиП II-28-73 средне-
грессивна по сульфату к бетону на портландцементе, пущолано-
м портландцементе, шлакопортландцементе слабоагрессивна, к
тону на сульфатостойком портландцементе и коррозийна по
ношению к металлу.

о РН вода среднеагрессивна к стальным и алюминиевым конструк-
циям.

5.I.I.2. Инженерно-геологические условия.

Участок строительства в геолого-литологическом отношении сложен четвертичными отложениями.

С поверхности они представлены мелким песком, местами заиленным, содержащим прослойки супеси и суглинка, мощностью до 0,5 м. Мощность песка достигает 7,0 м. Подстилается песок суглинками и местами супесью, вскрытой мощностью до 10 м. Данные грунты характеризуются следующими физико-механическими свойствами:

Baku

№№ пп	Физико-механические характеристики	Расчетные показатели	
		песок *sand*	суглинок *clay*
I.	Угол внутреннего трения	*φ* 28-30^0	20^0
2.	*cohesion* Сцепление	-	0,43 *kg/cm²*
3.	*water content* Консистенция	-	0,5
4.	*gradient (pore volume)* Коэффициент пористости	0,6-0,75	0,05
5.	*volume weight* Объемная масса *(γ)*	I,7 г/см3	2,04 г/см3

Сейсмичность площадки, согласно СНиП П-А, I2-69 равна 8 баллам.

5.I.2. Красноводский *морской порт*

Порт Красноводск расположен в обширнейшем Красноводском заливе, который глубоко врезается в восточный берег севернее полуострова Челикен и ограничен с севера грядой Кубадагских гор, с запада- низменной Красноводской косой: с юга-северной Челекенской косой, и с востока материком и плоским полуостровом.

Рельеф берегов залива разнообразен: северный берег гористый, южный, восточный и западный берега-лишенные растительности песчаные низменности с редкими песчанными холмами.

Глубины в заливе незначительные 4-4.5 м.

5.I.2.I. Гидро-метеорологические условия.

Климат Красноводского района характеризуется жаркой, сухой, малооблачной погодой в теплый период года и отрицательными температурами воздуха, незначительными осадками в холодный по количеству выпадаемых осадков район является одним из беднейших во всем Союзе и самым засушливым на Каспии и может быть сравнен лишь со среднеазиатскими пустынями.

Среднегодовая температура воздуха + I6,3°

Абсолютный максимум достигал + 44,I°

Абсолютный минимум - минус I7,8°.

Среднее количество дней с отрицательной температурой I6, а со снежным покровом - 6.

Среднегодовая относительная влажность - 60%, изменяясь от 45% в августе, до 74 в январе.

Среднегодовая величина абсолютной влажности равна II,I мб, от 5,9 мб в январе, до I8,2 мб в июле.

Осадки. Выпадение осадков наблюдается преимущественно в зимне-весенний период, когда среднемесячные суммы осадков равны I2-I7 мм, летом количество осадков равно II5,8 мм изменяясь в отдельные годы от 38 до I32 мм.

Абсолютно суточный максимум осадков составлял 7I мм и наблюдался в мае.

Число дней с осадками в году около 44 дней.

Выпадают осадки в виде дождя, реже снега и очень редко града.

Среднее число дней в году со снежным покровом - 3.

Туманы редки, непродолжительны и чаще всего наблюдаются утром и ночью; в среднем отмечается 10 дней в году с туманами.

Наблюдаются и сухие туманы (мгла,   пыльная буря).

Мгла обычно наблюдается при ветрах с берега и распространяется в большинстве случаев в прибрежной части моря.

Среднегодовая число дней с мглой равно [illegible], число дней с пыльной бурей - 15.

Продолжительность сухих туманов 4-5 часов, но иногда держат до 2-х суток.

<u>Ветровой режим</u> характеризуется преобладанием СВ ([illegible]), С (17.7%) и В (17,0%) ветров.

Повторяемость штормовых ветров более 14 м/сек составляет 7,7%.

Максимальная скорость достигает 34 м/сек по северному направлению.

<u>Волнение</u> В течении года в заливе господствует ветровое волнение северной четверти горизонта, среднегодовая повторяемость которого составляет 39%, при повторяемости штилей 49%.

Расчетные высоты волн 1% обеспеченности в системе волн для наиболее волно   направлений в Красноводском заливе имеют следующие значения:

-1,3 м - в р-не Уфринского канала на глубине 2,5 м

-1,6 м - в р-не II-го колена на глубине 3,0 м

2,0 м - в р-не I-го колена на глубине 4,0 м

Среднегодовая повторяемость таких волн менее 0,1%.

Течения в Красноводском заливе носят дрейфовый сточный характер.

Направление течений, как правило, совпадает с направлением ветра.

Максимальная скорость течений по данным натурных измерений не превышает 0,5 м/сек.

Ледовый режим Навигация в Красноводском порту поддерживается круглый год и только в особо суровые зимы проводка судов осуществляется при помощи ледоколов.

Лед преимущественно местного образования и частично приносится восточными ветрами из весьма мелководного Балханского залива.

Средняя продолжительность ледового периода в зимы со льдом равна 24 дням, максимально - 67 дн.

Средняя толщина льда 5-10см., наибольшая -28 см наблюдалась в зиму 1968-69 гг.

раннее появление льда - конец ноября. Самое позднее полное очищение - начало марта.

Физико-химические свойства воды

Средняя годовая соленость водного залива за многолетний период составляет 15,7% при максимальном 17,1 % - в сентябре, в октябре и минимуме 11,9% - в июне.

Морская вода в районе порта обладает только сульфатной агрессивностью к бетону и железобетону на всех марках бетона.

Наносы. Передвижение донных наносов в Красноводском заливе носит характер местных по   и почти одинаково интенсивно, как с юга на север, так и обратно.

Донные наносы передвигаются всецело подчиняясь направлениям волнения и вызываемого им течения.

Заносимость искусственных прорезей не превышает 0,2 м в году.

5.I.2.2. Геологические условия.

На участке строительства паромной переправы от поверхности до отметки минус 9,5 - минус I0,5 м залегают илы текучие.
Под слоем илов- суглинки тугопластичные.
Указанные грунты характеризуются следующими физико-механическими показателями:

№№ пп	Физико-механические характеристики	Нормативные значения	
		Ил organic [illegible]	Суглинок clay
I.	Угол внутреннего трения	I0°	[illegible]8°
2.	cohesion Сцепление	0,0[illegible]	0,45 кг/см2
3.	Консистенция	[illegible],4	0,4
4.	Коэф.пористости	I,6	I,7I
5.	Объемная масса (γ)	I,53	I,99

Сейсмичность района, согласно СНиП II-А I2-69 равна 9 баллам.

5.I.3. Уровень Каспийского моря.

Многолетний ход уровня характеризуется непрерывным падением периодически прерываемое кратковременными повышениями (см. черт. .. I7501)
Общее падение уровня моря за период I900-I977 г. составило 3,49 м.
Годовой ход уровня имеет периодический характер с минимумом в январе-марте, максимумом- в июне, июле. Максимальная амплитуда сезонных колебаний достигает 50 см.

значительны сгонно-нагонные колебания амплитуда которых достигает I47 см (нагон 6I см и сгон 86 см)

Расчетные значения уровней различной обеспеченности в отклонениях от среднегодовых даны в табл.5.I.

Пункты	Отклонения уровней в см							
	Максимум	Обеспеченность уровня в %						Минимум
		I	5	90	95	99	99,9	
г.Баку	+58	+3I	+22	-16	-2I	-28	-35	-68
г.Красноводск	+52	+38	+27	-10	-24	-40	-62	-95

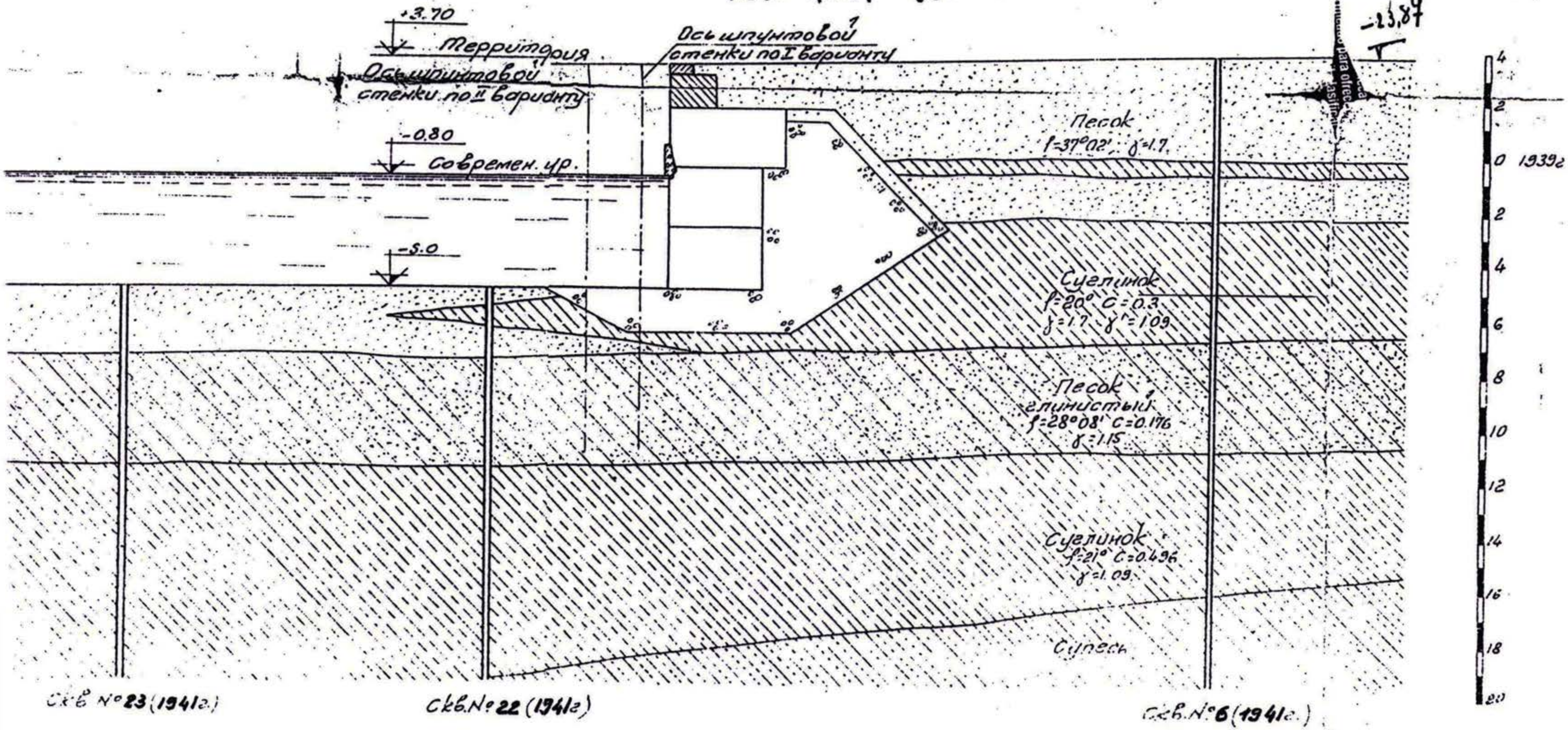
5.I.8.I. Современный уровень

За последнее десятилетие уровень моря неуклонно повышается. Достигнув к I977 г. своего крайнего низкого (среднегодового) положения. на отметке - I,66 м (-29.II м) уровень затем нáчал повышаться.К I987 г. среднегодовой уровень достиг отметки + 0,05 м(-27,32м). Среднегодовой уровень I988 г. ожидается на отметке + 0,I5 м (-27,22м).
Максимальные уровни в летние месяцы I988 г. (июнь, июль) достигали отмет ки +0,38 м (-27,I8м), исчерпав тем самым все официальное прогнозное значение (-27,50м) по письму Госкомгидромета СССР, имеющего юридическую силу.
Нового прогноза по отметке верхнего положения уровня в настоящее время нет.
Тенденция к повышению уровня, на основании сравнительного анализа хода уровней текущего и предыдущего годов, сохраняется.

annex 3

Геологический разрез

М=1:200. RENOVATION OF WEST QUAY '60.



Вид А-А

(Фасад оторочек)

М=1:100

Тумба

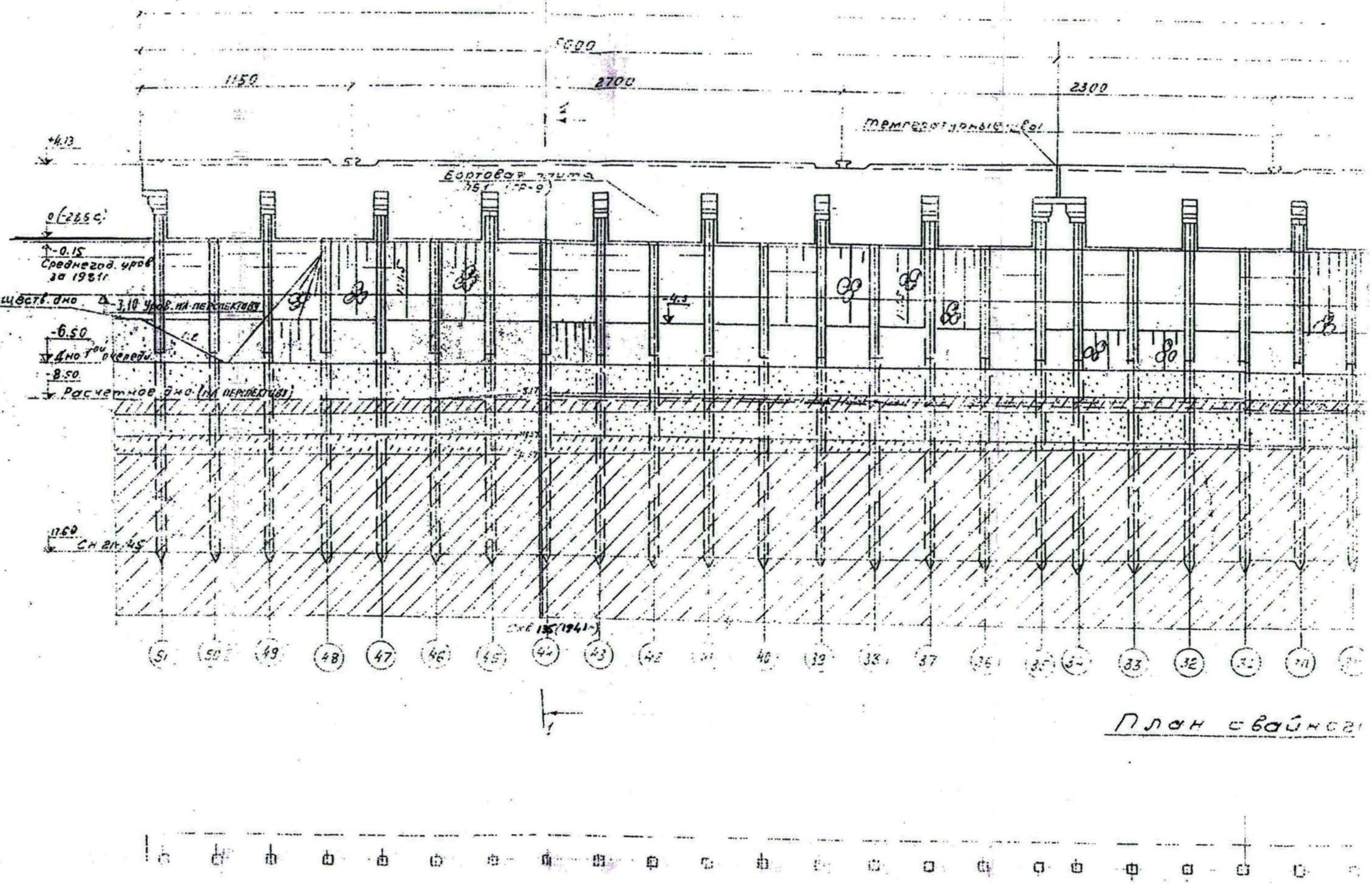
Песок = sand

СУГЛИНОК = clay

Ж б оголовок

+3.70

annex 2/1

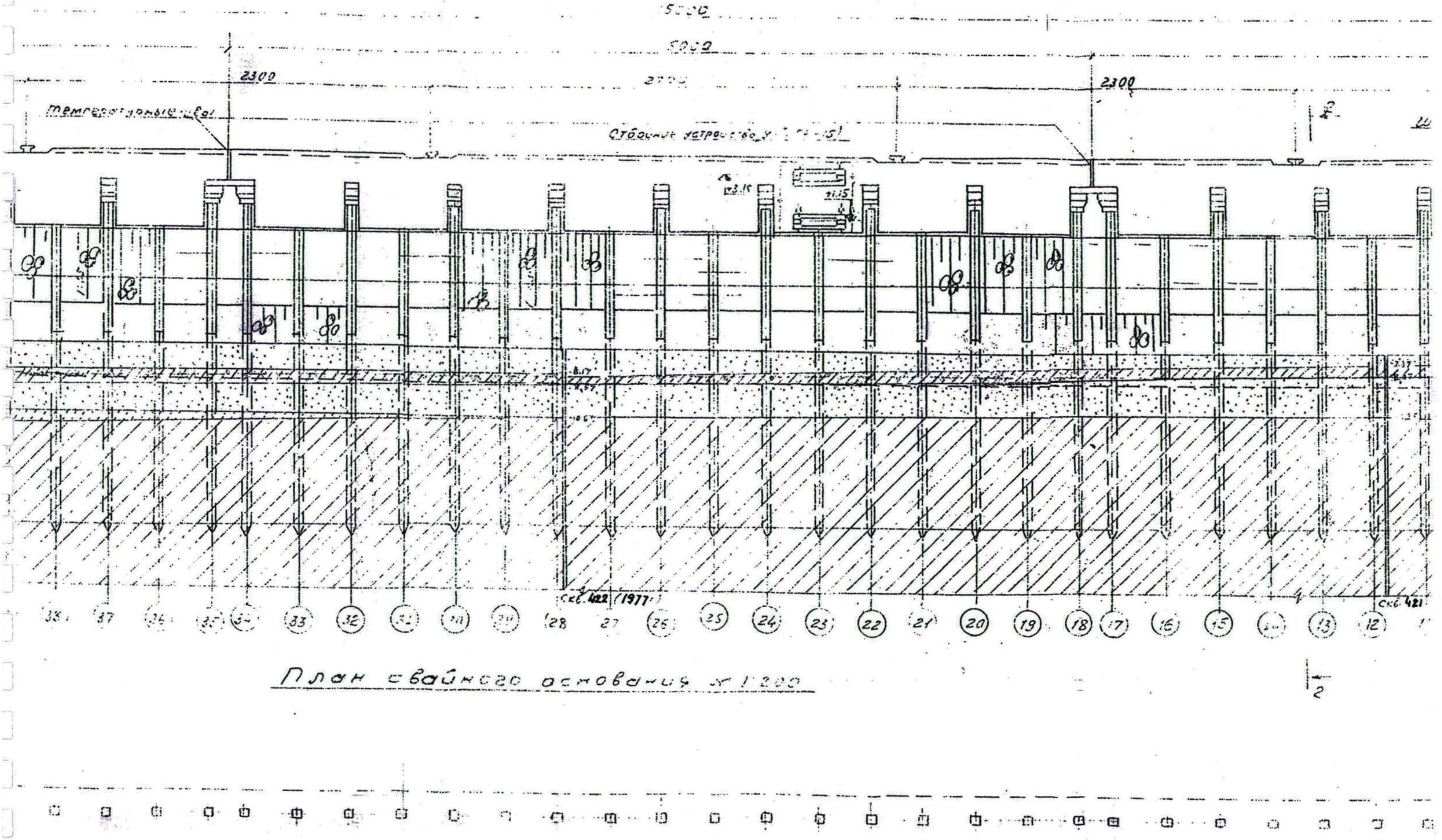


План свайного

Фасад М 1:200

QUAY EAST
Renovation - platform on piles.
project of 1982

annex 2/2

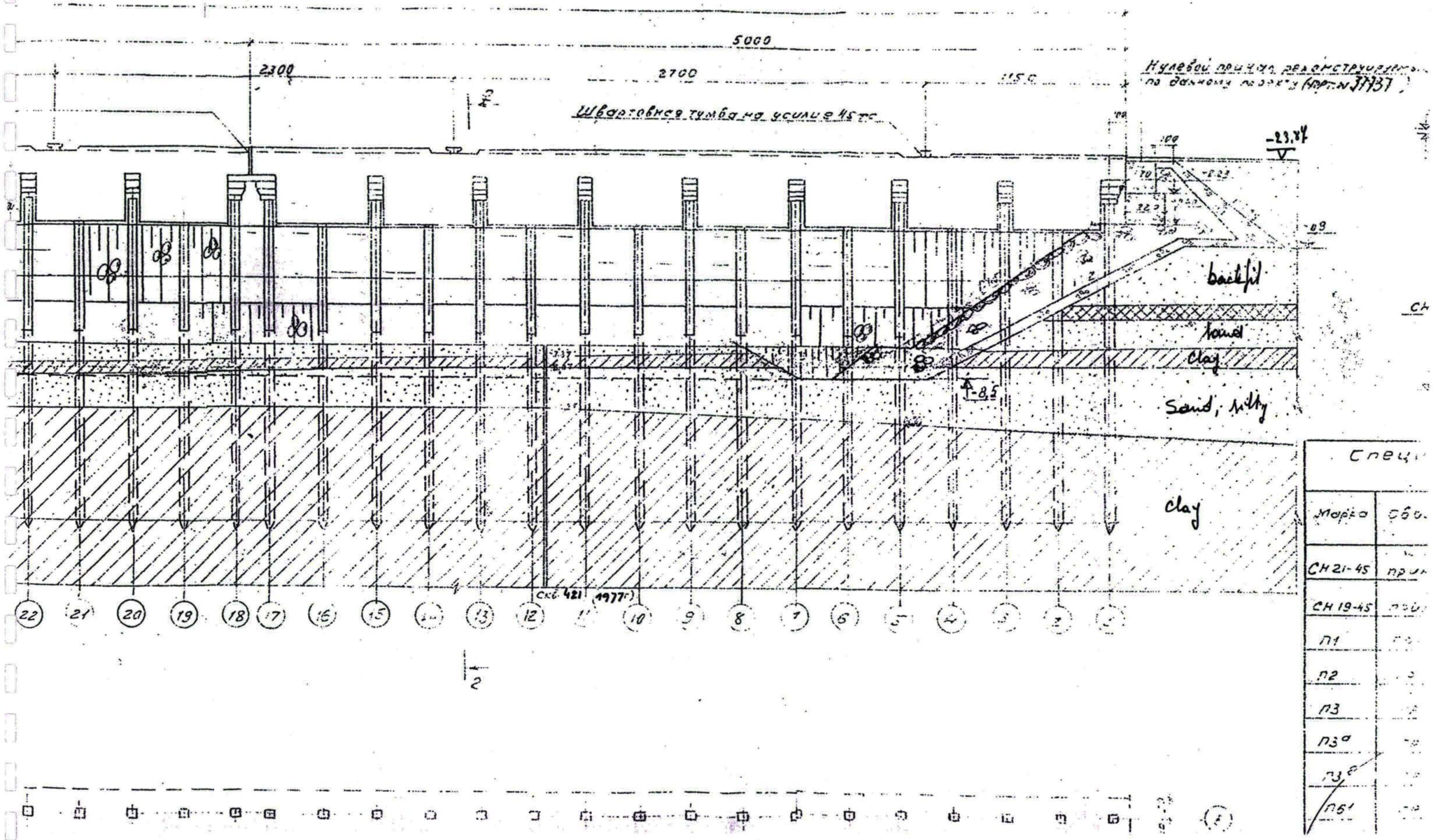


EAST

- platform on piles.

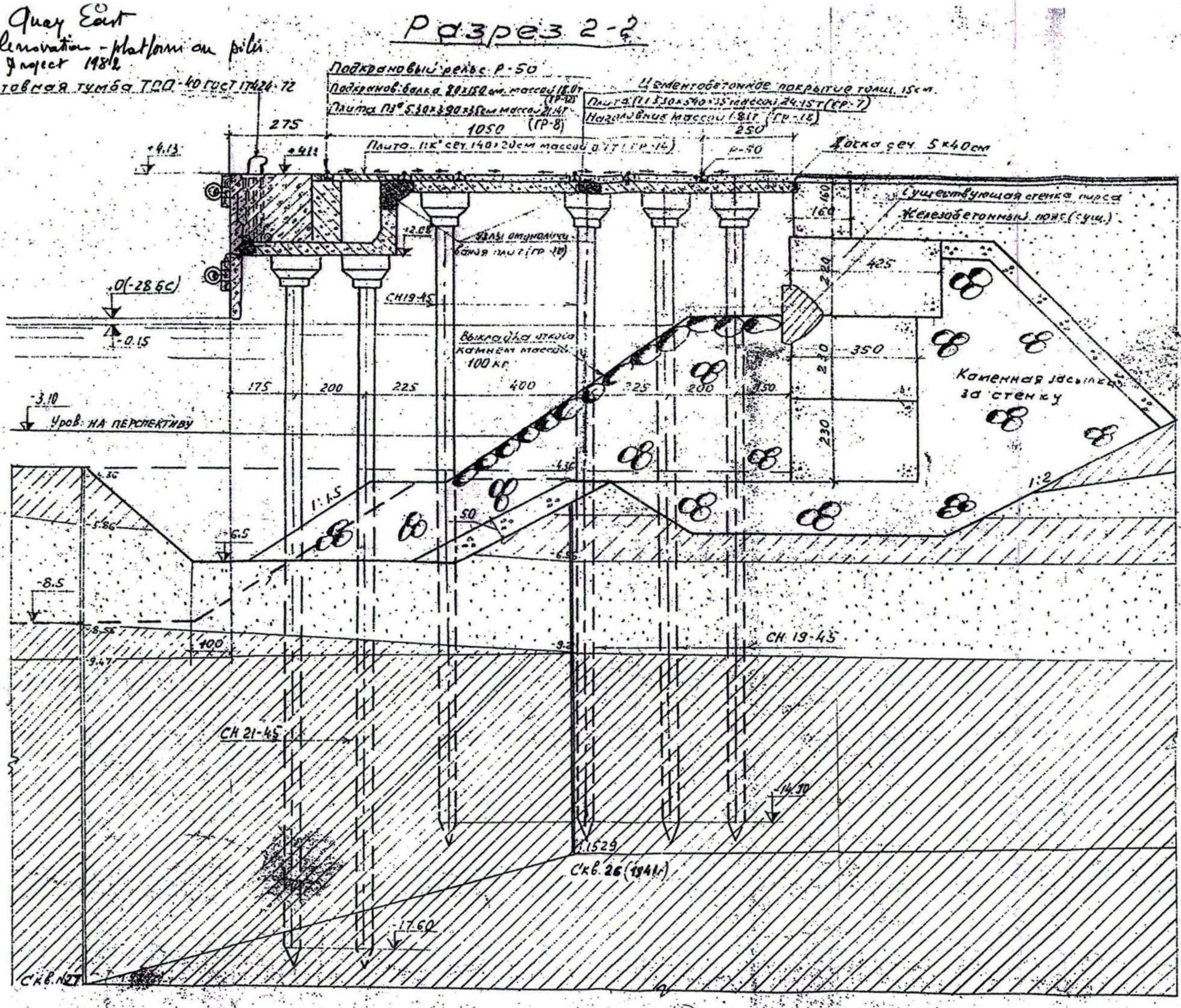
1982

annex 2/3.



Quay East
Renovation - platform on piles
Project 1982

Annex 4



Annex 3

Electricity Supply

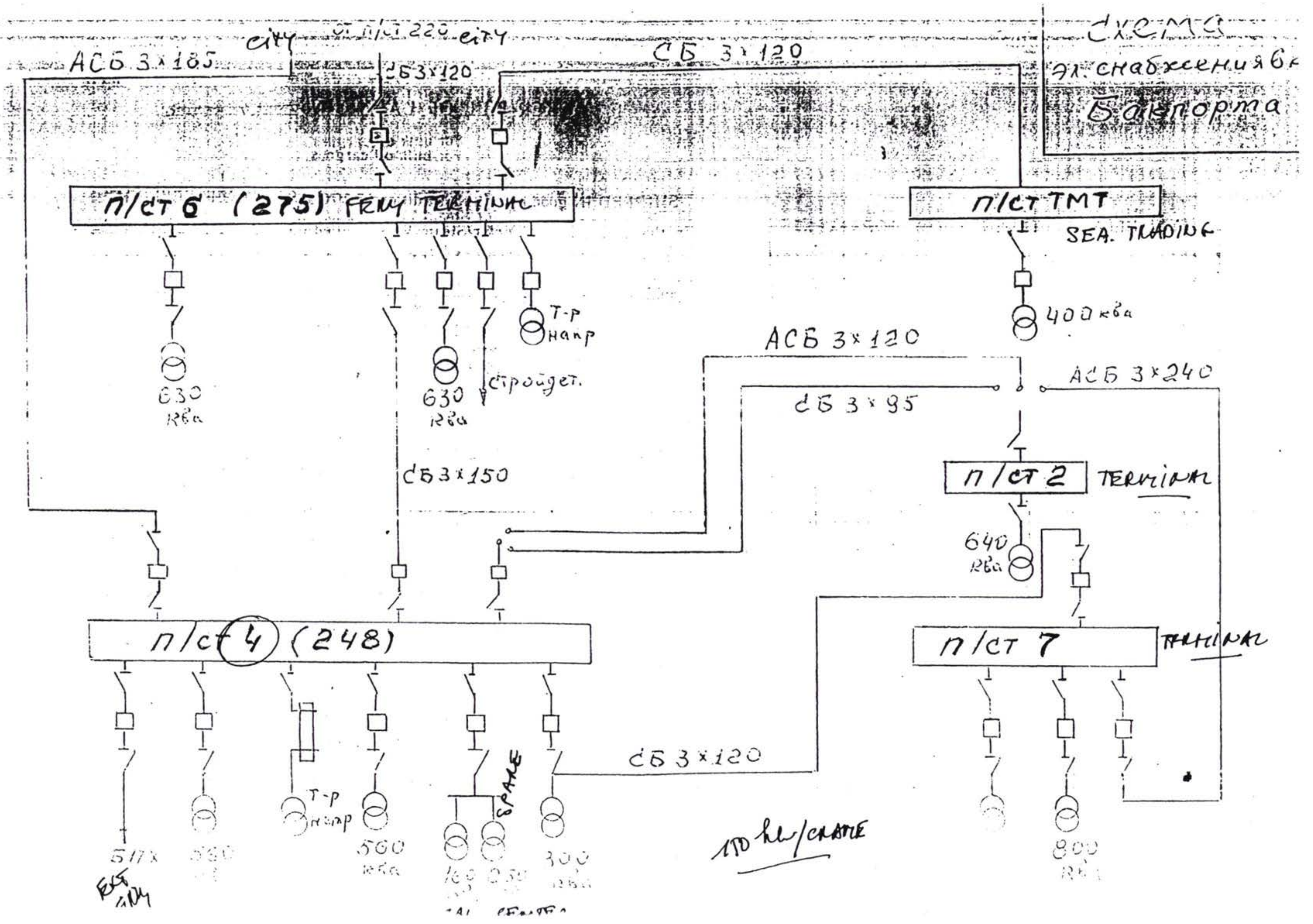
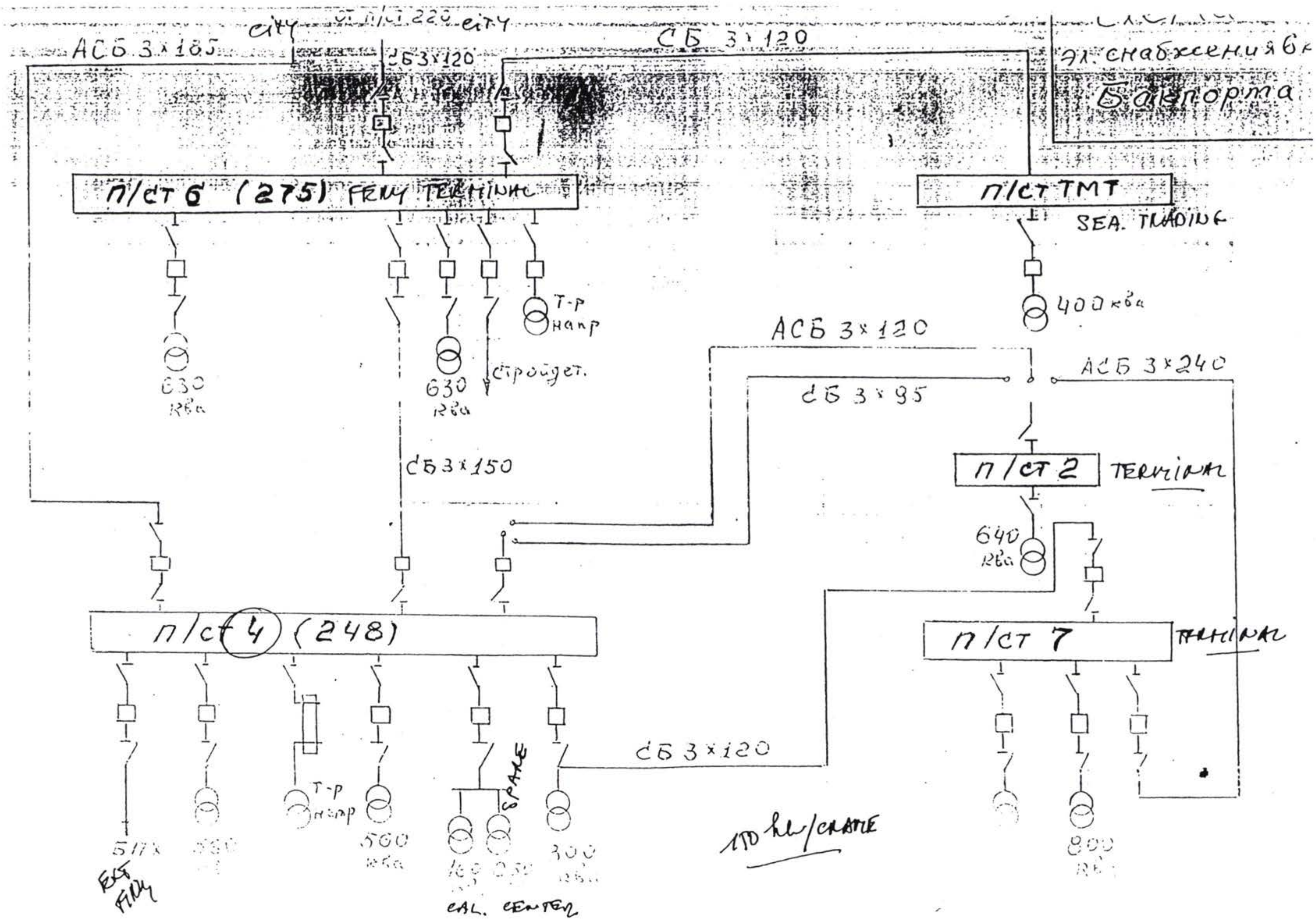
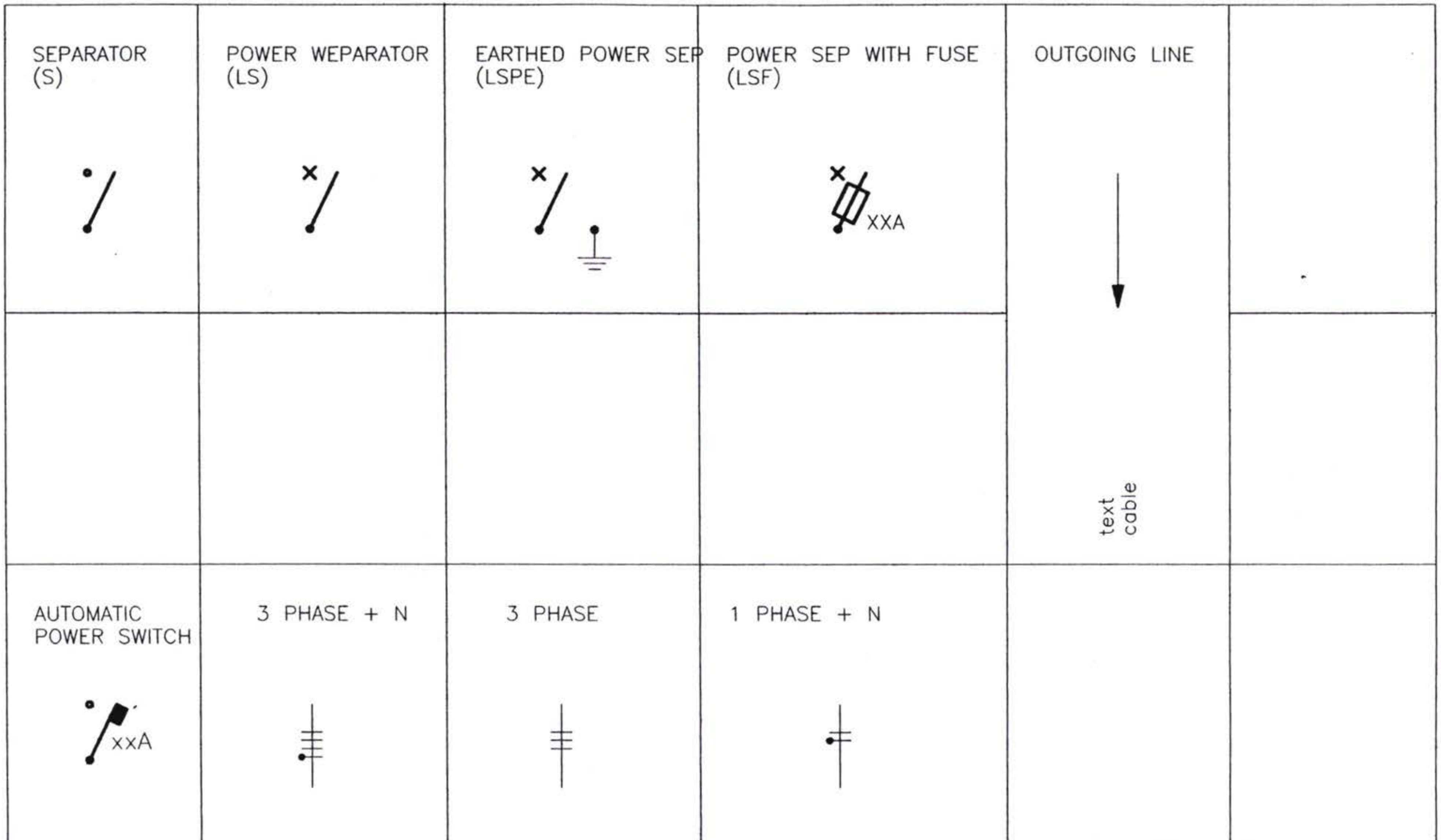


схема
эл. снабжения
АСБ 3×185
city
от п/ст 220 city
СБ 3×120
СБ 3×120
п/ст 6 (275) FERRY TERMINAL
п/ст ТМТ
SEA. TRADING
Т-р напр
400 кВа
630 кВа
630 кВа
стройдет.
АСБ 3×120
АСБ 3×240
СБ 3×95
СБ 3×150
п/ст 2
TERMINAL
640 кВа
п/ст 4 (248)
п/ст 7
TERMINAL
СБ 3×120
Т-р напр
560 кВа
SPARE
800 кВа
170 kw/crane
800 кВа



CITY
CITY
АСБ 3×185
СБ 3×120
СБ 3×120
эл. снабжения
П/СТ 6 (275) FERRY TERMINAL
П/СТ TMT
SEA. TRADING
Т-р напр
630 кВа
630 кВа
стройдет.
400 кВа
АСБ 3×120
АСБ 3×240
СБ 3×95
СБ 3×150
П/СТ 2
TERMINAL
640 кВа
П/СТ 4 (248)
П/СТ 7
TERMINAL
СБ 3×120
Т-р напр
SPARE
560 кВа
170 kw/CRANE
CAL. CENTER
800

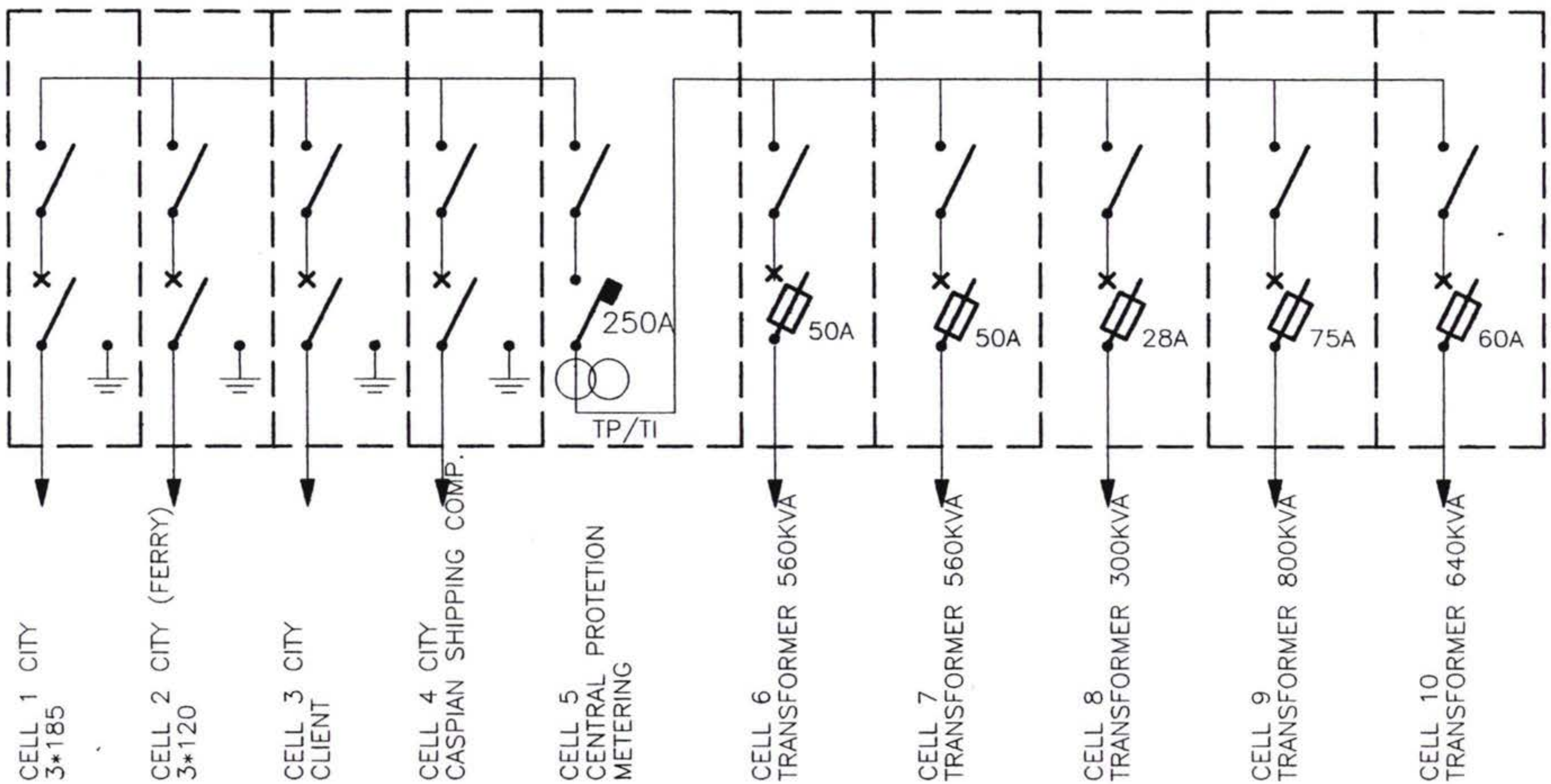


PORT OF BAKU
MAIN OPERATION AREA

LEGEND OF ELECTRICAL SYMBOLS

⊠ A B C D E F G H I J K DRAWING FILE : ELELEG

date of issue : 07/02/1997

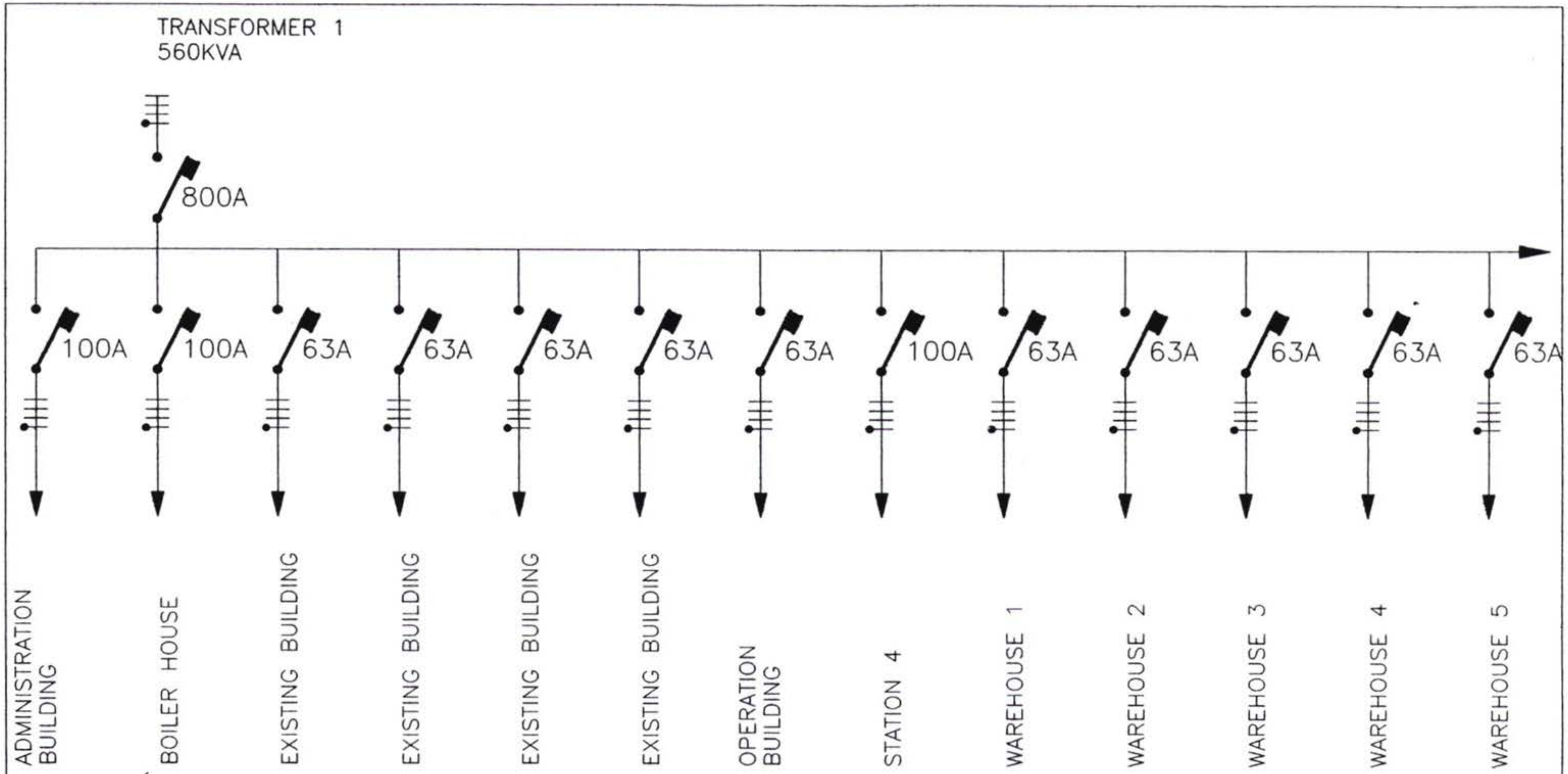


PORT OF BAKU

MAIN OPERATION AREA

0 A B C D E F G H I J K

HIGH VOLTAGE SCHEMATIC
NEW SITUATION
STATION NUMBER 4
date of issue : 07/02/1997



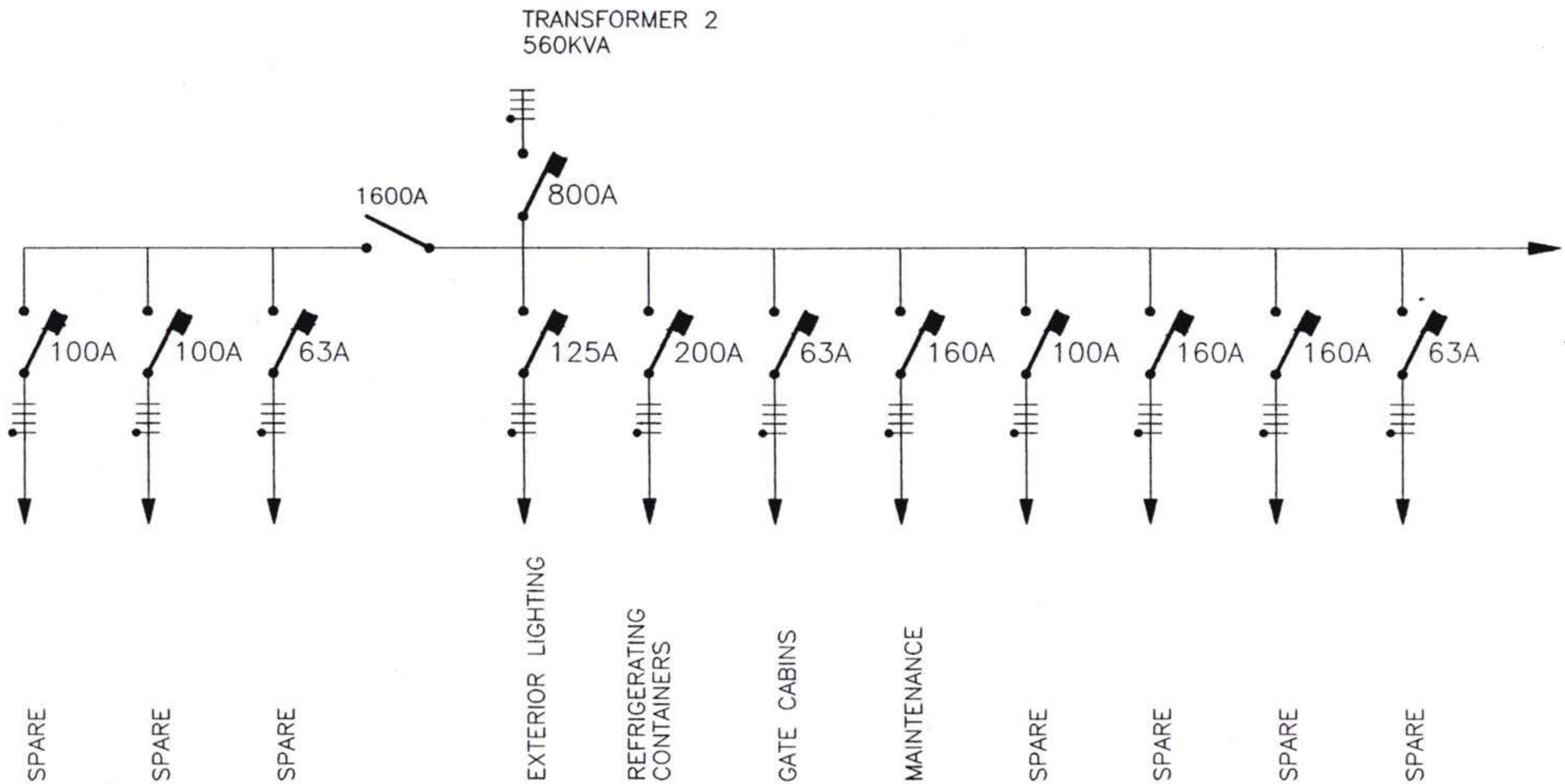
PORT OF BAKU

MAIN OPERATION TERMINAL

0 A B C D E F G H I J K

MAIN DISTRIBUTION PANEL
PAGE 1

date of issue : 08/02/1997



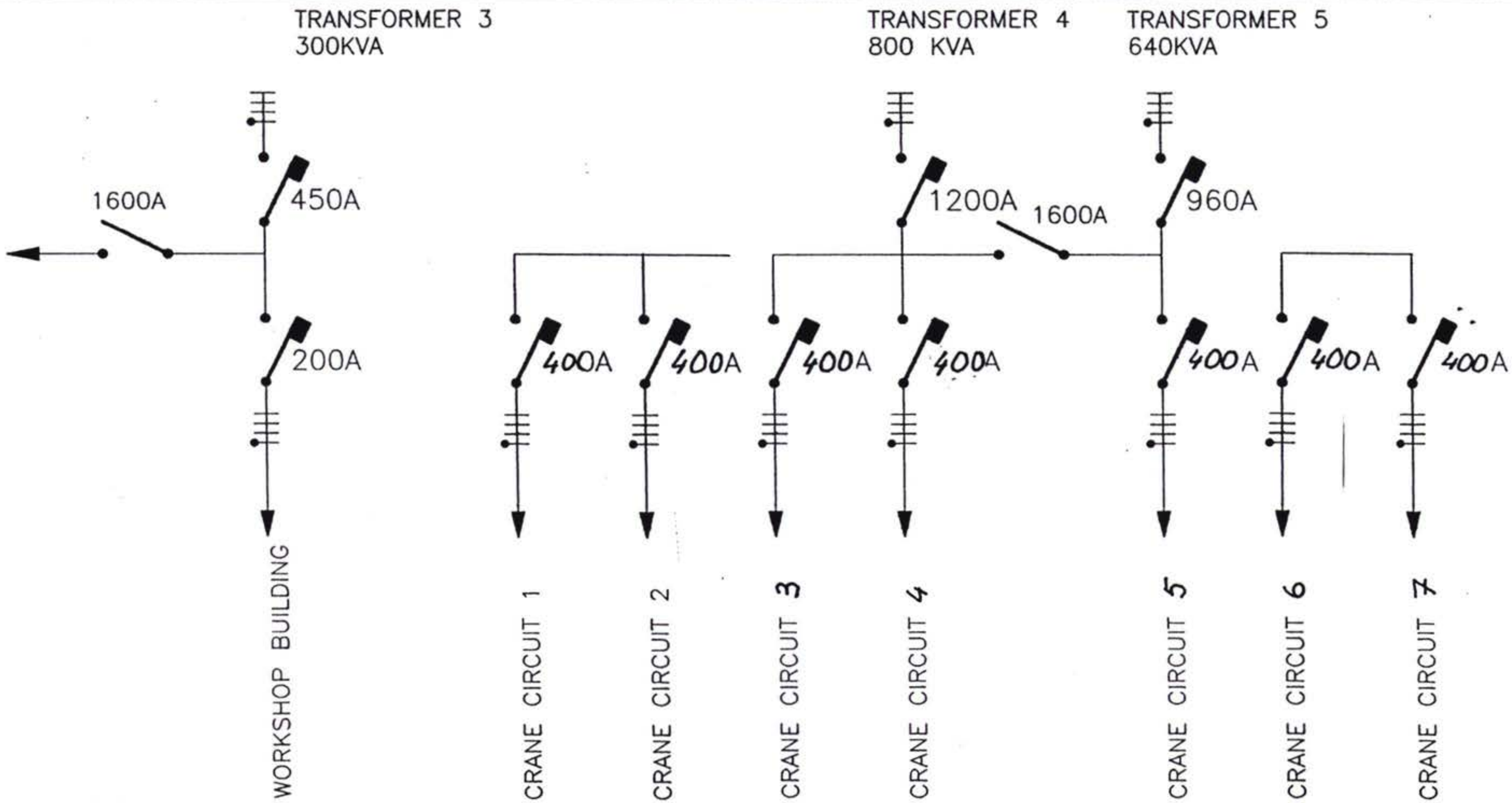
PORT OF BAKU

MAIN OPERATION AREA

0	A	B	C	D	E	F	G	H	I	J	K

MAIN DISTRIBUTION PANEL
PAGE 2

date of issue : 08/02/1997



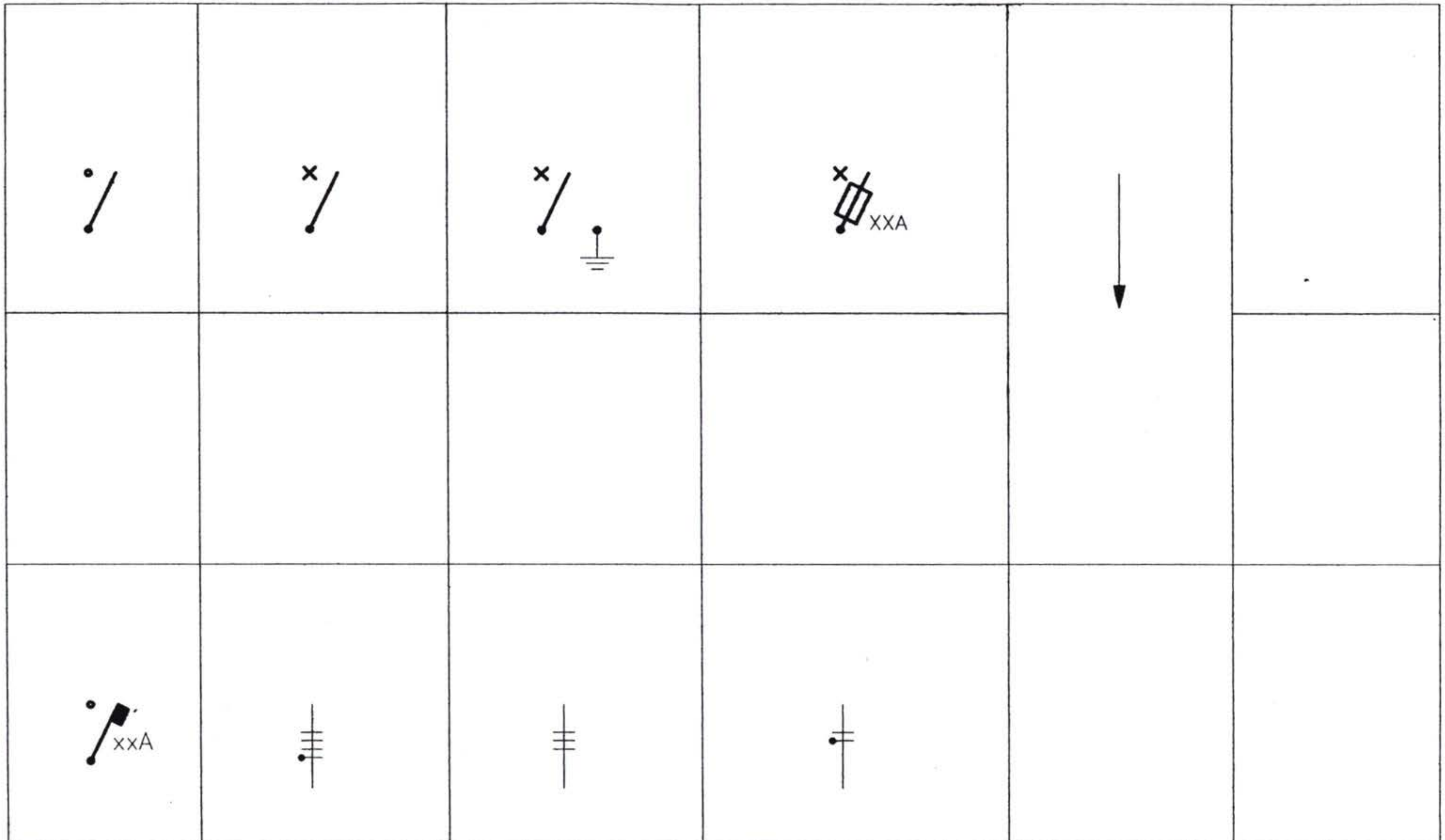
PORT OF BAKU

MAIN OPERATION AREA

☒ A B C D E F G H I J K

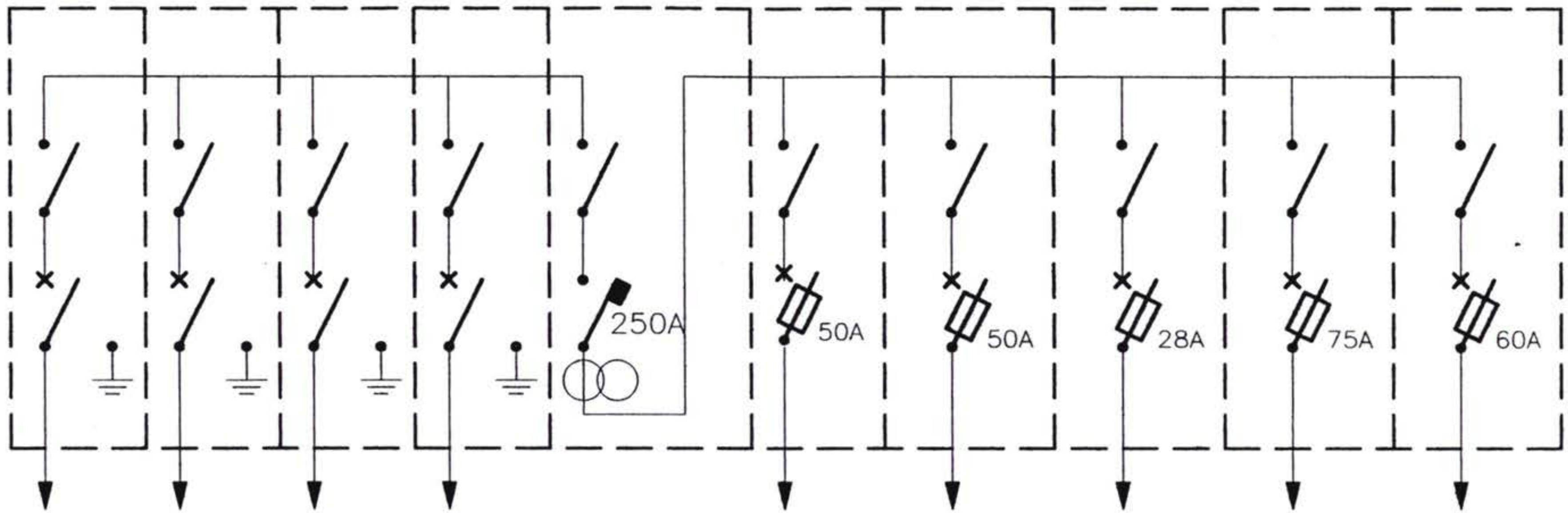
MAIN DISTRIBUTION PANEL
PAGE3

date of issue : 08/02/1997



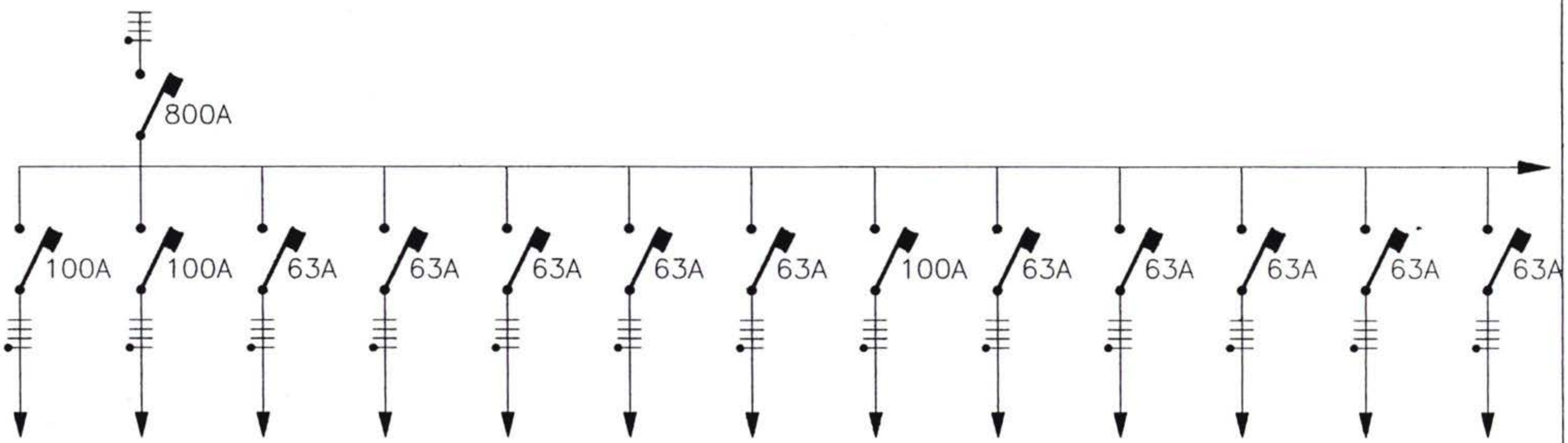
0	A	B	C	D	E	F	G	H	I	J	K

07/02/1997

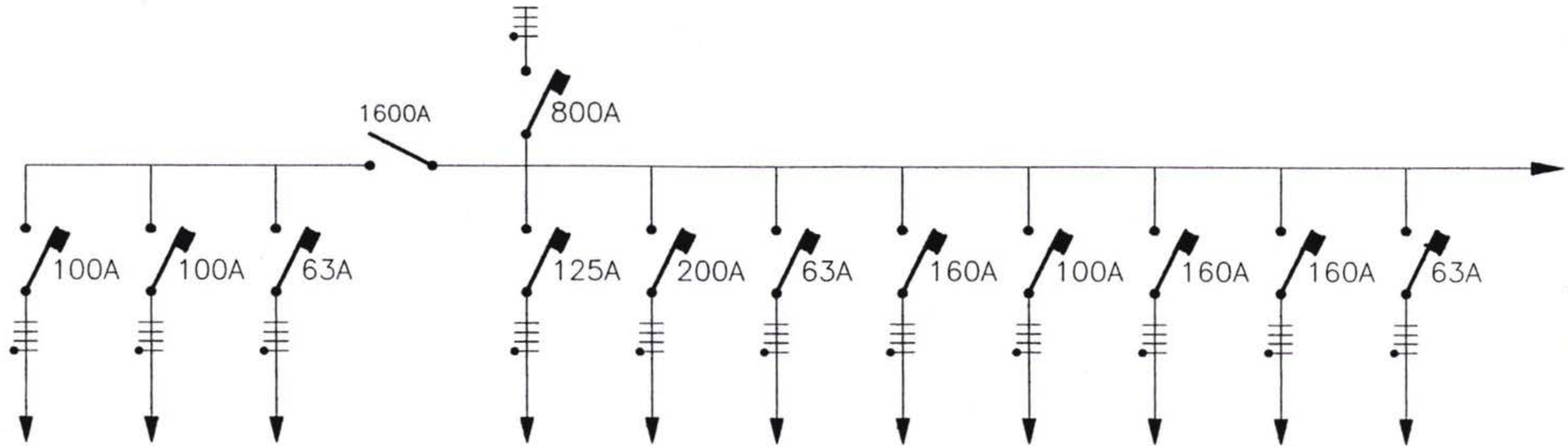


⊠ A B C D E F G H I J K

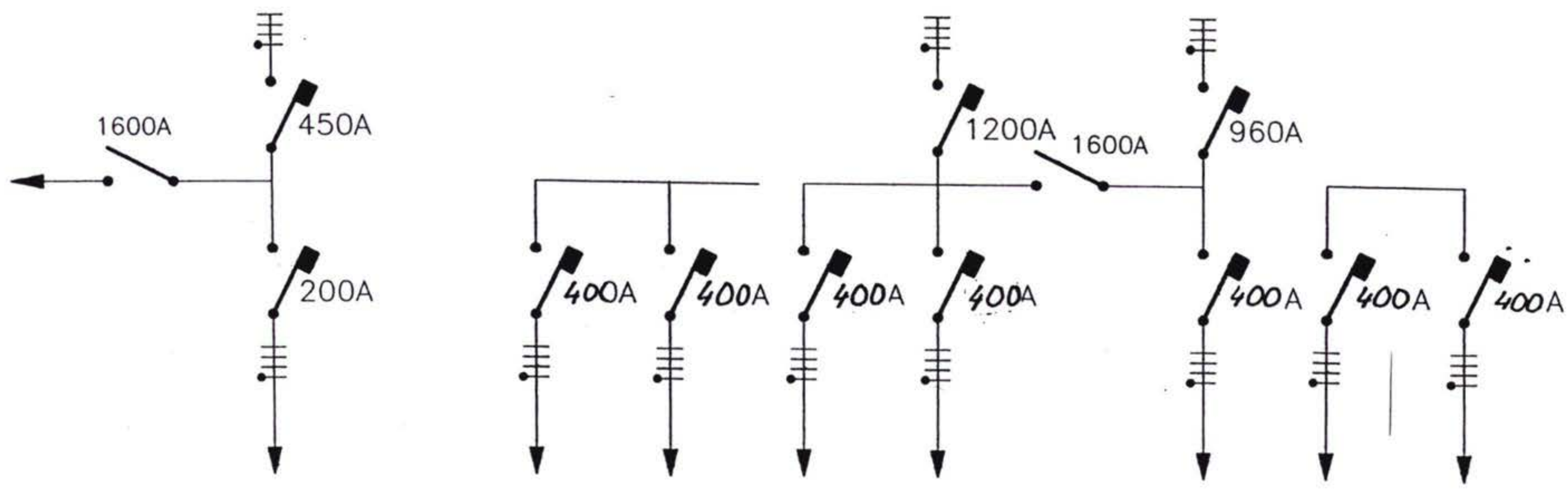
07/02/1997



0	A	B	C	D	E	F	G	H	I	J	K



0	A	B	C	D	E	F	G	H	I	J	K



☒ A B C D E F G H I J K