Chapter 5 Recommendations on port management and on short-term basis

5.1 Legal and Organizational Framework

5.1.1 Romanian Legal Structure regarding Port Management and Facilities

The present legal acts related to the Port Management and Facilities in Romania are shown in a previous chapter (See PART 1 Chapter 4). In this chapter, a detail examination will be done regarding ambiguous legal framework of port assets.

Regime of port assets

The infrastructure such as: natural land, land gained from the sea, land attached to the breakwaters, land attached to shelter breakwaters, quays, port basins, roads, passages and bridges have been considered as public property in the virtue of several laws, including the Constitution, but legally declared as such in the basis of art. 20(2) of Law no. 213/1998 through the GD no. 1045/2000 for the approval of inventories of assets belonging to state public property. MPWTH became their owner (on behalf of the state) and have the quality of “competent grantor authority” as mentioned in Law no. 219/1998.

Art. 40 (1) of Law no. 219/1998 provides that: "The assets which are public property of the state,….as well as public services of a national or local interest, are directly attributed to commercial entities, national companies or national societies established by the reorganization of autonomous regie – (RA s) which previously had these assets, activities or services in their administration, through a concession contract. This contract is concluded with the competent grantor authority for a period provided in the Government Decision or the local Council Decision for the establishment of that commercial entity."

Art. 2(5) of GD no. 517/1998 provide for the state public assets to be given in concession to CMPA for a duration of 20 years. As a commercial entity, CMPA can only have in concession the public property assets, as art. 135 of the Romanian Constitution provides expressly: only RA-s and public institutions can have public assets in direct administration, towards other entities they have to be conceded or rented.

Thus, according to the procedures provided by GD no. 216/1998, a contract of concession of port assets which are public property has been recently concluded between MPWTH and CPMA on the 1st of June 2001. It became effective on the 1st of July for a period of 20 years. It can be prolonged by another 10 years at the most.

The port infrastructure under CMPA's administration was divided into:

- land partially occupied with superstructure elements owned by CMPA or other commercial entities
- free land with no superstructure on it
- land conceded to some port operators (commercial entities), in conformity with the former law on concession, namely Government Decision no. 1228/1990, presently repealed and replaced by Law no. 219/1998.

These last concession contracts between CMPA (at that time CMPA was a autonomous regie - RA) and those port operators remain in force for their duration.

Up to now CMPA's commercial policy provided for the conclusion of two kind of contracts with port operators which had no concession contract:

- contracts for use of the port domain - each commercial entity, acting in the port, pays a monthly rent.
- contracts for rent of superstructure owned by CMPA (such as platforms, storehouses, offices).

The main part of port operators which are presently private are the heirs of the former publicly owned commercial companies. Some of them own port superstructure occupying public land. But practically, these operators have no legal right to stay on the port public land.

The situation of port operators owning superstructure situated on the public land has to be clarified and it is necessary to put port operators on a firm legal basis in order to make profitable use of the public assets.

But art. 28(6) of Law no. 219/1998 expressly provides that: "In all cases, the concession contract shall provide for the interdiction of concessionaire to grant sub-concessions of the concession object, either entirely or partially, to other person."

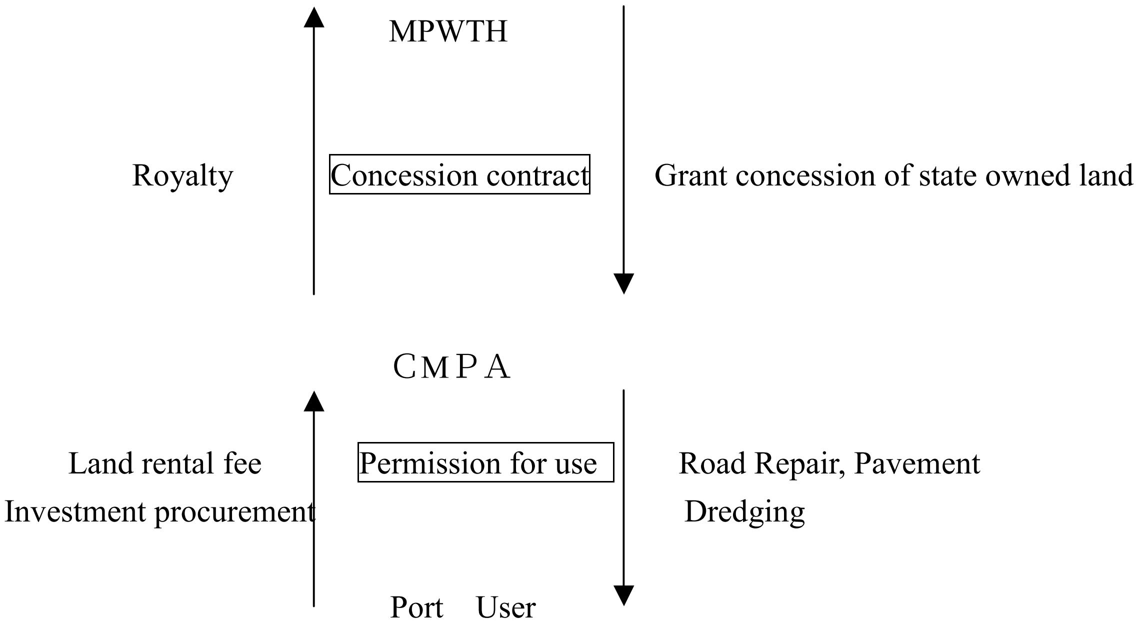
And also, art. 53(3) of GD no. 216/1998 provides that: "the concessionaire has the right to conclude contracts with third parties for ensuring and make profit of the exploitation of the assets which constitutes the object of concession*, without having the possibility to transfer to them any right gained in the virtue of the concession contract*".

So, the concession contract between MPWTH and CMPA provides for the interdiction to grant sub-concessions and also the interdiction to transfer any right obtained over these assets (which are: to exploit the assets directly, on its risk and responsibility, to use the assets and to collect what they produce). Practically, there is no legal possibility up to now to give the port operators a sound right to stay and use the port land.

MPWTH has recently initiated a procedure with the view to correct these anomalies. The basic modifications of the Law no. 219/1998 intended to be introduced and which concern ports are:

1. The possibility for the concessionaires under art. 40 of the law to sub-concede public assets covered by the concession with the special agreement of the initial grantor (so the possibility for CMPA to sub-concede public assets);
2. The possibility to have a direct sub-concession of public assets towards the port operators which are already using these assets since they were first in place.

CMPA must be clearly given the right to grant sub-concessions as a Port Management Body. The relationship between MPWTH, CMPA, Port User (operator) is after the Concession is finalized is envisaged below.



5.1.2 Organizational Framework of Constantza Maritime Ports Administration (CMPA)

Proposal on Organizational Framework of CMPA (LAW GIBB report)

The Organizational Framework was prepared in detail in "Romanian Ports Commercialization Enhancement Program" report in February 2000 by LAW GIBB.

In this report, several useful proposals are presented regarding changes to organizational structure in CMPA.

So it will be beneficial to review the proposal. The main points of this proposal are Rationalization of Departments and Use of the private sector in providing Branch Services.

Among the following proposals by LAW GIBB, we basically agree to A and B; however, we cannot agree to C as mentioned below.

A. Rationalization of Departments

The organizational structure of CMPA have five departments. Reducing the number of departments could be considered.

a. Domains and Port Services department

The Cadestre function (civil engineering skills for the improvement of records about port assets and technical support for future works) could be transferred to the Technical department which has the overall responsibilities for major expenditures by CMPA or within the port on equipments, new structure and refurbishment.

The contracts function (proceeding annual contracts with stevedores) performed in the Domains and Port Services department could be transferred to the Commercial department. There is common activity between the two departments with the Commercial department being responsible for negotiating all contracts for services supplied by CMPA.

With the above changes the Domains and Port Services department would be only responsible for security and the control of vehicles and people into the port and into building. In many ports, this function has been successfully left to the private sector. This has been mainly achieved through the use of service contracts. Given the operating environment and the alternative service providers available in Constantza, it is not considered that this would be appropriate in the short term. In the future, it would be desirable to leave the security function to the private sector which will be able to provide such function at lower costs and with the same or improved service standard. At least for the time being, it is not considered that this function requires a separate department. It is recommended that the function should fall under the responsibility of the Human Resources department.

b. Commercial and Financial department

There is a degree of synergy in the responsibilities for these two departments and hence there is room for integration. The principal duties are summarized as follows.

Commercial Department

Navigation of contracts for services supplied by CMPA
Establishing the port tariff
Invoicing
Purchase of sundry items
Printing

Financial Department

Financial services – receipt of revenues
Foreign investment office
Accounting department
Analysis department

The main benefit in integrating the two departments would be to facilitate the flow of information and improve business control. This is seen to be particularly relevant to establishing the level of port tariffs and for the financial aspects of contracts between CMPA and other users of the port. Given the existing staffing levels in these departments, significant savings in staffing costs could be realized through integration of the two departments.

B. Use of the private sector in providing Branch Services

The branch activities are distinguished from the five departments of CMPA in that income is directly earned from most of the services provided. The services covered include:

Port telecommunication
Supply of electrical and thermal energy
Within the port services branch (Transport department, Construction department, Installation department)
Within the technical vessel branch (Vessel operation department, Pollution control

and fighting department)

These functions are primarily non-core activities. The functions effectively cover supply of thermal and electrical energy, water, telecommunications and transports. These functions

account for around 50% of staff employed by CMPA and

realize 30% of the income of CMPA, but only 6% of recorded operating profits

These functions could be transferred to the private sector. It is considered that the introduction of the private sector to provide these functions would be beneficial. The benefits would be expected to arise out of efficiency enhancements and should lead to lower user charges.

C. Incorporation of the Harbor Master Function into CMPA

In LAW GIBB report, it says the role of Harbor Master is transferred into CMPA. The incorporation of the Harbor Master function into CMPA will facilitate control over ship movement, allocation of ships to berths and an integrated approach to handling dangerous goods. Additional benefits will arise from centralization of management information and potentially from a rationalization in resources employed by eliminating existing duplication of roles in CMPA and the Harbor Master.

But we disagree to transfer the role of Harbor Master to CMPA. The function to administrate port and that to supervise and lead the traffic control of vessel navigation in the port do not always correspond. It is possible that some conflicts of interests may occur. Therefore we believe these two functions should be divided and it desirable to cooperate and check each other.

5.2 Management and Operation System

5.2.1 Recommendation on Strengthening coordination function

Port of Constantza is also a public asset and therefore fair and transparent management is vital. At present, final decisions of CMPA are made by the board of directors(Council of Administration). The board consists of the General Manager of CMPA and five members from the Ministry of Public Works, Transport & Housing and three members from the Ministry of Finance. The board does not include relevant private organizations (for example, CFR, Free Zone Administration and so on), or a local government. When a port development plan is formulated, coordination process will be required among port related government and private organizations. To conduct this process smoothly, an efficient coordination system which involves various port related organizations should be introduced.

There are some examples which require such coordination. For example, the existence of feeder lines of CFR in the wharves decreases the efficiency of loading and unloading. And roads in the ports are narrow and have many sharp curves and many crossings with railways, which hinders the traffic flow in the port.

In order to adjust these issues, it would be useful to establish some kind of committee to coordinate the interests of related parties.

This committee should include the following members;

- CMPA
- CFR
- Free Zone Administration (South-Constantza & Basarabi)
- Local Government (City of Constantza)
- Port Users
- Persons of knowledge and experience

And main functions of this committee should be as follows

- Approval of port development plan
- Coordination among port management body, private organizations, port users, and local government
- Supervision of port activities

5.2.2 Problems of the Custom procedure and Policy of “Free Port”

(1) Problems of the customs procedures at present

The Romanian legislation provides that the customs duties be levied upon foreign goods that enter Romanian ports and the customs control can be carried out on the board. According to such provisions, the customs control is practically carried out on board. This procedure leads to delay in ship's operation as well as immobilization of a large amount of money for guaranteeing the customs duties upon import goods as well as transhipment goods.

The main articles related to customs procedures in ports are included in:

- Customs Code (CC) of Romania, which is established by Law no. 141/1997
- Regulation for the application of the Customs Code of Romania, approved by GD no. 626/1997

Art. 12 CC: “(1) The customs agent has the right to climb onboard any ship, including the military ones, which entered in the seaports or river ports or in their premises, in order to perform the customs control as provided by law.

(2) The captain or her first officer of the commercial or military ship is obliged to receive the customs authorities, to come along with them during the control and to give them the possibility to verify each place on the ship which is susceptible to hide goods or values which are subject to customs control.”

Art. 151 (1) CC: “Customs authority has the right to claim a guarantee covering the payment of customs duties.”

Art. 152 (1) CC: “The guarantee can be constituted as a bank deposit or a bank guarantee letter issued by a bank agreed by the customs authority.”

Art. 153 CC: “(1) The amount of the guarantee represents the exact amount of the customs duties where it can be determined in the moment when the guarantee is made.

(2) Where the amount of the guarantee cannot be determined, the biggest amount of the customs duties which would result from the customs clearing operation shall be considered.”

Art. 160 (1) Regulation: "The goods which were not subject to customs clearing when entering the country may be transported in customs transit on the Romanian territory under customs supervision and with a guarantee for customs duties"

Art. 59 (2) CC: "Where the customs regime provides for the payment of import duties or the deposit of a guarantee, the permit of clear from customs is granted only after fulfilling these obligations, in the terms and modalities provided in the present Code."

Art. 30 Regulation: "The Harbor Master allows the departure of ships in international traffic only after the customs authority sanctions the declaration of supplies on board and, if case, the cargo manifest."

(2) Regime of Free Ports in Romania

Considering the decrease of the port activities in Romania, which was more and more obvious in the latest years, due to the general decrease of industrial and agricultural activities, the adoption of certain measures for attracting the transit traffic and for promoting certain ports as distribution centers will be urgently required.

As shown above, the main issue in legislation is: *how to avoid the loss of time in the customs clearance process and how to avoid the requirement for large amount of guarantee money for customs duties.*

The regime of the free ports existing in countries of the European Union served as model for the measures provided for in the Government Ordinance no. 131/2000 regarding the establishment of certain measures for facilitating ports' exploitation.

The nomination of the free ports will be made by the Government, at the proposal of the MPWTH (with the approval of the Ministry of Public Finances).

The "Free Port" regime consists in the application of two main categories of measures which are intended to facilitate the port operation:

I. The application of the general rules for the Free Zones provided by the Romanian Customs Code (which follow the CCC) for the goods passing through the ports.

II. The application of a State aid scheme to the port operators for the purchase of port equipment from abroad, consisting in exoneration from the payment of import dues (customs tax and VAT).

A) Advantages

a) From the customs point of view

Measure to encourage the port use - Ships entering the Free Port are no longer subject to customs control before the discharging operations begin, so as the time the ship stays in the port will be reduced with 4-8 hours at least.

Measure to attract transit and distribution traffic through the port

- Foreign goods can be discharged in the Free Port or taken out from the Free Port without submitting customs declarations.
- While foreign goods stay in the Free Port no guarantee for the import dues is required.

Import dues are paid only for the parts of foreign goods taken out from the Free Port and introduced into the country and no longer for the entire quantity of goods introduced into the port.

Romanian goods introduced into the Free Port can be cleared before entering the port or after they are loaded onboard the ship, if they are to be exported.

For the foreign goods placed in the Free Port under a suspensive customs procedure such as inward processing, processing under customs control or temporary admission, no guarantee for the payment of customs dues is required.

For the foreign goods which are to be transited through Romania by water or railway, no guarantee for the payment of customs dues is required.

b) From the State aid point of view

Only the port operators and the port administration are exempted from the payment of import dues for the imported port equipment and installations which are destined to be used for port operations such as loading, unloading, transhipment of goods.

B) Constraints for the port activity:

The Free Port administration has to build the fence around the Free Port and all the access gates in the Free Port in conformity with the customs authority requirements.

The Free Port administration has the obligation to inform the customs authority, on its request, about the activities performed in the port.

Port operators have the obligation to keep stock records in conformity with the customs authority requirements and to inform the customs authority about this.

For all Romanian goods introduced into the Free Port which are destined either to export, consumption or use in the port, each commercial entity has to complete and submit to the customs authority simplified formalities for operative record keeping.

The Free Port gates are each designed to have special functions, which is for entrance, for exit, for passengers, for cars without goods etc.

Any type of building, permanent or provisional, which is to be made in a free port has to be approved by the customs authorities, prior to the commencement of the works.

(3) In the case of Romania joining the Community Customs Union, what will be the function of the Free Port ?

There are currently 32 free zones in operation in the Community. Only Austria, Sweden, the Netherlands, Belgium and Luxembourg do not have one but in some of them free warehouses have been approved.

From the point of view of the free ports administration, the G.O. no. 131/2000 brings no modification to the law framework established by the G.O. no. 22/1999. The customs authority exerts its functions of surveillance and control through the customs offices. It receives information from both the port administration and the port operators with regard to the activities performed in the port and the goods manipulated, in concordance with the Community Customs Code provisions.

Although G.O. no. 131/2000 establishes measures applicable in any port, when carrying it out, the view was directed to the ports of Constantza and Galatzi, which represent a high potential for the transit of goods towards other countries and for the distribution traffic within the Danube and Black Sea Area.

From the customs point of view the regime established for the free ports is completely harmonized with the community legislation regarding free zones. As regarding the state aid provided for in article 7 of the GO no. 131/2000, it is totally justified from the economic development point of view and constitutes no obstacle in the way of loyal competition among port operators.

When Romania will become part of the EU, the free port will be part of the Community customs territory. Community goods will have the same treatment as Romanian goods in the present and non-Community goods will have the treatment of foreign goods in the present.

In conclusion as the above mentioned, it necessary to abolish complicated and time-consuming procedures. The total port area of Constantza should be designated as a “Free Port”.

5.2.3 Influence of the Free Zone upon the Port of Constantza

(1) Legal acts related to Free Zone

The following specific laws and regulations apply in the Free Zone in Constantza South:

Law no. 84/1992 on the regime of Free Zones

GD no. 682/1994 for the approval of Methodology for concession of land and buildings in Free Zones

GD no. 410/1993 establishing the Free Zone Constantza South and the RA "Free Zone Constantza South Administration" modified by: GD no. 191/1997, GD no. 788/1997

Order of the Ministry of Transport no. 105/1996 for the approval of the Instructions for issuing work licences within Free Zones

In Free Zones also apply the specific provisions for the Free Zones provided for in:

Customs Code of Romania, which is established by Law no. 141/1997

Regulation for the application of the Customs Code of Romania, approved by GD no. 626/1997

(2) Law no. 84/1992 on the regime of Free Zones

The declared reason for establishing Free Zones in Romania is mentioned in this law, in art. 1:

"With the view to promote the international exchange and to attract foreign capital for the introduction of new technologies as well as for enhancing the possibility to use the resources of the national economy, the regime of Free Zone can be established in *Romanian sea and river ports*, *along the Danube - Black Sea Canal*, along other navigable canals and on territories near to the border crossing points."

According to this law, the management of a Free Zone is made by its own administration, which is organised and functions as a Regie Autonomous (RA).

The co-ordination body for the Free Zone administrations is the present Directorate General Free Zone Agency (former Free Zone Agency) within the Ministry of Public Works, Transport and Housing. It should also be mentioned that presently the Directorate General Free Zone Agency is under the Secretary of State for Public Works while the Directorate General for Maritime, on Danube river and Inland Waterways

Transport, which co-ordinates the port administrations, is under the Secretary of State for Transport.

The customs regime in the Free Zones is provided in the *Customs Code of Romania*, in a special chapter for Free Zones, the same which applies to Free Ports. This regime is in line with the Community Customs Code. Still, the Law no. 84/1992 provides for special fiscal facilities to apply in the Free Zones. These facilities are shown in the next table.

Art. 13 Law no. 84/1992	Means of transport and goods brought from or destined to a foreign country which enter or leave the FZ are exempted from the payment of customs duties and other taxes.
Art. 14 al.1 Law no. 84/1992	Companies performing activities within the FZ are exempted from the payment of VAT, excise and tax on profit.
Art. 17-19 Law no. 84/1992	Exemptions from the payment of customs duties for: Romanian goods used for construction, repairing and maintenance of objectives within the FZ ; Romanian materials and accessories entering the FZ and used for making other goods ; Goods transported from a FZ to another FZ.
Art. 29 Law no. 84/1992	But Goods made in the FZ and entering the Romanian customs territory are subject to the payment of customs duties ;
Art. 19 par.2 Law no. 84/1992 + Art. 160 al.1 Customs Regulation	Goods transported from a FZ to another FZ and passing on the Romanian customs territory are considered to be in transit and are subject to legal provisions: customs supervision and guarantee for customs duties.
Art. 15 Law no. 84/1992	Foreign natural persons or legal entities may transfer abroad the capital and profit, after payment of all duties to the Romanian State and contractual partners, when liquidating or restraining their activities within the FZ;
Art. 14 al.2 Law no. 84/1992	Transfer of profit is made according to the Romanian law.

Free Zones also benefit for a special methodology for concession of land and buildings, which derogates from the general *Law no. 219/1998 on the regime of concessions.*

Free Zone administrations, being organised as RAs, have the right to directly administrate public land and assets and also to concede or lease them. The royalties from these concessions and the leasing tariffs constitute revenue of the Free Zone administration.

The provisions of the *GO no. 22/1999 regarding the administration of ports and the services in ports* don't apply in the free zones (art. 1 par. (2)). *GO no. 42/1997 on civil navigation* apply where appropriate (no specification regarding the free zones).

(3) The Free Zone Constantza South

The Free Zone Constantza South and the RA "Free Zone Constantza South Administration" were established by the Government Decision no. 410/1993, on the basis of Law no. 84/1992 regarding the regime of Free Zones, by transferring land under the administration of the former RA "Constantza Port Administration" into the administration of RA FZCzaSA.

G.D. no. 410/1993 was amended twice in 1997 through:
G.D. no. 191/1997 for transferring back to RA CPA some land and
G.D. no. 788/1997 for the creation of RA " Administration of Free Zone Constantza South and Free Zone Basarabi" (designated below as FZA) by adding the Free Zone Basarabi as branch of the new FZA.

The FZA has as object of activity the administration and exploitation of the area declared free zone.

GD no. 191/1997 for the modification of the G. D. no. 410/1993 establishing the Free Zone Constantza South and the RA "Free Zone Constantza South Administration" , provides for:

"Art. 1 of the GD no. 410/1992 as modified - The Free Zone regime is established in the port complex Constantza South, on a land area of 37.00 ha, land gained over the sea as result of the hydrotechnical works in Constantza South Port, which is composed out of 2 platforms and the port land and quays that are to be carried out on the Eastern part of the pier II.S."

"Art. 4 of the GD no. 410/1992 as modified - The patrimony of the FZA is composed of:

the land area of 37.00 ha, with the existent afferent endowments and the quay afferent to the berth no. 119, having the length of 238 m;

The port land with a surface of 97.60 ha and the quays which are to be carried out on the Eastern part of the pier II.S. The quays afferent to the berths no. 128, 129 and 130, which are located on the pier II.S, having a length of 500 m, as well as a strip of land of 50 m breadth from the quay line to the inner part, having a surface of 2.50 ha, stay in the administration of the RA FZA up to the commencement of the building of the second phase of the development of the container terminal, which is the year 2007.

The warehouse built from the investment funds for the free zone which are transferred without payment from the patrimony of the state owned some commercial company in the patrimony of the RA FZA."

Through the GD no. 191/1997, some land was transferred back from the administration of the FZA to the former RA CPA, as follows:

"The land with a surface of 90.0 ha, carried out by fillings in Constantza Port, which includes the pier II.S and the part of land from the base of this pier to the technological lane of 44.0 m breadth, adjacent to the South breakwater, and the quays composed of the berths no. 122 - 127, fixed means and ongoing investments". (art. 1 of the GD no. 191/1997)

So, for the present, FZA has only the berth no. 119 and the adjacent quay which are operational. The quays afferent to the berths no. 128, 129 and 130, as GD no. 191/1997 says, stay in the administration of the RA FZA up to the commencement of the building of the second phase of the development of the container terminal, which is the year 2007, which can be interpreted as they are going to be excluded from the patrimony of the FZA before becoming operational.

There are still the berths from 131 - 137 and the adjacent quays, which are only planned for the time being, that are under the FZA and no transfer is envisaged for.

No legal provision clarifies what is the distribution of responsibilities concerning the water front area adjacent to the berth no. 119. As the GD no. 22/1999 doesn't apply in the free zone, it means that it applies up to the quay. So, the water area is under the administration of CMPA and the port services attached to this water area are subject to the GD no. 22/1999, while the services attached to the land area (berth no. 119 and quay) are under the free zone regime. Also the FZA has to maintain the quay afferent to the berth no. 119, so the FZA is supposed to collect the quay tariff while CMPA collects the tariff for entering the port.

The relevant activities of Inspectorate of Civil Navigation (ICN) and Harbour Master apply as well in the free zone.

(4) Comparison between the legal situations of FZA and CMPA

The FZA is organised as a RA having the right to administrate the land which is public property and to concede or lease land and buildings within the free zone, according to Law no. 84/1992 and the special procedure for concession of land and buildings within free zones regulated by GD no. 682/1994. The royalties from these concessions constitute revenue of the FZA.

CMPA is a commercial body and has the public land and assets in the port under concession. For these public assets, CMPA has to pay royalties to the state. In this stage, for the time being, it has no right to sub-concede.

All operators within the FZA enjoy financial benefits offered by Law no. 84/1992. Operators within the Constantza Port cannot enjoy financial benefits at present..

The FZA is clearly surrounded and delimited by fences and the customs authorities perform the control of goods entering or leaving the area at the entrance and exit gates.

In Constantza Port, customs control is still made onboard ship, before unloading, and at the loading place, before the commencement of the loading operations.

The FZA issues *work licences* for all FZ users. The work licence represents the document on the basis of which the FZA allows to an economic agent, Romanian or foreign natural person or legal entity, which is called *user*, to perform activities in the free zone on the basis of the concluded contracts. These contracts can be: contracts of concession, lease, association or service performance, concluded between the FZA and the users or between the users and third entities.

FZA issues the work licenses for 1 year period, against payment of a tax of a much higher amount of money than the *authorizations* issued by the ICN for performing port activities in Constantza Port. The tariff connected to the services performed by the FZA for issuing the work license is also to be paid by the user when receiving the work license.

If all the Constantza Port is declared as Free Port, the differences, except the customs procedures, still remain. The Free Zone will continue to offer the users a range of important fiscal facilities. The port operators in the Free Port area will enjoy limited benefit by the fiscal facility provided in the article no. 7 of the GD no. 131/2000.(exemption from the payment of import dues)

(5) Proposed Solutions

Since a part of the port waterfront (both water-side and land-side close to quay) is legally beyond administrative authority of CMPA, some difficulties may arise in berth allocation and construction of port facilities (for example a reclamation, a road construction) in the future. It is supposed the conflicts with the port management body and concessionaire will occur in the port planning.

The waterfront area is vital for the port planning. It's indispensable for the port management body to administer the waterfront area.

It is desirable that CMPA secures administrative authority over the land-side area sufficient for administration behind the quay. It will be necessary to transfer a part of the Free Zone Administration's authority to CMPA, which will require modification of the existing GD concerning the Free Zone.

CHAPTER 6 CARGO HANDLING EQUIPMENT

6.1 Introduction

This chapter deals with the preliminary design of major cargo handling equipment including those proposed in the Short Term Development Plan following the Master Plan.

The Short Term Development Plan includes the following terminals:

6.1.1 Scope of the Objective Terminal

The Short Term Development Plan includes the following terminals:

(1) Grain Terminal (Phase 1)
(2) Barge Terminal
(3) Others
  a. Steel Products Terminal (Multi-Purpose General Cargo Terminal)
  b. Timber Terminal (Multi-Purpose General Cargo Terminal)

The following Sections are the detailed descriptions on each terminal, obtained through the continuing studies.

6.1.2 Summary of the Study

The summaries of the descriptions are as follows:

(1) Grain Terminal (Phase 1)

The terminal will be newly constructed at Pier S3, and will be designed based on the following concepts.

a. Cargo volume to be handled:
  i. Export and transit (export): 2.0 million tons per year
  ii. Import and transit (import): 0.5 million tons per year

b. Grain receiving facilities:
  i. From barges and/or vessels: 2 units of each 400 ton/hr (2 nozzles x 200 ton/hr) pneumatic unloaders
  ii. From railway wagons: 2 units of each 400 ton/hr receiving hopper
  iii. From road trucks: 1 unit of 100 ton/hr receiving hopper

c. Silos:
   - i. Main silos: 20 units of each 5,000 ton storage capacity
   - ii. Buffer silos: 3 units of each 500 ton storage capacity

d. Grain delivery facilities:
   - i. To vessels and/or barges: 2 units of each 800 ton/hr loaders
   - ii. To railway wagons: 1 unit of 200 ton/hr loading chute
   - iii. To road trucks: 1 unit of 100 ton/hr loading chute

(2) Barge Terminal

At the Barge Terminal, no cargo handling equipment is considered since this terminal is mainly for the standby and preparation areas for the next trip up-stream of the barges. Even so, when any equipment is required, it will be provided by the related private sector operators, thus no equipment is provided here.

(3) Other Terminals

a. Steel Products Terminal (Multi-Purpose General Cargo Terminal)

According to the study results, the existing cargo handling equipment at the terminal has enough capacity for handling forecast cargo volume.

The Terminal will be used for multi-purpose general cargo handling mainly for steel products. Other commodities will be also handled.

b. Timber Terminal (Multi-Purpose General Cargo Terminal)

According to the study results, the existing cargo handling equipment at the terminal has enough capacity for handling forecast cargo volume.

The Terminal will be used for multi-purpose general cargo handling mainly for timber. Other commodities will be handled also.

6.1.3 Study Flow on Cargo Handling Equipment

The study on cargo handling equipment is carried out according to the following items:

(1) Cargo Characteristics

a. Cargo Volume to be handled
b. Cargo Traffic
c. Cargo Flow through the Terminal

(2) Transportation Means

a. Sea Transportation

b. Inland Transportation:
   i. Inland Waterway
   ii. Railway
   iii. Road

(3) Cargo Handling Means

a. Cargo Handling Facilities:
   i. System Layout
   ii. Traffic Rout

b. Cargo Handling System:
   i. Consisting Cargo Handling Equipment
   ii Outline Specifications of Cargo Handling Equipment

c. Cargo Handling Equipment:
   i. Type Selection
   ii. Number and Capacity Calculation

The following chapters are the results of the studies according to the study flow described above.

6.2 Grain Terminal

6.2.1 Cargo

(1) Cargo Volume to be Handled

Cargo volume to be handled at the grain terminal is based on the values described in PART II, Chapter 3.

a. Export and Transit (Export)

For the purpose of planning the grain handling equipment, the grain volume of 2,000,000 tons/year is based on the forecast of cargo volume.

b. Import and Transit (Import)

For the purpose of planning the grain handling equipment, the grain volume of 500,000 tons/year is based on the records of past years. This value is not necessarily being added to the export and transit (export) values. Grain import may be required when the domestic harvest is extremely low.

(2) Cargo Traffic

Data of the modal split (i.e. the traffic ratio by transportation means) for both river traffic and land transportation covering export, import and transit, is based on the values described in PART II, Chapter 4.

The traffic ratio adopted for planning the grain handling equipment is shown in Table 6.2.1 (2) Modal Split - Grain Transportation.

a. Export and Transit (Export)

Cargo volumes for export and transit(export) by transportation means is calculated based on the values of modal split.

Cargo volume for export and transit(export) by transportation means is shown in Table 6.2.1 (2) a. Cargo Traffic - Export.

b. Import and Transit (Import)

The cargo volume for import and transit(import) by transportation means is calculated based on the values of modal split.

Cargo volume for import and transit(import) by transportation means is shown in Table 6.2.1 (2) b. Cargo Traffic - Import.

(3) Cargo Flow

a. Export and Transit (Export)

Cargo flows of export and transit(export) through the grain terminal are shown in the following Figures:

Figure 6.2.1 (3) a. 1/3 Cargo Flow Chart - Export Cargo
Figure 6.2.1 (3) a. 2/3 Cargo Flow Chart - Transit (Export) Cargo
Figure 6.2.1 (3) a. 3/3 Cargo Flow Chart - Total Export & Transit (Export) Cargo

b. Import and Transit (Import)

Cargo flows of import and transit(import) through the grain terminal are shown in the following Figures:

Figure 6.2.1 (3) b. 1/3 Cargo Flow Chart - Import Cargo
Figure 6.2.1 (3) b. 2/3 Cargo Flow Chart - Transit (Import) Cargo
Figure 6.2.1 (3) b. 3/3 Cargo Flow Chart - Total Import & Transit (Import) Cargo

Table 6.2.1 (1) Modal Split - Grain Transportation

No.	Category	River Traffic Ratio (River Traffic / Maritime Traffic)						Land Transportation Mode Share			
		Discharged from River Ves.		Loaded to River Ves.		Sub Total		Export + Import		Transit	
		Export (Cabotage)	Transit	Import (Cabotage)	Transit	Export+Import (Cabotage)	Transit	Railway	Road	Railway	Road
1	Maximum	0.30	0.90	0.30	0.90	0.30	0.90	0.90	0.10	1.00	0.00
2	Minimum	0.20	0.80	0.20	0.80	0.20	0.80	0.70	0.30	1.00	0.00
3	Average	0.25	0.85	0.25	0.85	0.25	0.85	0.80	0.20	1.00	0.00

Note: 1. For river trafic, the average value has been adopted for planning cargo handling equipment.

2. For land transportation, the maximum value has been adopted for planning cargo handling equipment, because the grain transportation by railway can be considered to be of an overwhelming majority.

Table 6.2.1 (2) a. Cargo Traffic (Export)

Destination	Category	Arriving at Port of Constantza by:	Ratio by Transportation Means (%)	**Grains Total (tons/year)**	Ratio by Category (%)	Maize (tons/year)	Wheat (tons/year)	Others* (tons/year)
Export by Ocean-going Vessels (Loading)	Domestic Grains (Unloading)	Inland Waterway Barges	25.0	**250,000**	-	125,000	87,500	37,500
		Railway Wagons	67.5	**675,000**	-	337,500	236,250	101,250
		Road Trucks	7.5	**75,000**	-	37,500	26,250	11,250
		Total	**100.0**	**1,000,000**	**50**	**500,000**	**350,000**	**150,000**
		Ratio by Commodities (%)	-	**100**	-	50	35	15
	Transit Grains (Unloading)	Inland Waterway Barges	85.0	**850,000**	-	425,000	297,500	127,500
		Railway Wagons	15.0	**150,000**	-	75,000	52,500	22,500
		Road Trucks	0.0	**0**	-	0	0	0
		Total	**100.0**	**1,000,000**	**50**	**500,000**	**350,000**	**150,000**
		Ratio by Commodities (%)	-	**100**	-	50	35	15
	Total (Unloading)	Inland Waterway Barges	55.0	**1,100,000**	-	550,000	385,000	165,000
		Railway Wagons	41.3	**825,000**	-	412,500	288,750	123,750
		Road Trucks	3.8	**75,000**	-	37,500	26,250	11,250
		Total	100.0	**2,000,000**	**100**	**1,000,000**	**700,000**	**300,000**
		Ratio by Commodities (%)	-	**100**	-	50	35	15

*: Barley,

Table 6.2.1 (2) b. Cargo Traffic (Import)

Destination	Category	Leaving from Port of Constantza by:	Ratio by Transportation Means (%)	**Grains Total (tons/year)**	Ratio by Category (%)	Maize (tons/year)	Wheat (tons/year)	Others* (tons/year)
Import by Ocean-going Vessels (Unloading)	Domestic Needs (Loading)	Inland Waterway Barges	25.0	**87,500**	-	13,125	30,625	43,750
		Railway Wagons	67.5	**236,250**	-	35,438	82,688	118,125
		Road Trucks	7.5	**26,250**	-	3,938	9,188	13,125
		Total	**100.0**	**350,000**	**70**	**52,500**	**122,500**	**175,000**
		Ratio by Commodities (%)	-	**100**	-	15	35	50
	Transit Needs (Loading)	Inland Waterway Barges	85.0	**127,500**	-	19,125	44,625	63,750
		Railway Wagons	15.0	**22,500**	-	3,375	7,875	11,250
		Road Trucks	0.0	**0**	-	0	0	0
		Total	**100.0**	**150,000**	**30**	**22,500**	**52,500**	**75,000**
		Ratio by Commodities (%)	-	**100**	-	15	35	50
	Total (Loading)	Inland Waterway Barges	43.0	**215,000**	-	32,250	75,250	107,500
		Railway Wagons	51.8	**258,750**	-	38,813	90,563	129,375
		Road Trucks	5.3	**26,250**	-	3,938	9,188	13,125
		Total	100.0	**500,000**	**100**	**75,000**	**175,000**	**250,000**
		Ratio by Commodities (%)	-	**100**	-	15	35	50

*: Rice, etc.

Figure 6.2.1 (3) a. 1/3 Cargo Flow Chart: Case 1, Grain Exports in 2010

Export Cargo

Handling Commodity: **Grains**
Project Year: **2010**
Case: **Case 1**

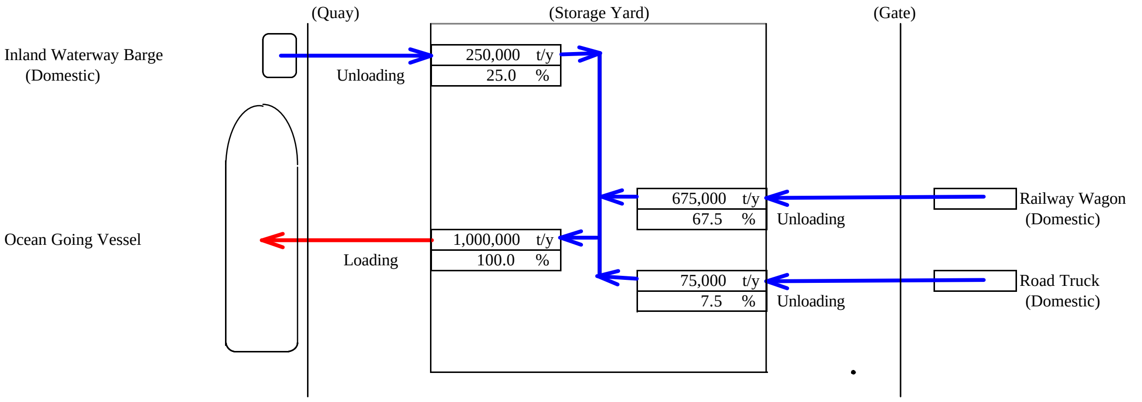


Figure 6.2.1 (3) a. 2/3 Cargo Flow Chart: Case 1, Grain Transit Exports in 2010

Transit (Export) Cargo

Handling Commodity: **Grains**
Project Year: **2010**
Case: **Case 1**

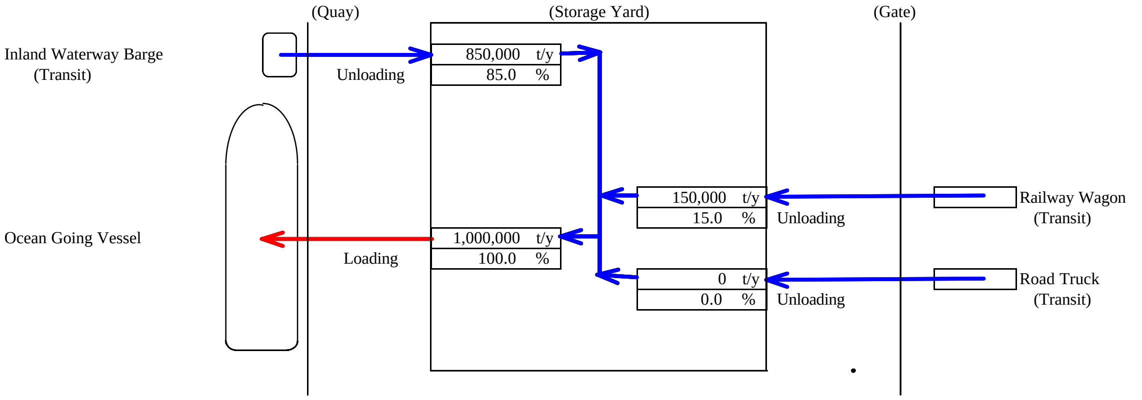


Figure 6.2.1 (3) a. 3/3 Cargo Flow Chart: Case 1, Grain Total Exports & Transit Export in 2010

Total Export & Transit (Export) Cargo

Handling Commodity: **Grains**
Project Year: **2010**
Case: **Case 1**

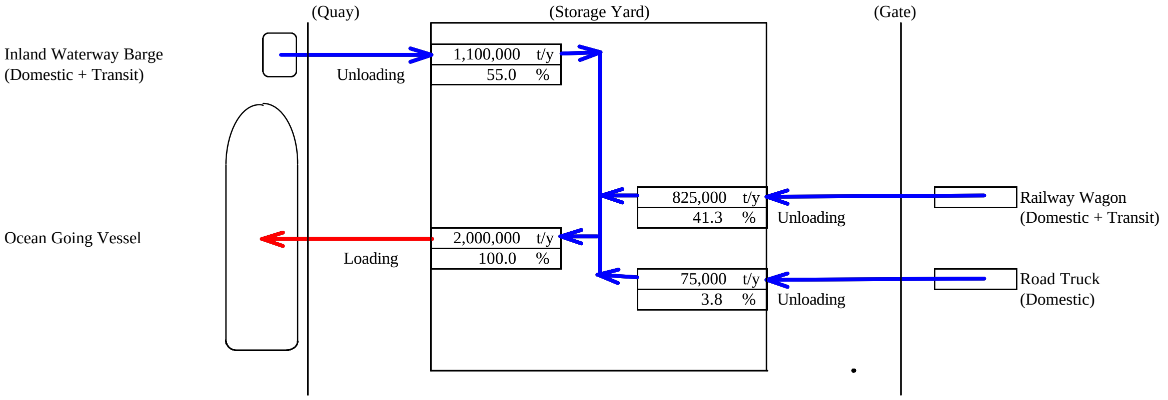


Figure 6.2.1 (3) b. 1/3 Cargo Flow Chart: Case 1, Grain Imports in 2010

Import Cargo

Handling Commodity: **Grains**
Project Year: **2010**
Case: **Case 1**

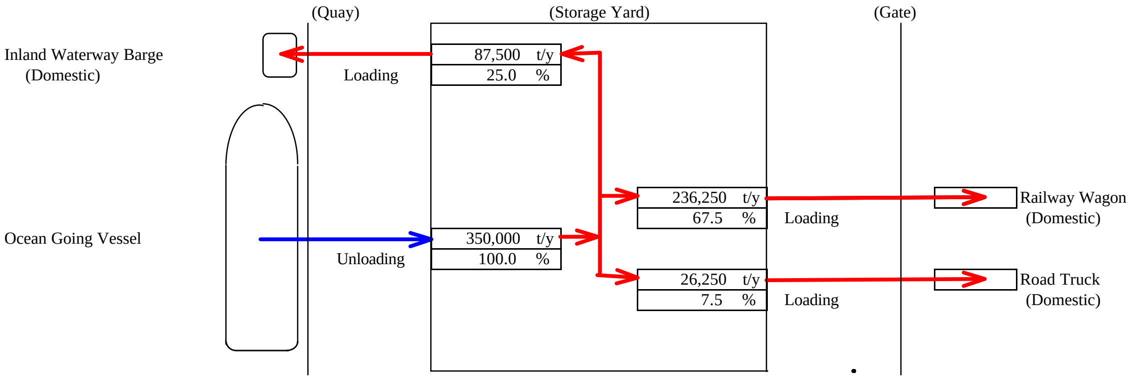


Figure 6.2.1 (3) b. 2/3   Cargo Flow Chart: Cse 1, Grain Transit Imports in 2010

Transit (Import) Cargo

Handling Commodity: **Grains**
Project Year: **2010**
Case: **Case 1**

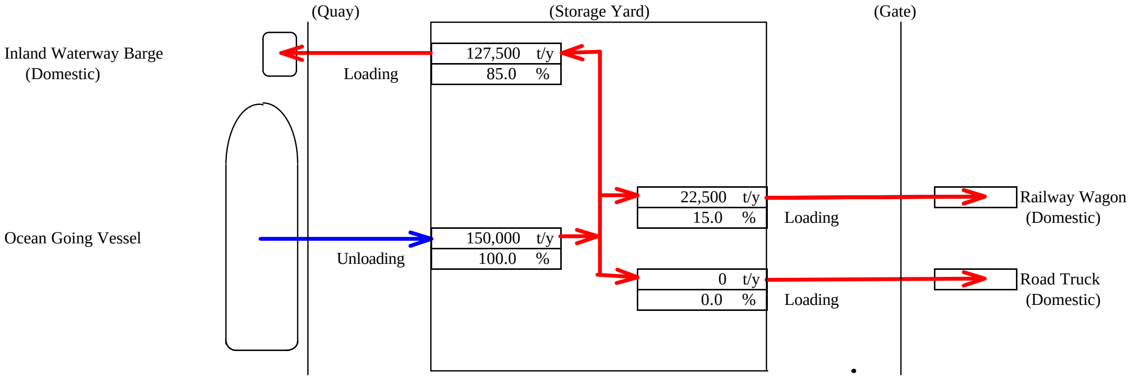
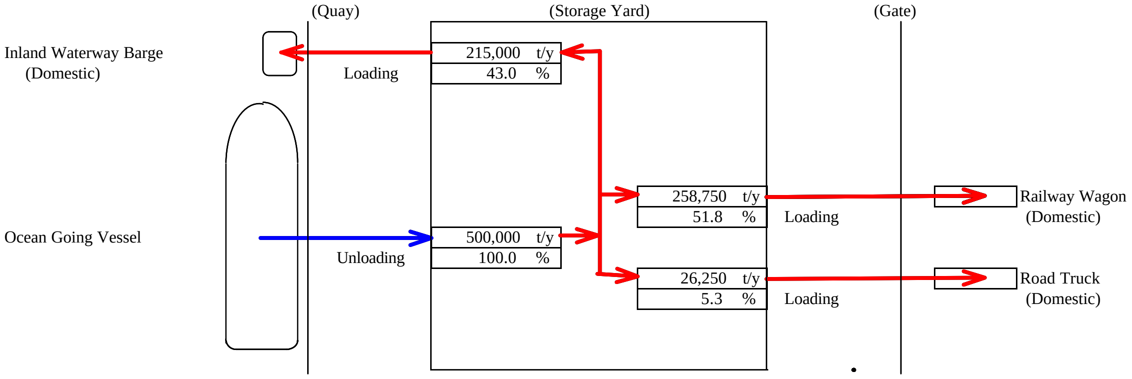


Figure 6.2.1 (3) b. 3/3 Cargo Flow Chart: Case 1, Grain Total Imports & Transit Import in 2010

Total Import & Transit (Import) Cargo

Handling Commodity: **Grains**
Project Year: **2010**
Case: **Case 1**



6.2.2 Transportation Means

Transportation of grains will be carried out as follows:

(1) Ocean-going Vessels

The grains for export and transit(export) leaving from the Port of Constantza to the other countries, and the grains for import and transit(import) arriving to the Port from the other countries will be transported by ocean-going bulk carrier vessels up to 65,000 DWT.

The dimensions of the vessels of the Romanian vessels are shown in Table 6.2.2 (1) a. Bulk Carrier Vessels - 1/2 (Romanian Register of Shipping).

The dimensions of the vessels other than Romanian vessels are shown in Table 6.2.2 (1) b. Bulk Carrier Vessels -2/2 (Worldwide Average).

(2) Inland Waterway Barges

The grains for export and transit(export) arriving to the Port of Constantza from the Danube coast areas both domestic and other countries, and the grains for import and transit(import) leaving from the Port to the Danube coast areas both domestic and other countries will be transported by inland waterway barges with hatch covers specialized for grain transport up to 3,000 DWT.

The dimensions of the vessels of the Romanian vessels are shown in Table 6.2.2 (2) Inland Waterway Vessels (Romanian Register of Shipping).

(3) Railway Wagons

The grains for export and transit(export) arriving to the Port of Constantza from the areas both domestic and other countries, and the grains for import and transit(import) leaving from the Port to the areas both domestic and other countries will be transported by railway wagons specialized for grain transport.

Dimensions of the wagons for grain transportation are shown in Table 6.2.2 (3) Railway Wagon for Grain Transport (Romanian Railway - “CFR MARFA”SA).

(4) Road Trucks

The grains for export arriving to the Port of Constantza from the domestic areas, and the grains for import leaving from the Port to the domestic areas will be transported by road trucks specialized for grain transport.

The dimensions of the road trucks for grain transportation are shown in Table 6.2.2 (4) Road Trucks for Grain Transport.

Table 6.2.2 (1) a. Bulk Carrier Vessels - 1/2

Type	Tonnage	Grain Capacity	Overall Length	Bow to 1st Hatch	Number of Hatches	Hatch Coverage	Last Hatch to Stern	Breadth	Hatch Width	Molded Depth	Loaded Draft	Ballasted Draft
	DWT	-	Loa	R	-	S	T	B	b	D	d	db
	(t)	(m^3)	(m)	(m)	-	(m)	(m)	(m)	(m)	(m)	(m)	(m)
18000 TDW	18,295	20,497	145.10	14.40	4	93.60	37.10	21.00	10.00	13.20	10.14	
25000 TDW	24,850	29,214	185.21	21.47	7	117.81	45.93	22.80	11.44	14.15	10.23	
55000 TDW	54,615	75,516	220.00	20.80	10	149.30	49.90	32.30	15.60	17.00	12.40	
55000 TDW	54,158	75,516	220.00	20.80	10	149.30	49.90	32.20	15.60	17.00	12.40	
65000 TDW	64,900	83,997	253.90	20.70	11	184.40	48.80	32.20	15.60	17.00	12.35	
65000 TDW	64,854	83,997	253.90	20.70	11	184.40	48.80	32.20	15.60	17.00	12.35	

Data Source: Romanian Register of Shipping, Album of Ship Types.

Table 6.2.2 (1) b. Bulk Carrier Vessels - 2/2

Type	Tonnage	Overall Length	Bow to 1st Hatch	Number of Hatch	Hatch Coverage	Last Hatch to Stern	Breadth	Hatch Width	Molded Depth	Loaded Draft	Ballasted Draft
	DWT	Loa	R	-	S	T	B	b	D	d	db
	(t)	(m)	(m)	-	(m)	(m)	(m)	(m)	(m)	(m)	(m)
	10,000	140	24.5	-	70.0	45.5	18.5	7.5	10.5	8.3	2.6
Handy	15,000	160	29.0	-	87.0	44.0	21.0	7.0	12.0	8.9	2.9
	20,000	172	21.0	-	103.0	48.0	23.1	9.8	12.8	9.2	3.0
	25,000	182	30.0	-	93.0	59.0	24.5	12.0	13.7	9.8	3.1
	30,000	196	30.0	-	107.0	59.0	24.5	11.5	14.3	10.1	3.4
	35,000	203	34.0	-	110.0	59.0	26.0	12.0	14.6	10.5	3.6
Panamax	40,000	208	26.0	-	139.0	43.0	29.0	11.5	15.7	10.9	4.2
	45,000	209	33.5	-	106.0	69.5	29.5	13.0	16.3	11.2	4.5
	50,000	221	29.0	-	134.0	58.0	31.0	13.8	17.0	11.7	5.8
	55,000	228	35.0	-	125.0	68.0	32.5	14.2	17.2	12.0	5.8
	60,000	234	30.0	-	140.0	64.0	33.0	13.6	18.0	12.3	5.6
	65,000	238	30.0	-	145.0	63.0	33.0	14.5	18.1	12.8	5.4
	70,000	245	35.0	-	146.0	64.0	33.5	12.0	18.2	13.0	6.1
	75,000	252	30.0	-	170.0	52.0	33.0	14.2	18.7	13.2	6.3
Cape Size	80,000	258	35.0	-	163.0	60.0	34.0	14.0	19.2	13.7	5.7
	95,000	260	36.5	-	165.0	58.5	38.5	18.5	19.8	14.3	6.1
	100,000	263	39.5	-	170.0	53.6	40.0	18.9	20.3	14.7	6.5
	105,000	256	56.5	-	148.0	51.4	39.0	16.1	21.2	15.0	6.6
	110,000	260	29.7	-	178.0	52.3	40.0	20.0	21.9	15.2	7.0
	115,000	261	29.0	-	179.5	52.5	41.0	17.5	22.5	15.4	7.2
	120,000	264	29.2	-	181.7	53.1	41.0	19.5	22.5	15.7	7.4
	125,000	267	29.5	-	183.9	53.6	42.0	18.0	22.9	15.9	7.7
	130,000	281	31.0	-	193.5	56.5	42.0	18.8	23.0	16.1	8.0
	135,000	289	32.0	-	198.9	58.1	42.0	17.7	22.4	16.2	8.2
	140,000	278	30.7	-	191.4	55.9	41.5	17.6	23.3	16.6	8.4
	145,000	292	25.3	-	218.0	58.7	44.0	17.6	24.4	16.8	8.8
	150,000	300	29.7	-	210.0	60.3	44.0	21.0	24.0	16.9	9.1
	160,000	300	30.0	-	215.0	55.0	45.0	20.0	24.0	17.2	11.0
	200,000	327	32.8	-	234.6	59.6	52.0	22.0	27.0	18.8	9.1
	220,000	310	33.0	-	234.0	43.0	50.0	14.5	25.5	19.2	9.3
	225,000	315	26.0	-	239.0	50.0	50.0	21.4	26.6	19.3	9.6
	250,000	325	28.0	-	240.0	57.0	53.0	25.0	30.0	20.0	9.9
	260,000	336	42.0	-	224.0	70.0	54.0	14.0	28.0	20.4	10.0
	350,000	390	43.0	-	223.0	78.4	61.0	26.0	34.5	22.5	14.0
	365,000	343	34.0	-	258.0	51.0	63.5	21.5	30.2	23.0	12.0

Data Source: Data received from Mr. Iancu Constantinescu, IPTANA, July, 2001.(CLOUGH-Australia)

Table 6.2.2 (2) Inland Waterway Vessels

Category	Type	Tonnage	Dimensions					Hull		Cargo	
			Loa	B	D	dm	dM	Material	Joint	Grain Capacity	Hold Length
		(t)	(m)	(m)	(m)	(m)	(m)			(m3)	(m)
Barge	1000 T	1,000	61.40	11.00	2.60	0.41	2.00	Steel	Welded	453	50.40
	1400 T	1,424	71.00	11.60	2.70	0.45	2.40	Steel	Welded	800	55.00
	1500 T	1,492	70.27	11.00	3.10	0.43	2.50	Steel	Welded	1,680	56.25
	2000 T	2,000	76.18	11.00	3.60	0.45	3.00	Steel	Welded	2,090	64.70
	3000 T	2,906	88.90	11.00	4.40	0.62	3.80	Steel	Welded	-	72.00
	3000 T	2,894	82.00	11.00	4.40	0.63	3.60	Steel	Welded	2,130	72.00

Category	Type	Tonnage (Max.)	Dimensions					Hull		Engine	
			Loa	B	D	dm	dM	Material	Joint	Power	Speed
		(t)	(m)	(m)	(m)	(m)	(m)			HP	km/h
Pusher	2*420 HP	282	30.4	11	2	1.1	1.28	Steel	Welded	2*420	17
	2*820 HP	388	33.16	10.17	3.3	1.5	1.7	Steel	Welded	2*820	-
	2*1200 HP	490	34.6	11	2.8	1.57	2	Steel	Welded	2*1200	20

Category	Type	Tonnage (Max.)	Dimensions					Hull		Engine	
			Loa	B	D	dm	dM	Material	Joint	Power	Speed
		(t)	(m)	(m)	(m)	(m)	(m)			HP	km/h
Tug	500 HP	237	33.4	6.3	2.6	1.5	1.65	Steel	Welded	500	21
Pusher Tug	2*280 HP	152	20.9	7.8	3.7	1.3	1.5	Steel	Welded	2*280	-

Data Source: Romanian Register of Shipping, Album of Ship Types.

Table 6.2.2 (3) Railway Wagon for Grain Transport

Specialized Wagon on 4 Axles by Gravity Discharging

Wagon Type:	UAGPS
Bogie Type:	Y25
Automatic Brake Type	KE-2c-Al-SL
Fabrication Year	1966 - 1992

Item		Unit	Figures
Length between Buffers		mm	14,840
Wheel Base		mm	9,800
Chassis Length		mm	13,600
Wagon Max. Length		mm	3,090
Wagon Max. Height		mm	4,053
Usable Volume		m3	80
Own Weight		t	23.3
Loading Capacity		t	56.7
Number of Unloading Gates		-	3
Dimension of Unloading Gate		mm	800x770
Dimension of Loading Gate		mm	505x10,088
Minimal Curve Radius	Current Line	m	150
	Garage Line	m	75
Minimal Speed		km/h	100

The UAGPS type wagon is a steel welding construction, hat has gravity discharging.
It is destined for transporting grains (rye, maize, barley, oats, wheat, rice, sunflower seeds, soy beans, groats(sunflower
The wagon has at the top, on the longitudinal axis, charging gate for all length of roof, which permits to do loadings by belt conveyors direct to the wagon.
The charging gate is provided with 4 articulated tops (manually operated).
In order to may do discharging, the wagon is provided with 3 gates that are placed on the longitudinal axis.
The wagon discharging is donegravitationally. The device is provided with gear wheel and rack - that are operated ma

Data Source: Romanian Railway - "CFR MARFA" SA

Table 6.2.2 (4) Road Trucks for Grain Transport

Type	Items					Description	Note
Tractor for Grain Transport	(1)	Type	a.	Series No.	-	MP440E43T/P	
			b.	Name	-	IVECO	
	(2)	Loading Capacity	a.	Rated Weight	ton	-	
			b.	Rated Volume	m^3	-	
	(3)	Dimensions	a.	Overall Length	m	6.226	
			b.	Overall Width	m	2.500	
			c.	Overall Height	m	2.947	
	(4)	Weight	a.	Self Weight	ton	6.580	
			b.	Laden Weight	ton	11.420	
	(5)	Wheels	a.	Number of Wheels	Number	2 x 2	
			b.	Size of Wheels	-		
	(6)	Wheel Spacing	a.	Wheel Centers	m	3.900	
			b.	Boggie Centers	m		
	(7)	Wheel Loads	a.	No Load	ton		
			b.	Laden	ton		
	(10)	Traveling Speed	a.	No Load Condition	km / h		
			b.	Laden Condition	km / h		
	(11)	Power			HP		
Trailer for Grain Transport	(1)	Type	a.	Series No.	-	SKPP24P	
			b.	Name	-	KOGEL	
	(2)	Loading Capacity	a.	Rated Weight	ton	27.960	
			b.	Rated Volume	m^3	50.000	
	(3)	Dimensions	a.	Overall Length	m	11.200	
			b.	Overall Width	m	2.540	
			c.	Overall Height	m	3.590	
	(4)	Weight	a.	Self Weight	ton	7.040	
			b.	Laden Weight	ton	35.000	
	(5)	Wheels	a.	Number of Wheels	Number	2 x 3	
			b.	Size of Wheels	-	65R22.5	
	(6)	Wheel Spacing	a.	Wheel Centers	m	1.310	
			b.	Boggie Centers	m	7.250	
	(7)	Wheel Loads	a.	No Load	ton		
			b.	Laden	ton		
	(9)	Grain Discharging Method	a.	Side Discharge	-	-	
			b.	Rear Discharge	-	x	

6.2.3 Grain Handling Facilities

The basic model of grain handling facilities will consist of the following systems:

(1) Grain unloading/Receiving System
(2) Receiving Conveyor Line System
(3) Grain Storage System
(4) Silos
(5) Delivery Conveyor Line System
(6) Grain Loading/Delivery System
(7) Common System
(8) Assisting Equipment

The basic model of grain handling facilities, including systems, equipment and their outline specifications are shown in Table 6.2.3 Grain Handling Facilities.

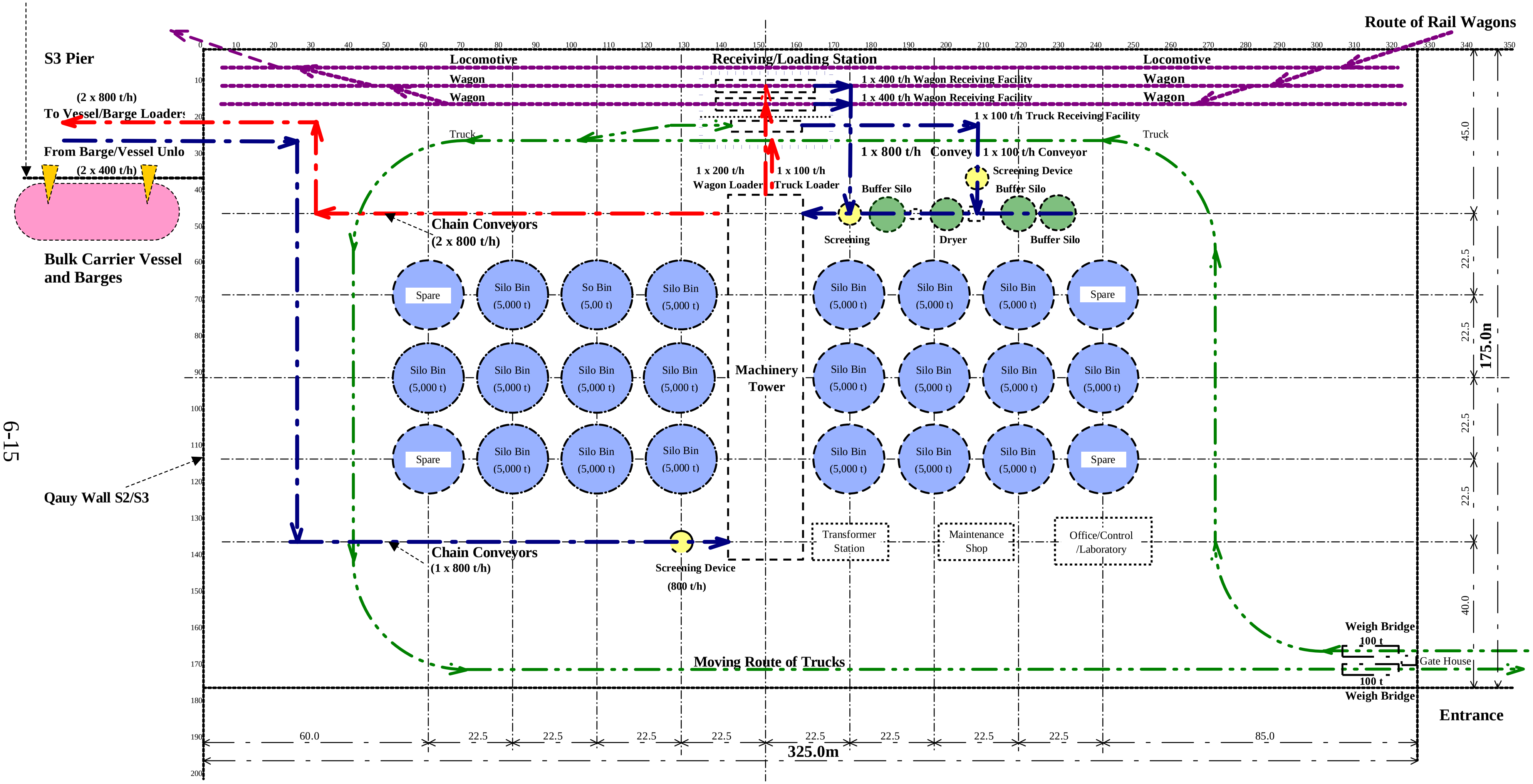
The basic model of grain handling facilities in the Grain Terminal is shown in the figure, Fig. 6.2.3 A General Layout Drawing.

The concept of grain handling facilities in the Grain Terminal is shown in the figure, Fig. 6.2.3 B Grain Handling Facilities Conceptual Drawing.

Table 6.2.3 Grain Handling Facilities

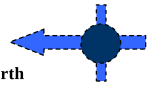
Equipment List

System		Equipment		Outline Specifications	Number	Unit
1	Unloading / Receiving System	1	Barge/Vessel Unloader (For vessels up to 55,000 DWT)	Pneumatic type, with metal detector/ magnet separator 400 t/h capacity (2 x 200 t/h nozzles), with 10 t winch at boom top	2	units
		2	Railway Wagon Receiving System (Length x Breadth = 27.0 x 3.5 m)	400 t/h capacity with chain conveyors 1 line x 30m with metal detector/ iron separator	2	units
		3	Road Truck Receiving System (Length x Breadth = 18.0 x 3.0 m)	100 t/h capacity with chain conveyors x 70m with metal detector/ iron separator	1	units
2	Receiving Conveyor Line System	1	Conveyor System From Barge/Vessel Unloaders to the Grain Storage System	Chain conveyors, 1 line x (250m+110m+125m+75m) 800 t/h	560	m
				Bucket elevator 800 t/h	1	units
				Screening Device 800t/h	1	units
		2	Conveyor System From Railway Wagon Receiving System to Grain Storage System	Chain conveyors, 1 line x (35m+15m) 800 t/h	50	m
				Bucket elevator 800 t/h	1	units
				Screening Device 800t/h	1	units
		3	Conveyor System From Road Truck Receiving System to Grain Storage System	Chain conveyors, 1 line x (25m+70m) 100 t/h	95	m
				Bucket elevator 100 t/h	1	units
				Screening Device 100t/h	1	units
3	Grain Storage System	1	Bucket Elevators	800 t/h, chain bucket	6	units
				200 t/h, chain bucket	2	units
		2	Distributing Conveyors over Silos	800 t/h, chain conveyor, 6 line x 90m	540	m
				800 t/h, chain conveyor, 2 line x 45m	90	m
		3	Retrieving Conveyors under Silos	800 t/h, chain conveyor, 6 line x 90m	540	m
				800 t/h, chain conveyor, 2 line x 45m	90	m
		4	Weighing System	Bulk weighers/electronical, 800 t/h	4	units
				Bulk weighers/electronical, 200 t/h	2	units
		5	Fumigation System	Spraying of insecticide liquid and/or tablets for grains 800 t/h	1	units
		6	Drying System	Tower dryer, 100 t/h for reducing 5% of moisture	1	units
				100 t/h, bucket elevator	1	units
				100 t/h, bucket elevator	2	units
				100 t/h, conveyor, 1 line x 70m	70	m
		7	Sampling System	Automatic rotary cross cut type samplers (800 t/h)	3	units
				Core type truck probe (100 t/h)	1	units
		8	Dust Collecting System	Dust emission prevention	1	units
		9	Explosion Preventing System	Dust suppression	1	units
		10	Temperature Sensing System	Sensing temperature of grains in silos	1	units
4	Silos	1	Main Silos	Steel silo bins (excl. concrete cone bottom), 5,000 t capacity Diameter = 18.3 m; total height = 36.0 m	20	units
		2	Buffer Silos	Steel silo bins (cone bottom), 500 t capacity each Diameter = 9.00 m; total height = 16 m	3	units
5	Delivery Conveyor Line System	1	Conveyor System From Silo System to Ship Loader	Chain conveyors, 2 lines x (110m+45m+30m+550m) 800 t/h	1,470	m
				Bucket elevator 800 t/h	2	units
		2	Conveyor System From Silo System to Wagon Loading Chute	Chain conveyors, 2 lines x 30m 200 t/h	30	m
				Bucket elevator 200 t/h	2	units
		3	Conveyor System From Silo System to Truck Loading Chute	Chain conveyors, 1 line x 15m 100 t/h	15	m
				Bucket elevator 100 t/h	0	units
6	Loading / Delivery System	1	Ship Loader	Bucket elevator, with swing type dustless telescopic chute 800 t/h, vessels up to 65,000 DWT	2	units
		2	Railway Wagon Loading System	Dustless telescopic chute, 200 t/h capacity	2	units
		3	Road Truck Loading System	Dustless telescopic chute, 100 t/h capacity	1	units
7	Common System	1	Truck Scale System	Weigh bridge, electronic, 100 t	2	units
		1	Control System	Equipment/system control, automatic/sequential operation Inventory management	1	units
		2	Communication System	Internal communication system External communication system	1	units
		3	Fire Fighting System	Hydrants	1	units
8	Assisting Equipment	1	Front bucket wheel loader	"Bobcat" For barge/vessel hold bottom cleaning	3	units
		2	Forklift	5 t lifting capacity For maintenance work, etc., general use	1	units
9	Others	1	Auxiliary Equipment	-	1	units



Cargo Volume to be Handled at the Terminal

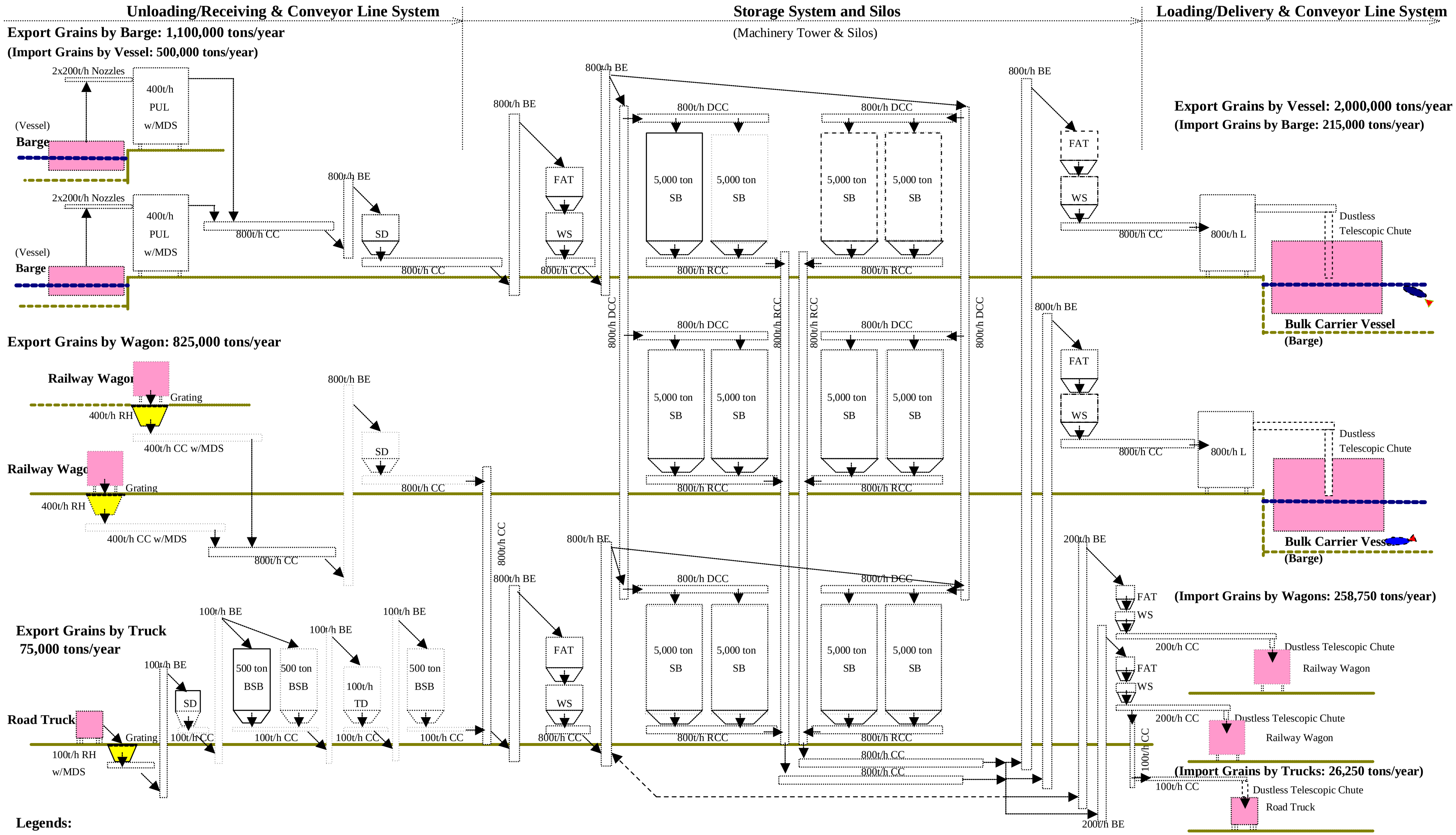
	Receiving from: (t/year)		Delivery to: (t/year)	
Export	Barges	1,100,000	Vessels	2,000,000
	Railway Wagons	825,000	-	
	Road Trucks	75,000	-	
	Total	2,000,000	Total	2,000,000
Import	Vessels	500,000	Barges	215,000
	-		Railway Wagons	258,750
	-		Road Trucks	26,250
	Total	500,000	Total	500,000



Port of Constantza Development Project
Grain Terminal

General Layout Drawing

Fig. 6.2.3 A



Legends:

- ⬚ **PUL**: Pneumatic Unloader
- 🟨 **RH**: Receiving Hopper
- **CC**: Chain Conveyor
- **BE**: Bucket Elevator
- **MDS:** Metal Detector/Magnet Separator
- **SD**: Screening Device
- ⬚ **BSB**: Buffer Silo Bin
- ⬚ **SB**: Silo Bin
- **TD**: Tower Dryer
- **FAT**: Flow Adjusting Tank
- **WS**: Weigh Scale
- **DCC**: Distributing Chain Conveyor
- **RCC**: Retrieving Chain Conveyor
- ⬚ **L**: Loader

20 x 5,000 ton Silo Bins

Including fumigation System, Sampling System, Dust Collecting System, Explosion Preventing System, Temperature Sensing System, etc.

Port of Constantza Development Project
Grain Terminal
Grain Handling Facilities
Conceptual Drawing
Fig. 6.2.3.B

(1) Grain Unloading/Receiving System

Grain unloading/receiving system will consist of following sub-systems:

a. Barge/Vessel Unloading System

Two (2) units of each 400 ton/hr (2 nozzles x 200 ton/hr) pneumatic unloader, with metal detector and magnet separator, and a 10 ton winch for lifting a bottom clean-up front bucket wheel loader at boom top, adequate for vessels up to 55,000 DWT.

Type Selection of the Unloader:

There are several types of unloaders for grain handling: namely, pneumatic type, grab bucket type, mechanical continuous type, etc. After careful study, the pneumatic type was selected for the Project taking into account the following advantages:

Environmental friendly system: Dust emission rate is the lowest when comparing to other types.
Operational versatility:
  Especially for work in the narrow holds of inland waterway barges.
  Efficient bottom clean-up operation in the holds of the barges.

The details of comparison among unloaders of grab bucket type, pneumatic type, and mechanical continuous type are shown in Table 6.2.3 (1) a-1 Comparison between Pneumatic Unloaders and Mechanical Unloaders.

Number and Capacity Calculation of Unloaders:

Calculation formula and the results of calculation are shown in Table 6.2.3 (1) a-2 Unloader Number and Capacity Calculation.

b. Railway Wagon Receiving System

Two(2) units of 400 ton/hr receiving hopper, chain conveyor with metal detector and magnet separator, adequate for two(2) railway wagons at the same time, 27.0 m length x 3.5 m width underground hopper.

Number and Capacity Calculation of the Railway Wagon Receiving System:

The calculation formula and the results of calculation are shown in Table 6.2.3 (1) b. Railway Wagon Receiving System Number and Capacity Calculation.

c. Road Truck Receiving System

One(1) unit of 100 ton/hr receiving hopper, chain conveyor with metal detector and magnet separator, adequate for one road truck, both side-discharge type and back-discharge type, 18.0 m length x 3.0 m width underground hopper.

Number and Capacity Calculation of Road Truck Receiving System:

The calculation formula and the results of calculation are shown in Table 6.2.3 (1) c. Road Truck Receiving System Number and Capacity Calculation.

Table 6.2.3 (1) a-1 Comparison between Pneumatic Unloaders and Mechanical Unloaders

Items	Pneumatic Unloaders	Mechanical Unloaders			
		Grab Bucket Type	Mechanical Continuous Unloaders		
			Common	Screw type	Bucket Elevator Type
Advantages	- In view of safety, the system has few moving parts. Any moving part represents a source of possible damage which can stop the handling operation. - Operating safety is high. - The pneumatic unloader can self-discharge the materials before manual cleaning. That means an important reduction of workers and cost of operation. - After this self-discharge into vessel's holds, remaining is only 5 – 10 % of materials. - Not need an additional special device to gather the materials in all spaces of vessel's holds. - The equipment has its own installation for air cleaning: filters and cyclones. - The filters reduce the dust and the pollution against workers who are exposed to. - Direct access in the narrow space of vessel's hold. - Handling the materials from wagons and trucks is easier. - Can ensure a variety of handling possibilities. - Can handle all kinds of grain products.	- Maintenance and repair work are easier because the type of equipment is very common. - Not need imported spare parts. - Maintenance and repair costs are not expensive. - The grain particles are not broken during the operations. - When the grab is damaged, it can be changed and the equipment can continue the work. - Can handle all types of grain products.	- High productivity - Can reach the materials from the spaces with the most difficult access such as vessel's holds, railway wagons, and trucks. - Can transport the materials on uneven routes. - does not break the materials. - Can transport the materials in the horizontal, vertical and inclined positions. - Not need very skilled operators. - For maintain and repair this equipment does not need imported spare parts. - Can handle all types of grain products.	- High productivity. - There are not many moving parts. - The maintenance and repair costs are not expensive. - Not need skilled operators. - Non polluting equipment. - Can handle all types of grain products.	- High productivity. - The equipment is non polluting. - Not need skilled operators. - There are not many moving parts. - The maintenance and repair costs are not expensive. The parts of elevators are common types. - The cost of construction is not so high. - The power consumption is lower. - The friction between materials and the protection wall does not exist. - The elevator is auto-changing type from its tab. The change of the tab is in accordance with the maximum bucket capacity. Is not possible a overcharge during the operation. - The construction of elevator is very simple and narrow for the height which is needed for work. - Not need imported spare parts. - Can handle all type of grain products.
Disadvantages	- Maintenance and repair for this type of equipment is very expensive. Imported spare parts are necessary. - It needs skilled operators. - The grain particles are broken during operation, especially the maize particles when they are very dry. - For maintenance and repair, this type of equipment needs skilled workers in the workshop. - The power consumption is very high. - In case of some damage, all the equipment is stopped. - The transfer distance of materials is limited (suction and repression). - The equipment is very expensive.	- Does not ensure total discharge from the vessel's holds. In this case, must utilize auxiliary equipment such as tractor shovels. It means supplementary costs and extension of the vessel's berthing time during operation. - Equipment with grab bucket has many moving parts which represent much more possibilities of damages. - The grab does not ensure necessary tightness for materials (especially powdery materials) during the operation. This is the biggest source of pollution in the ports. - Moving the grab bucket in the railway wagons during discharge brings about some damage of wagon's walls. In the vessels also. - The grab bucket repair is always a problem. - During unloading the vessel's holds, tractor shovel must change the hold. These movements mean supplementary costs and extension the vessel's berthing time during operation. - The operating cycle is bigger and the equipment productivity is lower.	- The maintenance and repair are very expensive. The equipment has many moving parts. - In case of damage, all the equipment is stopped. - For some conveyors, the transport distance is limited.	- In case of damage, all the equipment is stopped. - The screw is a special device and maintenance and repair is very difficult. - Needs skilled workers for maintenance and repair. - If the principal component (screw) deteriorates, it must be changed. The cost is very high and immobilization needs a long time. - The power consumption is very high. - The length for transport is small because the torsion effect is high. - Maximum length is 100 – 150 times diameter because the friction increases very much.	- For function and installation, needs a concrete foundation in accordance with own weight and the material weight which it handles. - For the Reddler type elevator (with scraper) the friction between materials and steel wall protections exists. The power consumption in this case is high. - In case of elevator with scraper, there are many moving parts. - In case of damage, all the equipment is stopped. - The elevator with scraper has many moving parts which represent much more possibility of damages.

Table 6.2.3 (1) a-2 Unloader Number and Capacity Calculation

Annual cargo handling capacity of the terminal is calculated by adopting the following formula:

Qt = 365 x 24 x Rw x Rh x Rbo x Nb x Pe x Ne x Ree x Ee

The results of the calculation are shown on the table below:

Barge/Vessel Unloader(Number of Berth: 2, Number of Equipment/Berth: 1, BOR: 0.55)

Marks	Description	Units	Study 1	Study 2	Study 3	Remarks
Nb	Number of Berth per Terminal	number	2	**2**	2	
Rbo	Berth Occupancy Ratio	-	0.55	0.55	0.55	Nb=1: <0.50, Nb=2: <0.55
Rw	Equipment Working Hour Ratio	-	0.90	0.90	0.90	working hour/berthing hour
Rh	Cargo Handling Hour Ratio	-	0.70	0.70	0.70	handling hour/working hour
Pe	Theoretical Equipment Productivity	tons/hour	300	**400**	500	
Ne	Number of Equipment per Berth	number	1	**1**	1	
Ree	Equipment Effectiveness Ratio	-	1.0	1.0	1.0	Ne=1: 1.0, Ne=2: 0.9, Ne=3 :0.8
Ee	Average Equipment Efficiency	-	0.50	0.50	0.50	Pneumatic Unloading Operation
Qt	Annual Cargo Handing Capacity	tons/year	910,602	**1,214,136**	1,517,670	
Sb	Average Bulk Carrier Barge Size	DWT	2,000	2,000	2,000	
Nb	Number of Barges per Conboy	-	5	5	5	4 or 6
Vc	Cargo Volume (0.90 x DWT)	tons/vessel	9,000	9,000	9,000	
Tr	Required Hours to Unload 1 Convo	hour	95.2	71.4	57.1	
Dr	Required Days to Unload 1 Convoy	Days	4.0	**3.0**	2.4	
Note	Year	year	2010			
	Required Unloading Capacity	t/year	1,100,000			2,000,000 ton/yr x 0.55 (by barge)

Thus, two (2) units and 400 ton/hr capacity unloaders have been selected.

Table 6.2.3 (1) b. Railway Wagon Receiving System Number and Capacity Calculation

Annual cargo handling capacity of the terminal is calculated by adopting the following formula:

Qt = 365 x 24 x Rw x Rh x Rfoa x Nf x Pf x Ne x Ref x Ef

The results of the calculation are shown in the table from below:

Railway Wagon Receiving System

Marks	Description	Units	Study 1	Study 2	Study 3	Remarks
Nf	Number of Facility per Terminal	number	**2**	1	1	
Rfoa	Allowable Facility Occupancy Rati	-	0.55	0.50	0.50	
Rw	Facility Working Hour Ratio	-	0.50	0.50	0.50	working hour/Facility Occupancy hour
Rh	Cargo Handling Hour Ratio	-	0.75	0.75	0.75	handling hour/working hour
Pf	Theoretical Facility Productivity	tons/hour	**400**	600	800	
Ne	Number of Equipment per Facility	number	1	1	1	
Ref	Facility Effectiveness Ratio	-	0.9	1.0	1.0	Nf=1: 1.0, Nf=2: 0.9, Nf=3 :0.8
Ef	Average Facility Efficiency	-	0.70	0.70	0.70	
Qt	Annual Cargo Handing Capacity	tons/year	**910,602**	689,850	919,800	
Note	Year	year	2010			
	Required Unloading Capacity	t/year	825,000			2,000,000 ton/yr x 0.55 (by barge)

Thus, two (2) units and 400 ton/hr capacity unloading system have been selected.

Table 6.2.3 (1) c. Road Truck Receiving System
Number and Capacity Calculation

Annual cargo handling capacity of the terminal is calculated by adopting the following formula:

Qt = 365 x 24 x Rw x Rh x Rfoa x Nf x Pf x Ne x Ref x Ef

The results of the calculation are shown in the table from below:

Truck Receiving System

Marks	Description	Units	Study 1	Study 2	Study 3	Remarks
Nf	Number of Facility per Terminal	number	1	**1**	1	
Rfoa	Allowable Facility Occupancy Rati	-	0.50	0.50	0.50	
Rw	Facility Working Hour Ratio	-	0.50	0.50	0.50	working hour/Facility Occupancy hour
Rh	Cargo Handling Hour Ratio	-	0.75	0.75	0.75	handling hour/working hour
Pf	Theoretical Facility Productivity	tons/hour	50	**100**	150	
Ne	Number of Equipment per Facility	number	1	**1**	1	
Ref	Facility Effectiveness Ratio	-	1.0	1.0	1.0	Nf=1: 1.0, Nf=2: 0.9, Nf=3 :0.8
Ef	Average Facility Efficiency	-	0.50	0.50	0.50	
Qt	Annual Cargo Handing Capacity	tons/year	41,063	**82,125**	123,188	
Note	Year	year	2010			
	Required Unloading Capacity	t/year	75,000			

Thus, one (1) unit and 100 ton/hr capacity receiving system has been selected.

(2) Receiving Conveyor Line System

Receiving conveyor line system will consist of following sub-systems:

a. From Barge/Vessel Unloading System to Grain Storage System

Total 560 m length of 800 ton/hr chain conveyor, with bucket elevator and screening device.

b. From Railway Wagon Receiving System to Grain Storage System

Total 50 m length of 800 ton/hr chain conveyor, with bucket elevator and screening device.

c. Road Truck Receiving System to Grain Storage System

Total 95 m length of 100 ton/hr chain conveyor, with bucket elevator and screening device.

Type Selection of the Conveyor:

There are several types of conveyors for grain handling: i.e. namely, belt conveyor type, chain conveyor type, etc. After careful study, the chain conveyor type was selected for the Project, taking into account the following advantages:

Environmental friendly system: Dust emission rate is the lowest among other types.
Simple construction
Low maintenance cost

The details of comparison among belt conveyor type and chain conveyor type are shown in Table 6.2.3 (2) Comparison between Belt Conveyor and Chain Conveyor.

Table 6.2.3 (2) Comparison between Belt Conveyor and Chain Conveyor

	Belt Conveyor	Chain Conveyor
Advantages	- High speed of travel. - High Productivity: A high productivity is important when thinking of ship operating time. - The maintenance and repair activities are easier because a direct access exists. - No spare parts are required from imports. -	- Based on its construction system, this conveyor is recommendable for Environment Protection Regulations for the working areas in port. It would not generate dust during operation. - The inclination angle is bigger than natural slope of the bulk. The working scale is very large. - Chain conveyor dimensions are smaller. - To discharge the bulk at any point one would not need a trimmer which is very heavy and very expensive. -
Disadvantages	- Own weight is big. - In view of Environmental Protection this type of conveyor is very polluting. - The cost for covering the belt conveyor to stop the pollution is very expensive. - In order to discharge the material to any point one would need a trimmer device. The trimmer is very heavy and very expensive. - Centering the belt during operation is difficult; it is necessary to stop the belt. - High loss of materials during the activity. - Inclination angle is limited. If the inclination angle is bigger than natural slope of materials, they cannot be transported. - The transport system with belt conveyor must be provided with a belt tensioning system which is also very expensive and a very big device (heavy and would increase the size of the installation).	- The friction coefficient is very high because the bulk is moving (transported) by dragging. - It needs big power. - Maintenance and repairing are expensive. - The down time for maintenance and repairing is bigger. - The speed is small - Low speed of travel.

(3) Grain Storage System

Grain storage system will consist of following sub-systems:

a. Grain Elevating System

Six(6) 800 ton/hr and two(2) 100 ton/hr bucket elevators

b. Grain Distributing System

Total 630 m length of 800 ton/hr chain conveyors, with remote control slide gates.

c. Grain Retrieving System

Total 630 m length of 800 ton/hr chain conveyors, with remote control slide gates.

d. Weighing System

Four(4) units of 800 ton/hr and two(2)units of 200 ton/hr bulk weighing scale, electronic data processing type.

e. Fumigation System

One(1) complete set of insecticide liquid and/or tablet spray system for grains of 800 ton/hr.

f. Drying System

One(1) complete set of 100 ton/hr tower dryer for reducing 5 % of moisture, with chain conveyor and bucket elevator.

g. Sampling System

Three(3) units of automatic rotary cross cut type samplers for grains of 800 ton/hr.
One(1) unit of core type truck probe for grains of 100 ton/hr.

h. Dust Collecting System

One(1) complete set of dust collecting system for grains of 800 ton/hr for preventing dust emission.

i. Explosion Preventing System

One(1) complete set of dust suppression liquid spray system for grains of 800 ton/hr.
One(1) complete set of static electricity absorbing system.

j. Temperature Sensing System

One(1) complete set of temperature sensing system for each silo bins.

(4) Silos

a. Main Silos

Twenty(20) units of steel silo bins of 5,000 ton capacity each, over concrete cone bottom, with weather proof treating, heat insulating construction, sufficient aeration system, explosion safety means.

b. Buffer Silos

Three(3) units of steel silo bins of 500 ton capacity each, over concrete cone bottom, with weather proof treating, heat insulating construction, sufficient aeration system, explosion safety means.

Type Selection of the Silo Construction:

There are several types of silo construction for grain storage: namely, concrete silos, steel silos, etc. After careful study, the steel silos was selected for the Project, taking into account the following advantages:

Less self weight than concrete silos, resulting in less foundation construction cost.
Less construction period than concrete silos, resulting in faster starting operation.

The details of comparison among concrete silos and steel silos are shown in Table 6.2.3 (4) a. Comparison between Concrete Silos and Steel.

Number, Capacity and Dimension Calculation of the Main Silos:

Calculation formula and the results of calculation are shown in Table 6.2.3 (4) b Main Silos Number, Capacity and Dimension Calculation.

Table 6.2.3 (4) a. Comparison between Concrete Silos and Steel Silos

Item	Concrete Silos	Steel Silos
Advantages	- The life of the silo is longer. - The evacuation of cereals is easier. Cells are like a hopper type. - Discharging of cells is done gravitationally. The number of personnel is reduced. The exploitation cost is also reduced. - The protection of cereal quality is higher. - The maintenance and repairing costs are lower. - To repair the concrete construction one will need only common, not special materials. This advantage is very important for good and efficient terminal use (costs, vessels waiting time that are under operations at quay and others).	- The construction time (to put into operation) is shorter. - The cereal ventilation can be improved and the cost of operation is reduced. The cost of energy is lower. - Loads on the supporting foundation are lower. - If necessary, it can be changed and the displacement is easy. - Damages can be repaired with usual material possibilities. - Higher air tightness.
Disadvantages	- The construction time (to put into operation) is longer - Loads on the supporting foundation are bigger. - The construction costs of the silo are higher. - The energy consumption for cereal ventilation is higher. - It is very difficult to put out a fire because the access to cells is difficult. -	- The maintenance and repairing costs are high. - When having to discharge and clean the cells a lot of workers would be needed. Operations are more expensive – low productivity. - Maintenance and repairing costs are high. - The retrieving system from the flat bottom bins (cells) is complicated (many devices) and there are a lot of breakdown possibilities. - Temperature rise tendency is caused by direct exposure to sunlight.

Table 6.2.3 (4) b. Main Silos Number, Capacity and Dimension Calculation

1. Rt=Q/qt

   where: Rt: Silo Turnover Rate (times/year) (20 - 30)
   Q: Annual Cargo Handling Capacity (t/year)
   qt: Required Total Silo Storage Capacity (t)

2. qs=qt/Ns

   where: qs: Required Silo Bin Storage Capacity (t)
   Ns: Total Number of Silo Bins

3. Vs=qs/g

   where: Vs: Required Silo Bin Storage Volume (m^3)
   g: Specific Gravity (t/m^3)

3.1 Case 1 Rt: 20

	Q	Rt	qt	Ns	qs	g	Vs
	(t/year)	(times/year)	(t)	-	(t)	(t/m^3)	(m^3)
(1)	2,000,000	20	100,000	10	10,000	0.7	14,285.7
(2)	2,000,000	20	100,000	15	6,667	0.7	9,523.8
(3)	**2,000,000**	**20**	**100,000**	**20**	**5,000**	**0.7**	**7,142.9**
(4)	2,000,000	20	100,000	30	3,333	0.7	4,761.9

3.2 Case 2 Rt: 25

	Q	Rt	qt	Ns	qs	g	Vs
	(t/year)	(times/year)	(t)	-	(t)	(t/m^3)	(m^3)
(1)	2,000,000	25	80,000	10	8,000	0.7	11,428.6
(2)	2,000,000	25	80,000	15	5,333	0.7	7,619.0
(3)	2,000,000	25	80,000	20	4,000	0.7	5,714.3
(4)	2,000,000	25	80,000	30	2,667	0.7	3,809.5

Thus, one has selected twenty (20) units and 5,000 ton (7,150 m^3) capacity silo bins, considering the nature of commodities handled and the convenience of sorting them.

4 Vs=p*d^2*h/4

where: d: Inner Diameter of Silo Bin Projection Area(m)

h: Effective Height of Silo Bin (m)

4.1 Case 1 Rt: 20

(1)	Ns = 10		qs = 10,000 t	d (m)	h (m)	Note:
a.	h=1.0*d	Vs=1.0*p*d^3/4	d={(4*Vs)/(p*1.0)}$^{1/3}$=	26.3	26.3	
b.	h=1.5*d	Vs=1.5*p*d^3/4	d={(4*Vs)/(p*1.5)}$^{1/3}$=	23.0	34.5	
c.	h=2.0*d	Vs=2.0*p*d^3/4	d={(4*Vs)/(p*2.0)}$^{1/3}$=	20.9	41.8	Too high
d.	h=2.5*d	Vs=2.5*p*d^3/4	d={(4*Vs)/(p*2.5)}$^{1/3}$=	19.4	48.5	Too high
e.	h=3.0*d	Vs=3.0*p*d^3/4	d={(4*Vs)/(p*3.0)}$^{1/3}$=	18.2	54.7	Too high
f.	h=4.0*d	Vs=4.0*p*d^3/4	d={(4*Vs)/(p*4.0)}$^{1/3}$=	16.6	66.3	Too high
g.	h=5.0*d	Vs=5.0*p*d^3/4	d={(4*Vs)/(p*5.0)}$^{1/3}$=	15.4	76.9	Too high

(2)	Ns = 15		qs = 6,667 t	d (m)	h (m)	Note:
a.	h=1.0*d	Vs=1.0*p*d^3/4	d={(4*Vs)/(p*1.0)}$^{1/3}$=	23.0	23.0	
b.	h=1.5*d	Vs=1.5*p*d^3/4	d={(4*Vs)/(p*1.5)}$^{1/3}$=	20.1	30.1	
c.	h=2.0*d	Vs=2.0*p*d^3/4	d={(4*Vs)/(p*2.0)}$^{1/3}$=	18.2	36.5	
d.	h=2.5*d	Vs=2.5*p*d^3/4	d={(4*Vs)/(p*2.5)}$^{1/3}$=	16.9	42.3	Too high
e.	h=3.0*d	Vs=3.0*p*d^3/4	d={(4*Vs)/(p*3.0)}$^{1/3}$=	15.9	47.8	Too high
f.	h=4.0*d	Vs=4.0*p*d^3/4	d={(4*Vs)/(p*4.0)}$^{1/3}$=	14.5	57.9	Too high
g.	h=5.0*d	Vs=5.0*p*d^3/4	d={(4*Vs)/(p*5.0)}$^{1/3}$=	13.4	67.2	Too high

(3)	**Ns = 20**		**qs = 5,000 t**	d (m)	h (m)	Note:
a.	h=1.0*d	Vs=1.0*p*d^3/4	d={(4*Vs)/(p*1.0)}$^{1/3}$=	20.9	20.9	
b.	**h=1.5*d**	**Vs=1.5*p*d^3/4**	**d={(4*Vs)/(p*1.5)}$^{1/3}$=**	**18.2**	**27.4**	**Adopted**
c.	h=2.0*d	Vs=2.0*p*d^3/4	d={(4*Vs)/(p*2.0)}$^{1/3}$=	16.6	33.1	
d.	h=2.5*d	Vs=2.5*p*d^3/4	d={(4*Vs)/(p*2.5)}$^{1/3}$=	15.4	38.5	
e.	h=3.0*d	Vs=3.0*p*d^3/4	d={(4*Vs)/(p*3.0)}$^{1/3}$=	14.5	43.4	Too high
f.	h=4.0*d	Vs=4.0*p*d^3/4	d={(4*Vs)/(p*4.0)}$^{1/3}$=	13.2	52.6	Too high
g.	h=5.0*d	Vs=5.0*p*d^3/4	d={(4*Vs)/(p*5.0)}$^{1/3}$=	12.2	61.0	Too high

(4)	Ns = 30		qs = 3,333 t	d (m)	h (m)	Note:
a.	h=1.0*d	Vs=1.0*p*d^3/4	d={(4*Vs)/(p*1.0)}$^{1/3}$=	18.2	18.2	
b.	h=1.5*d	Vs=1.5*p*d^3/4	d={(4*Vs)/(p*1.5)}$^{1/3}$=	15.9	23.9	
c.	h=2.0*d	Vs=2.0*p*d^3/4	d={(4*Vs)/(p*2.0)}$^{1/3}$=	14.5	29.0	
d.	h=2.5*d	Vs=2.5*p*d^3/4	d={(4*Vs)/(p*2.5)}$^{1/3}$=	13.4	33.6	
e.	h=3.0*d	Vs=3.0*p*d^3/4	d={(4*Vs)/(p*3.0)}$^{1/3}$=	12.6	37.9	
f.	h=4.0*d	Vs=4.0*p*d^3/4	d={(4*Vs)/(p*4.0)}$^{1/3}$=	11.5	46.0	Too high
g.	h=5.0*d	Vs=5.0*p*d^3/4	d={(4*Vs)/(p*5.0)}$^{1/3}$=	10.7	53.3	Too high

Thus, 1.5*d type silo bin has been selected.

(5) Delivery Conveyor Line System

Delivery conveyor line system will consist of the following sub-systems:

a. From Grain Storage System to Barge/Vessel Loading System

Total 1,470 m length of 800 ton/hr chain conveyor, with bucket elevator.

b. From Grain Storage System to Railway Wagon Loading System

Total 30 m length of 200 ton/hr chain conveyor, with bucket elevator.

c. From Grain Storage System to Road Truck Loading System

Total 15 m length of 100 ton/hr chain conveyor, with bucket elevator.

(6) Grain Loading/Delivery System

Grain loading/delivery system will consist of following sub-systems:

a. Vessel/Barge Loading System

Two(2) units of 800 ton/hr vessel loaders, with swing type dustless telescopic chute, adequate for vessels up to 65,000 DWT.

Type Selection of the Loader:

There are several types of loading device of loaders for grain handling: namely, swinging telescopic chute, trimmer, dustless chute, etc. After careful study, the swing type telescopic chute was selected for the Project, taking into account the following advantages:

Environmental friendly system: Dust emission rate is lower.
Operational versatility:
Especially for work in the narrow holds of inland waterway barges.

The details of comparison among unloaders of dustless telescopic chute and trimmer are shown in Table 6.2.3 (1) a - 1 Comparison between Loaders with Dustless Telescopic Loading Chute and Loaders with Trimmer.

Number and Capacity Calculation of the Vessel/Barge Loading System:

Calculation formula and the results of calculation are shown in Table 6.2.3 (6) a-2 Vessel/Barge Loading System Number and Capacity Calculation.

b. Railway Wagon Loading System

Two(2) units of 200 ton/hr loading system, with dustless telescopic chute, adequate for loading railway wagons for grain transport.

Number and Capacity Calculation of the Railway Wagon Loading System:

Calculation formula and the results of calculation are shown in Table 6.2.3 (6) b. Railway Wagon Loading System Number and Capacity Calculation.

c. Road Truck Loading System

One(1) unit of 100 ton/hr loading system, with dustless telescopic chute, adequate for loading road trucks for grain transport.

Number and Capacity Calculation of the Road Truck Loading System:

Calculation formula and the results of calculation are shown in Table 6.2.3 (6) c. Road Truck Loading System Number and Capacity Calculation.

Table 6.2.3 (6) a-1 Comparison between Loaders with Dustless Telescopic Chute and Loaders with Trimmer

Item	Loaders with Dustless Telescopic Loading Chute	Loaders with Trimmer
Advantages	- Can cover total charging volume of the vessel’s hold. - Big productivity - The total flow course of grain products is covered. - The maneuvering of the equipment is very easy - Ensures the tightness of grains. No contact with other commodities. - Limited pollution equipment. - Can reduce the dust emission by using spray oil device	- Can cover the total charging volume of the vessel’s hold. - No need skilled personnel for operation. - Does not need skilled personnel for maintenance and repairing. - Low productivity - Does not need spare parts from import because the components are very common. - In case the trimmer is damaged and removed, the equipment can still work. - The maneuvering of equipment is easy.
Disadvantages	- Needs skilled personnel for operation. - Needs skilled personnel for maintenance and repairing. - Needs spare parts from import. - In case of damage, all the equipment stops.	- Low productivity - The equipment has many moving parts, which increases the damage possibilities. - It is a polluting equipment, because of trimmer action. - Low productivity. The equipment works gravitationally and by the scattering speed of the trimmer belt. When the belt speed increases, it becomes possible to break the grain particles as they get in contact with vessel hold walls. - The equipment has many moving parts which increase the damage possibilities.

Table 6.2.3 (6) a-2 Loader Number and Capacity Calculation

Annual cargo handling capacity of the terminal is calculated by adopting the following formula:

Qt = 365 x 24 x Rw x Rh x Rbo x Nb x Pe x Ne x Ree x Ee

The results of the calculation are shown on the table below:

Vessel/Barge Loader(Number of Berth: 1, Number of Equipment/Berth: 2, BOR: 0.50)

Marks	Description	Units	Study 1	Study 2	Study 3	Remarks
Nb	Number of Berth per Terminal	number	1	**1**	1	
Rbo	Berth Occupancy Ratio	-	0.50	0.50	0.50	Nb=1: <0.50, Nb=2: <0.55
Rw	Equipment Working Hour Ratio	-	0.90	0.90	0.90	working hour/berthing hour
Rh	Cargo Handling Hour Ratio	-	0.70	0.70	0.70	handling hour/working hour
Pe	Theoretical Equipment Productivity	tons/hour	600	**800**	1,000	
Ne	Number of Equipment per Berth	number	2	**2**	2	
Ree	Equipment Effectiveness Ratio	-	0.9	0.9	0.9	Ne=1: 1.0, Ne=2: 0.9, Ne=3 :0.8
Ee	Average Equipment Efficiency	-	0.60	0.60	0.60	Loading Operation
Qt	Annual Cargo Handing Capacity	tons/year	1,788,091	**2,384,122**	2,980,152	
Sb	Average Bulk Carrier Vessel Size	DWT	27,500	27,500	27,500	
Vc	Cargo Volume (0.90 x DWT)	tons/vessel	24,750	24,750	24,750	
Tr	Required Hours to Load 1 Vessel	hour	60.6	45.5	36.4	
Dr	Required Days to Load 1 Vessel	Days	2.5	**1.9**	1.5	
Note	Year	year	2010			
	Required Loading Capacity	t/year	2,000,000			

This way one has selected two (2) units and some 800 ton/hr capacity loaders.

Table 6.2.3 (6) b. Railway Wagon Loading System

The annual cargo handling capacity of the terminal is calculated by adopting the following formula:

Qt = 365 x 24 x Rw x Rh x Rfoa x Nf x Pf x Ne x Ref x Ef

The results of the calculation are shown in the table below:

Railway Wagon Loading System

Marks	Description	Units	Study 1	Study 2	Study 3	Remarks
Nf	Number of Facility per Terminal	number	1	**1**	1	
Rfoa	Allowable Facility Occupancy Rati	-	0.50	0.50	0.50	
Rw	Facility Working Hour Ratio	-	0.60	0.60	0.60	working hour/Facility Occupancy hour
Rh	Cargo Handling Hour Ratio	-	0.75	0.75	0.75	handling hour/working hour
Pf	Theoretical Facility Productivity	tons/hour	150	**200**	250	
Ne	Number of Equipment per Facility	number	1	**1**	1	
Ref	Facility Effectiveness Ratio	-	1.0	1.0	1.0	Nf=1: 1.0, Nf=2: 0.9, Nf=3 :0.8
Ef	Average Facility Efficiency	-	0.75	0.75	0.75	
Qt	Annual Cargo Handing Capacity	tons/year	221,738	**295,650**	369,563	
Note	Year	year		2010		
	Required Loading Capacity	t/year		258,750		

Thus, one (1) unit and 200 ton/hr capacity loading system has been selected

Table 6.2.3 (6) c. Road Truck Loading System
Number and Capacity Calculation

The annual cargo handling capacity of the terminal is to be calculated by adopting the following formula:

$$Qt = 365 \times 24 \times Rw \times Rh \times Rfoa \times Nf \times Pf \times Ne \times Ref \times Ef$$

The results of the calculation are shown on the table below:

Truck Loading System

Marks	Description	Units	Study 1	Study 2	Study 3	Remarks
Nf	Number of Facility per Terminal	number	1	**1**	1	
Rfoa	Allowable Facility Occupancy Rati	-	0.50	0.50	0.50	
Rw	Facility Working Hour Ratio	-	0.50	0.50	0.50	working hour/Facility Occupancy hour
Rh	Cargo Handling Hour Ratio	-	0.50	0.50	0.50	handling hour/working hour
Pf	Theoretical Facility Productivity	tons/hour	40	**50**	60	
Ne	Number of Equipment per Facility	number	1	**1**	1	
Ref	Facility Effectiveness Ratio	-	1.0	1.0	1.0	Nf=1: 1.0, Nf=2: 0.9, Nf=3 :0.8
Ef	Average Facility Efficiency	-	0.50	0.50	0.50	
Qt	Annual Cargo Handing Capacity	tons/year	21,900	**27,375**	32,850	
Note	Year	year	2010			
	Required Loading Capacity	t/year	26,250			

Thus, one has selected one (1) unit and a 50 ton/hr capacity loading system.
However, in order to shorten the loading time for each truck,
it is recommended as one (1) unit and a 100 ton/hr capacity system.

(7) Common System

Common system will consist of following sub-systems:

a. Truck Scale System

Two(2) units of weigh bridge for one (1) road truck or road trailer, 100 ton capacity, with electronic data processing.

One(1) unit of weigh bridge will be installed at the entrance lane of the terminal gate and the other one(1) unit at the exit lane.

b. Control System

Control system will include the following basic functions:

i. System Control:
ii. Inventory Management:

c. Communication System

Communication System will include the following basic functions:

i. Internal Communication
ii. External Communication

d. Fire Fighting System

Sufficient numbers of fire hydrant will be provided on the grain handling facilities according to the Romanian Fire Fighting Regulations.

(8) Assisting Equipment

a. Front Bucket Wheel Loader

Three(3) units of front bucket wheel loader (“Bobcat”) will be provided for clean-up the bottom of barge/vessel’s holds.

b. Forklift Truck

One(1) unit of forklift truck, 5 ton capacity, will be provided for maintenance operation and other general use.

6.3 Barge Terminal

The barge terminal is one of the core project among the Master Plan components.

The purpose of the Barge Terminal, as described in Chapter 2 Short Term Development Plan, is as follows:

(1) To mitigate present congestion state.
(2) To cope with the increase of future barge demand.

Cargo volume to be handled at the Port of Constantza:

Present: 10.9 million tons
In 2010: 17.2 million tons
In 2020: 20.3 million tons

(1) Present cargo volume of 10 million tons will be increased to 20 million tons.
(2) Improvement of utilization rate of the Danube and Danube Black Sea Canal.
(3) To contribute improving export and import trade.

For the Barge Terminal Project, civil work is the main activity, due to increase of the number of berths and increase of berthing area for tugboats and pusher boats. In order to accelerate the utilization of barge terminal, supporting facilities will be provided. Supporting system is the space of offices, car parking area and minimum utilities. Utilities will include the facilities such as water supply system, power supply and lighting system.

The Terminal does not aim to have cargo handling activity.

Therefore, no equipment is considered since this terminal is mainly for standby and preparation areas for the next up-stream trip of the barges. Even so, any equipment that might be required will be provided by the related private sectors.

Discussion of these will be carried out Part II Chapter 7.

6.4 Other Terminals

6.4.1 Steel Products Terminal

The preliminary study on the required major equipment of the integrated steel product terminal was carried out based on the future demand and present situation of equipment at site. The main target to integrate is to rise of operation efficiency by scale merit. At this moment, operational and institutional consideration is omitted.

For the analysis of required cargo handling equipment, the following reference data was prepared for review:

Table 6.4.1 Annual Cargo Handling Capacity Calculation - Steel Products Terminal

Based on the forecast cargo volume, capacities of existing cargo handling equipment are studied.

Table 6.4.1 indicates the annual cargo handling capacity of existing cargo handling equipment at the terminal. According to the study results, the existing cargo handling equipment at the terminal has enough capacity for handling the forecast cargo volume in 2010.

The Terminal will be used for multi-purpose general cargo handling, mainly for steel products. Other commodities will also be handled.

6.4.2 Timber Terminal

The main aim of this terminal is similar to the steel product terminal. The preliminary study on the required major equipment of the gathering steel product terminal was carried out based on the estimated future traffic demand and on the present situation of equipment at site. The main target of this effort is to increase of operation efficiency by scale merit. At this moment, operational and institutional consideration has not been considered.

For the analysis of the required cargo handling equipment, following reference data were prepared for review:

Table 6.4.2 Annual Cargo Handling Capacity Calculation - Timber Terminal

Based on the forecast cargo volume, capacities of existing cargo handling equipment are studied.

Table 6.4.2 indicates the annual cargo handling capacity of existing cargo handling equipment at the terminal. According to the study results, the existing cargo handling equipment at the terminal has enough capacity for handling forecast cargo volume in 2010.

The Terminal should be used for multi-purpose general cargo handling, mainly for timbers. Other commodities should also be handled.

Table 6.4.3-5 in Part II indicates the annual cargo handling capacity of existing cargo handling equipment at the terminal. According to the study results, the existing cargo handling equipment at the terminals in the port has enough capacity for handling forecast cargo volume in 2010.

Timber cargo is currently for the exports. It is recorded that sharp timber export increase was observed by the end of last century. As shown in Part II Chapter 3, forecasted future timber cargo demands, however, indicates a weak demand. It is estimated that timber export will decrease after the peak volume in 2010.

It is recommended to review the cargo traffic of timber exports before the decision making of investment. It is also recommended to start the construction after the concession contract with private operators are carried out.

Table 6.4.1 Required Number of Quay Cranes for Steel Products Terminal

South Port(Berth 108, 109, 110 & 117 & 118)

The annual cargo handling capacity of the Quay Cranes is calculated by adopting the following formula:
Qb = Nq x Pqt x Hw x Dw x Rb x Rw x Rh x Re

The results of the calculation are shown on the table below:

Berth 108, 109 & 110

Marks	Descriptions	Units	6.3t Crane	20t Crane	Remarks
Nb	Total Number of berth	-	5	5	per Terminal
Nq	Number of quay cranes	sets	4	2	
Lr	Rated Load	tons	6.3	20	
La	Average Lifting Load	tons	5.0	16.0	Average Lifting Load/Rated Load=0.8
T	Cycle Time	cycles/hour	15	10	
Pqt	Theoret'l ave. productivity of crane	tons/hour	75	160	Pqt = La x T
Hw	Working hours per day	hours/day	22	22	
Dw	Working days per year	days/year	355	355	Subtracted holidays
Rb	Berth occupancy ratio	-	0.6	0.6	Nb=1:0.4, Nb=2:0.5,Nb=3:0.55,Nb=>4:0.60
Rw	Crane working hour ratio	-	0.90	0.90	working hour/berthing hour
Rh	Cargo handling hour ratio	-	0.70	0.70	handling hour/working hour
Pqn	Nominal ave. productivity of crane	-	47	101	Pqn = Pqt x Rw x Rh
Re	Crane effectiveness factor	-	0.8	0.8	Nq/Nb=1:1,Nq/Nb=2:0.9, Nq/Nb=3:0.8
Q	Annual cargo handling capacity	tons/year	708,523	755,758	
Qst	Sub-Total	-	1,464,281		

Berth 117 & 118

Marks	Descriptions	Units	6.3t Crane	20t Crane	Remarks
Nb	Total Number of berth	-	5	5	per Terminal
Nq	Number of quay cranes	sets	4	2	
Lr	Rated Load	tons	6.3	20	
La	Average Lifting Load	tons	5.0	16.0	Average Lifting Load/Rated Load=0.8
T	Cycle Time	cycles/hour	15	10	
Pqt	Theoret'l ave. productivity of crane	tons/hour	75	160	Pqt = La x T
Hw	Working hours per day	hours/day	22	22	
Dw	Working days per year	days/year	355	355	Subtracted holidays
Rb	Berth occupancy ratio	-	0.6	0.6	Nb=1:0.4, Nb=2:0.5,Nb=3:0.55,Nb=>4:0.60
Rw	Crane working hour ratio	-	0.90	0.90	working hour/berthing hour
Rh	Cargo handling hour ratio	-	0.70	0.70	handling hour/working hour
Pqn	Nominal ave. productivity of crane	-	47	101	Pqn = Pqt x Rw x Rh
Re	Crane effectiveness factor	-	0.8	0.8	Nq/Nb=1:1,Nq/Nb=2:0.9, Nq/Nb=3:0.8
Q	Annual cargo handling capacity	tons/year	708,523	755,758	
Qst	Sub-Total	-	1,464,281		

Qt	Total cargo handling capacity	tons/year	2,928,562	Total terminal
Note:	Target Year		2010	
	Cargo Throughput per year	tons/year	1,800,000	0.61

Note: The terminal has sufficient cargo handling capacity.
The terminal can handle not only steel products, but as well other commodities.

Table 6.4.2 Required Number of Quay Cranes for Timber Terminal

The annual cargo handling capacity of the Quay Cranes is calculated by adopting the following formula:

Qb = Nq x Pqt x Hw x Dw x Rb x Rw x Rh x Re

The results of the calculation are shown on the table below:

Berth 45, 46, 47 & 48

Marks	Descriptions	Units	6.3t Crane	20t Crane	Remarks
Nb	Total Number of berth	-	6	6	per Terminal
Nq	Number of quay cranes	sets	7	2	
Lr	Rated Load	tons	6.3	20	
La	Average Lifting Load	tons	5.0	16.0	Average Lifting Load/Rated Load=0.8
T	Cycle Time	cycles/hour	15	10	
Pqt	Theoret'l ave. productivity of crane	tons/hour	75	160	Pqt = La x T
Hw	Working hours per day	hours/day	22	22	
Dw	Working days per year	days/year	355	355	Subtracted holidays
Rb	Berth occupancy ratio	-	0.6	0.6	Nb=1:0.4, Nb=2:0.5,Nb=3:0.55,Nb=>4:0.60
Rw	Crane working hour ratio	-	0.90	0.90	working hour/berthing hour
Rh	Cargo handling hour ratio	-	0.70	0.70	handling hour/working hour
Pqn	Nominal ave. productivity of crane	-	47	101	Pqn = Pqt x Rw x Rh
Re	Crane effectiveness factor	-	0.8	0.8	Nq/Nb=1:1,Nq/Nb=2:0.9, Nq/Nb=3:0.8
Q	Annual cargo handling capacity	tons/year	1,239,916	755,758	
Qst	Sub-Total	-	1,995,674		

Berth 49 & 50

Marks	Descriptions	Units	6.3t Crane	20t Crane	Remarks
Nb	Total Number of berth	-	5	5	per Terminal
Nq	Number of quay cranes	sets	10	1	
Lr	Rated Load	tons	6.3	20	
La	Average Lifting Load	tons	5.0	16.0	Average Lifting Load/Rated Load=0.8
T	Cycle Time	cycles/hour	15	10	
Pqt	Theoret'l ave. productivity of crane	tons/hour	75	160	Pqt = La x T
Hw	Working hours per day	hours/day	22	22	
Dw	Working days per year	days/year	355	355	Subtracted holidays
Rb	Berth occupancy ratio	-	0.6	0.6	Nb=1:0.4, Nb=2:0.5,Nb=3:0.55,Nb=>4:0.60
Rw	Crane working hour ratio	-	0.90	0.90	working hour/berthing hour
Rh	Cargo handling hour ratio	-	0.70	0.70	handling hour/working hour
Pqn	Nominal ave. productivity of crane	-	47	101	Pqn = Pqt x Rw x Rh
Re	Crane effectiveness factor	-	0.8	0.8	Nq/Nb=1:1,Nq/Nb=2:0.9, Nq/Nb=3:0.8
Q	Annual cargo handling capacity	tons/year	1,771,308	377,879	
Qst	Sub-Total	-	2,149,187		

Qt	Total cargo handling capacity	tons/year	4,144,861	Total terminal
Note:	Target Year		2010	
	Cargo Throughput per year	tons/year	1,130,000	0.27

Note: The terminal has excesive cargo handling capacity.
The terminal can handle not only timbers, but other commodities as well.

CHAPTER 7 PRELIMINARY DESIGN OF MAJOR PORT FACILITIES

7.1 General Description

This chapter deals with the preliminary design of the major port facilities including those proposed in the Short Term Development Plan following the Master Plan.

From the three project components selected in the Short Term Development Plan, two terminals (namely Grain Terminal and Barge Terminal), were further selected as they are the priority projects that should be undertaken within the Feasibility Study. It is assumed that the selected first priority projects should be the major objectives of the preliminary design.

Verification was also scheduled on the viability of the Short Term Development Plan. For this reason, the schematic design of the major facilities proposed in the Plan will be conducted accordingly.

Refer to PART III Chapter 8 for the construction program and Chapter 9 for the project cost estimation of the Short Term Development Plan.

The main purposes of this chapter are enumerated below as the basis to formulate the construction program and the cost estimate to be discussed in the next two chapters:

1) To develop the preliminary design of the main facilities as a basis for cost estimation by means of comparative studies on the design alternatives of the principal components.
2) To determine the unit price of each construction work for the physical components of the terminal construction based on analysis of the standard unit price, such as wages, materials, equipment, etc..
3) To provide the basic conditions needed to estimate the overall project cost derived from the above unit prices and the preliminary quantity of the project components.
4) To develop the general construction sequences and formulate the overall construction schedule.
5) To identify the key considerations in the environmental preservation from the above preliminary design exercises.

Based on these objectives, this chapter are prepared for the preliminary design of the major port facilities. Together with the design aspects, the technical essence of the port design as delivered from the past design records at Constantza is also reviewed. These will be the key aspects for the preliminary design needed for the Feasibility Study.

Based on the aspects and physical scope of the Short Term Development Plan as defined through planning exercises, this chapter will summarise the study results on design aspects conducted by the Study Team.

This chapter also covers the preliminary design of the possible project components proposed in the Short Term Development Plan. Proposed project components divided by terminal and common facilities are the following:

Terminals:

1) **Grain Terminal (First Priority Project)**
2) **Barge Terminal (First Priority Project)**

Common Facilities:

1) **Inland Transport Facilities: Inner Port Road Access, Gate 5 Access**

7.2 Discussion Summary of Previous Chapters in PART III

Chapter 1 covers the reason for selection of the Short Term Development Plan and the Planning Concepts and Development Strategies.

Chapter 2 describes the Short Term Development Plan and the Priority Projects of the feasibility study. The terminal planning issues of the Grain and Barge were studied in detail to meet the feasibility study requirements. Chapter 2 also covers the study recent development in regards the transport modal split and the grain cargo demand that was reviewed mainly by the transit cargo.
Cargo handling system is one of the major study items used to generate the optimum system arrangement for undertaking preliminary design.

Chapter 2 also covers the physical plan of Short Term Development Plan. This physical master plan formulates the layout of various port facilities, namely:

a) Channel
b) Turning basin
c) Quay and berth
d) Breakwater
e) Road alignment
f) Railway alignment

Chapter 3 also covers the Short Term Development Plan. Outline planning was also provided for the other terminals: namely for Steel product and Timber. It is also studied the inner port access including Access Road and Railway issues.

Chapter 4 provides verification and review of the General Port Layout under the Short Term Development Plan proposed in Chapter 2. The basic port layout is proposed and planning was carried out in order to maintain the vessel maneuvering safety. Several breakwater arrangement alternatives were given to select the best breakwater alignment. The result of the Wave Calmness Study is also presented here.

Chapter 5 describes the recommendations on port management and operation required for the Short Term Development Plan. The management information system is also discussed.

Chapter 6 covers the required cargo handling equipment based on the handling system proposed in Chapter 3, mainly for the Grain Terminal. Required cargo handling equipment was recommended including quay crane, silo, conveyors etc,   General Yard Layout of the Grain Terminal was also studied.

7.3 Basic Concept of Preliminary Design

This section deals with the basic concept of preliminary design delivered from both the previous chapters and technical consideration as shown in below.

7.3.1 Common Criteria for Preliminary Design

1) General Description

In principle, the major marine facilities should be the best selection from the several alternative ideas or schemes. In order to achieve this, past experience of facility use at the port are verified. In this respect, natural conditions such as wave, wind, and soil are carefully studied.

The locality is also taken into consideration. Local availability of labor, materials, construction skill and equipment should be evaluated in order to maximize participation of local construction capability. When necessary to reduce the required cost, construction method which is normal procedure in international view point will be adopted even it is not familiar to Romanian contractors.

It is recommended to include the contingency costs to supplement the possible cost increase occurring during the detailed design stage. As shown in Subsection 9.1.3, physical contingency is introduced for the civil works and equipment of 10% and 5%

2) Best Selection Criteria

The selection criteria of the most suitable design should include the following:

a) Exiting Land Use
This is one of decisive factors in design, since the most of the waterfront port area was lent to the private operators or occupied by CFR. Free or empty areas neighboring to the applied study area of the proposed terminal was basically limited since most of areas are already occupied by operators.

b) Existing Facilities
Land reclamation and quay wall construction has been partly undertaken at the proposed terminals, grain and barge. Thus physical site characteristics of them should be incorporated in design.

c) Intention of the Private investors
At this moment, it is not the time to get the requirement of private operators.

d) Harmonizing Surroundings

e) Harmonizing with other infrastructure projects
Proposed terminals can not survive without the smooth traffic connection with inland transport networks. In this regards, three modal splits namely canal barge transport, truck and railway should be carefully studied. Barge terminal has heavily relation to the bulk grain terminal.

f) Locality
Construction materials availability and work force skill of local man-powers should be taking into account. Source of reclamation materials of the proposed grain terminal at S3 is one of items to be located at its neighboring.

g) Maritime safety
Arrangement of the proposed grain terminal will be affected by wave calmness conditions since its area is the nearest basin to the port entrance. Proposed grain terminal berths are located at the western inner-end basin and wave calmness condition at this is good and safety to barge maneuvering. However before arriving this basin vessels should pass through the rough zone of the inner channel. Barge should be given more calmness than the ocean-going vessels. This was discussed in Chapter 2 and Chapter 4.

h) Efficiency
Efficiency of the new terminal should be maximized to maintain the quick cargo movement in the shortest distance. In this respect, cargo handling system and facility arrangement should be carefully planned and evaluated.

i) Construction Economy
To maintain the required cost minimum is the most important target

j) Ease of Construction
Ease of construction in the marine works is essential to reduce th required costs, and maintain the quality of works.

k) Ease of Maintenance Works
   Ease of maintenance works is also essential to reduce the maintenance costs. In some case, high cost of initial cost makes the maintenance cost low.

l) Future Expansion
   Facility design should be harmonized with future expansion plan. For example, the new grain terminal to discuss is Phase 1 development and the Phase 2 will follow it by 2012. Efficiency of land-use is also important in order to give other project with the waterfront area, which should be understood of the limited resources in the port.

m) Flexibility
   Land-use of the proposed site should have enough open space which the private investors can arrange utilization by his own idea and scheme.

n) Environment
   It is an era of environment. The proposed grain terminal should meet with the international standards in environmental aspects.

7.3.2 Special Considerations to Preliminary Design

1) General Description

The design is conducted based on the common criteria shown above and the reason behind selection of the existing port facilities.

2) Harmonization with the Present Operation

The present facilities utilization in the surrounding area is assured as much as possible. This can be done that the adverse affect of the construction works on present port operation be minimum. Any disturbance thereto should be as minimal as possible.
For the time being, the site of proposed two terminals have few influences to the port operation.

3) Coastal Changes

It is reported that coastal changes have minimal effect on the port, however, these phenomena should be also considered during the detailed design phase.

4) Environment

In order to last the life span of the port long, the required environmental protection facilities proposed by the previous study are considered.

7.4 Outline of Physical Arrangement

7.4.1 Zoning and Functional Allocation

Port development aims generally at increasing cargo handling capacity and handling efficiency. However the major task in Constantza is to improve the operation efficiency.
PART II Chapter 6 provides **the proposed Master Plan** to meet the forecasted cargo demand determined in PART II Chapter 3 and non-demand orientation like a modernization of facilities.

According to the existing port capacity study, most berths, excluding the container and grain terminals, have more than enough cargo handling capacity for the traffic demand in 2020. However it is the time to improve the port operation and cargo handling method by modernisation and systemisation. It is reported the port capacity is so large although the quality of works and facilities are old models. Thus the focus is to determine present problems in operation and to propose solutions to improve efficiency. It is concluded that the systematic port rearrangement is one of the major tools towards modernization.

Main influential factors for the facility arrangement are port area zoning and functional allocation. This work will require not only CPA support, but also contribution by private operators who currently handle the cargo.

To consider the preliminary design the entire port area is divided into seven zones, basically following the port construction history.

1)	Area A	North port,	Northern area of SNC
2)	Area B	North port,	SNC
3)	Area C	North port,	Southern area of SNC
4)	Area D	Barge Terminal	
5)	Area E	Barge Terminal offshore:	the East Side
5)	Area F	South port,	West
6)	Area G	South port,	East for future

Refer to the discussion in PART II Chapter 6.

The largest occupant of the port common yard is CFR which shares more than a half of the common area. SNC also shares a large part of north port area that restricts normal port activities. Compared to the north port, the south port is rather open and has a chance to expand to future.

PART II Chapter 6 proposed the Master Plan of Constantza Port.

The preliminary design was undertaken following port area zoning and functional allocation. The port area use consists of two categories: namely, the common areas and the terminal. All the port users use the former and the latter areas are occupied by the contract operators.

1) **The common area** which covers the transport system, utilities etc. that are used in common by the operators and port users. Channel, breakwater and navigation aids also belong to this. Theses systems have normally few revenues. It is assumed thus the public sector might directly manage these.
2) **The terminal area** which is exclusively used and operated by the private operator under the concession contracts. These areas can generate enough revenues to operate it.

7.4.2 Traffic - Circulation

1) General Description

The port has been supported by four transportation modes: namely roads, railway, inland waterway with the Danube-Black Sea Canal, and pipelines for the liquid cargoes. The shared structures of these modes as seen for 2010 and 2020 are forecast to be: “12.1%, 25.1%, 22.3% and 40.5%” and “11.9%, 27.7%, 24.9% and 35.5%” respectively. These shared structures vary by commodity.

Notes: These figures were reviewed and modified in June, 2001. Refer to the latest share diagram shown in PART II Chapter 4 and PART III Chapter 2..

For land transport modes, it may be seen that the access points at ten gates are provided along the port boundary that extends from the north to the south. The basic characteristics of the each gate are the following:

a) **Gate 1** The main gate for non-cargo vehicles at north most at grade section.
b) Gate 2 Road accesses by fly-over.
c) Gate 3 Road accesses by fly-over.
d) Gate 4 Road accesses by fly-over.
e) **Gate 5** **A main road access for cargo vehicles** by fly-over to the entire north port area for handling cargo.
f) **Gate 6** **A main road access for cargo vehicles** by fly-over to the entire north port area for handling cargo. A railway connection point.
g) Gate 7 Road accesses.
h) Gate 8 Road accesses.
j) **Gate 9** Road accesses by fly-over to the barge terminal. A railway connection point located at the immediate north of the Danube Black Sea Canal.

k) **Gate 10** Road accesses by fly-over to the south port, Free Zone located at the immediate south of the Danube Black Sea Canal. A long detour is required to get there from the north bank of the canal.

2) Basic system

Basic system of these three modes is as follows:

a) The railway approaches the port through the boundary near Gates 6 and 9. Three sidings are provided: one near the Gate 2/3, one in front of Gate 4 and one between Gates 4/5. The railway is available to the barge terminal and the south port/ Free Zone. The access to the port area is limited due to the existence of a 20 to 50m high cliff along the boundary. Most of quay and waterfront areas have rail tracks under the quay cranes.

b) The roads approach the port through the ten gates. Among these, only three gates (Gates 5, 6 and 10) are important in terms of cargo transport. These gates are not prepared for customs and safety operation. The main access to port area is by the Flyover Bridge going over the railway tracks. There is no truck terminal within the port. The access in the port area is narrow and limited to a two-way service road. Quayside arrangement is not provided for truck loading activities, and most quay and berth areas have only rail tracks under the quay cranes.

c) An entrance to the Danube Black Sea Canal is located near Gate 9. At 1.5 km upstream, there is a double 350 m long gate, and a bridge is provided at the seaside. Further 700 m towards landside, there is a main bridge where ordinary traffic runs and connects the transport between the south port and north port.

3) Arrangement

The proposed arrangement of these three modes is discussed in PART III Chapter 2 and Chapter 3.

7.4.3 Future Development

It is assumed that future port development will be undertaken in the undeveloped areas, including Area D (Barge Terminal), Area E (Barge Terminal offshore, the East Side) and Area G (South port, East for the Grain Terminal).

Refer to PART III Chapter 2 for more details.

7.4.4 Consideration of Existing Land Use by Private Operators

1) General Description

The terminal site selection is related to the present land use pattern under the scope of the concession contract, that is between the private operators and MOT/CPA.

It is further assumed that a private operator under a concession contract will operate the terminal. It is also assumed that the project will contain both investment by MOT/CPA and private operators. The preliminary design covers both categories.

2) Management Aspects

The establishment of legal relationship between Public Sector MOT/CPA and Private Sector is believed to be one of the most important aspects of port development strategy. Roles and responsibilities of Public Sector and Private Sector are identified in order to generate a clear management organization of the port.
Refer to PART II Chapter 5 and PART III Chapter 5 for recommendation on port management and operation for the Short Term Basis.

3) Design Aspects

During preparation of the preliminary design, following criteria were maintained:

a) "Infrastructure" (mainly the civil works) will basically be invested in by the Public Sector. Note: It is assumed that CPA is public sector, at least for the near future.
b) "Superstructure" (mainly the cargo handling equipment or similar) will basically be developed by the Private Sector.

It is assumed that the infrastructure will be designed based on average procedure which might be accepted by the private sectors. This consideration will be required for operation by the private sectors.

This criteria should be reviewed when so required. It is recommended that the public sector should be brave enough to cover the superstructure. The private investor's interest is its own business, not in the contribution to the industry thus national development. For example, beneficiaries of grain terminal are not the private operator but agriculture industries. In this regards, duty and responsibility of public sector is so important to built the terminals which contribute to the national economy.

Private operator will express their interest when the tender of the concession contract is taken place.

7.5 Design Conditions

7.5.1 General Consideration

The main purpose of the preliminary design is to develop a technical solution for the Short Term Development Plan to provide enough data for cost estimation and to roughly verify the viability of the Plan. Global evaluation is checked through the economic analysis, in Chapter 10.

As mentioned in Chapter 2, the Study Team proposed two terminals as First Priority Projects taking from five candidates. A feasibility study is scheduled for each First Priority Project. The selected terminals for the Feasibility Study are the Grain Terminal and Barge Terminal.

The port planners of the Study Team carried out a thorough analysis and established their suggestions based on the basic cargo handling system and with the necessary facilities and their arrangement in the Short Term Development Plan. So to remain in compliance with the scale of port facilities determined in PART III Chapter 2, the facilities scale and type for the specified project components were planned below from the technical viewpoint as well as consideration of the following related aspects:

a) **Natural conditions including sub-soil, meteorological and oceanographic situations**
b) **Loading conditions, vehicles and cargo handling equipment**
c) **Size and type of ships, barges, etc.**
d) **Type and volume of cargoes**
e) **Inland Transport Mode**
f) **Materials and equipment availability in Romania**
g) **Construction workability**
h) **Safety of structures and systems, cost for maintenance and operations**
i) **Environmental conditions and mitigation measures**
j) **Project life of facilities**
k) **Past design records at Constantza, and so on.**

The required project design should comply with the technical regulations specified in STAS, the Romanian standards. Some of the STAS design conditions and other parameters taken from field measurement, etc. are shown below.

7.5.2 Site Conditions

The site conditions related to the marine environment, especially to the oceanographic conditions and seismic conditions, are listed below:

- a) **Water Level** HWL : +0.60m
  MSL : +0.00m
  LWL -0.30m

- b) **Offshore Wave** H_0’ = 10.8 m
  T = 9 -12 sec

  Note: The wave characteristics in the port area are affected by the seabed configuration. Any waves propagated near the shore will change their shape and characteristics as influenced by the seabed friction. The equivalent for the offshore waves is estimated from place to place according to the general layout.

- c) **Sub-Soil Conditions**

  Based on the results of the soil investigation, the soil conditions are assumed as having the two profiles shown **below**.

+2 - 3m	+2 - 3m
Fill Material	**Fill Material**
-15m - -17m	-15m - -17 m
Clay ϕ=15^o C = 0.3 kg/cm^2	**Clay** ϕ=15^o c = 0.3 kg/cm^2
-20m	-35m
Limestone	**Limestone**
(Area A: Pier S2)	**(Area B: Pier S3)**

- d) **Seismic Conditions** kh = 0.10

  This means that the maximum horizontal acceleration is estimated to be about 10% of the gravitational acceleration. It is assumed that the structure will be decided under serious situation conditions, that is somewhere between normal and seismic conditions.

7.5.3 Objective Vessels and Berth Dimensions

The size of the future vessels is studied and described in PART III Chapter 2. Based on the results, the objective vessels and relevant berth dimensions, used for the preliminary design, are summarized in **Table 7.5.1.**

Table 7.5.1   Objective Vessels and Berth Dimensions

Terminals	No	Ship Size				Berth		**Remarks**
		DWT (ton)	LOA (m)	Beam (m)	Full Draft (m)	Length (m)	Depth (m)	
Grain Terminal	(1)	10,000	140	18.5	8.3	180	-9.5	**General Cargo**
	(2)	25,000	185.2	22.8	10.2	220	-11.0	**Handy B. C**
	(3)	**65,000**	**253.9**	**32.2**	**12.4**	**300**	**-14.0**	**Panamax B. C.**
Barge Terminal	(1)	**2,906**	**88.9**	**11.0**	**3.8**	125	**-4.5**	**River Barge**
	(2)	490	34.6	11.0	2.0	50	-3.0	**Pusher2400 hp.**
Steel Product Terminal	(1)	10.000	137	19.9	8.5	160	-10.0	General Cargo
	(2)	50,000	216	31.5	12.4	250	-13.5	General Cargo
Timber Terminal	(1)	3,000	92	14.2	5.7	110	-7.0	General Cargo
	(2)	15,000	153	22.3	9.3	180	-10.5	General Cargo

Note: BC: Bulk Carriers

Data for the steel product terminal and timber terminal are just for reference.

7.5.4 Loading Conditions

A) Facilities near the Existing Port Facilities

Following to the design load used for the existing quaywalls, the similar loading conditions are used for the preliminary design:

1) Surcharge Load : 10 t/m^2
2) Quay Crane : as required

B) Independent Facilities

The following loading conditions are adopted for the preliminary design.

1) Surcharge Load : 5 t/m^2
2) Quay Crane : as required

C) Basic Formation Level at Quay

The formation level will vary by terminal and land use. However it is assumed that the standard formation is +2.5m to +3.0m above the datum line.
It is recommended to maintain +3.0m at the Grain Terminal.

7.6 Grain Terminal (Phase I)

7.6.1 General Description

As proposed in PART III Chapters 2 & 6, this terminal should annually handle about two million tons of bulk grains at export peak, and one half million tons for imports when required. As seen in the PART II Chapter 3, the following criteria to estimate the peak grain traffic to design the facility are established and applied. The following formula provides these criteria in relation to the traffic indicators.

P = N + F

Where,

N: Net Grain Traffic Volume

F: Expected Annual Fluctuation by Serious Changes in Crop, in Romania or elsewhere

P: Peak Grain Traffic Volume

Notes
1. Actual traffic is the new grain traffic plus annual fluctuation based on performance in harvest season.
2. Previous World Bank report considers only the net traffic in the facility design.
3. This study covers both, the net traffic and fluctuation.

If only the variable N designs the terminal facility, the export volume during a high crop condition will be limited. However the investment costs will be minimal. If the terminal facilities would be planned so as to meet the variable P, there would be few troubles to export the excess grain even it is a large harvest year. The latter idea will stimulate producer's minds. However the required cost will increase accordingly.

It is recommended to provide terminal facilities with a handling capacity to cover and meet the Peak Grain Traffic Volume, not the Net Volume.

According to the grain traffic forecast data, the grain volume in year 2010 (Case 1, High) is:

N = 4.4 million tons	**68.7 %**
F = 2.0 million tons	**31.2 %**
P = 6.4 million tons	**100 %**

This 6.4 million tons is the design handling capacity, however this is not to be the design capacity of the new grain terminal since working grain handling facilities exist due to the private operator efforts. Actually, MOT has already approved that several investors should install some new equipment and/or increase their present grain handling capacity. According to the latest information provided by IPTANA, the existing grain handling capacity at Constantza

Port will increase to 3.7 million tons within a few years. This consists of existing capacity of 2.0 million tons and 1.7 million tons of additional capacity including the improvement of existing terminals. Thus the grain handling capacity of the proposed new grain terminal is:

2.7 million tons (6.4 million tons – 3.7 million tons)

This calculation shows that the theoretical annual handling capacity of new grain terminal is about 2.7 million tons. However the Study Team proposes one unit of two million-ton terminal for the following reasons:

(1) Due to the high demand of grain traffic in the long term, in the future some investors may participate in this business.
(2) A two million ton grain terminal is likely to be a standard volume when taking into account reasonable balance among silo loaders/unloaders under a single berthing facility for ocean-going vessel.
(3) It is recommended to provide a second two million tons grain terminal in Phase II development near the proposed grain terminal (Phase I). The second grain terminal will provide a place and related common utility facilities for future requirements.

Based on these considerations, it is recommended to allocate two grain terminals each with a two million ton annual handling capacity. Of course the first is the grain terminal is a priority focus.

Note: It is assumed that the new grain terminal will theoretically receive 35.1 % of actual grain traffic. Existing net share of grain handling is as follows:

Existing terminal capacity plus additional capacity:	3.7	64.9 %
New grain terminal (Phase I project):	2.0	35.1 %
Total	5.7	100 %

The high grain demand seekers can welcome this arrangement as the World Bank's Romanian Grain Export Study concluded in 1997. The report estimated 7.7 million tons as Net Traffic in 2010 and recommended to build a 4 million ton grain terminal after considering the existing grain terminal handling capacity for traffic demand in 2010.

The Study Team agrees with the World Bank's recommendation to come up with a layout with two terminals for maintaining a good competition, although the investment timing of the second terminal might be delayed.

For this reason, the proposed grain terminal yard arrangement located in the long term layout is capable of holding two grain terminals each with 2 million ton annual handling capacity.

Notes: It is assumed that such applications and requests of private operators be approved. Regarding the facility design, it is assumed that there is no possibility of withdrawal, capacity deduction or suspension from the side of the operators. However, there is a possibility of investment withdrawal and reduction of 3.7 million tons.

Thus preliminary design will use Case-1: High Demand Ttraffic as follows:

Export Bulk Grain: **2.0 million tons**
Import Bulk Grain: **0.5 million tons**
Note: These two conditions will not co-exist.

Refer to Figure 7.6.1 'Cargo Demand and Required Grain Handling Capacity at Proposed Terminal'.

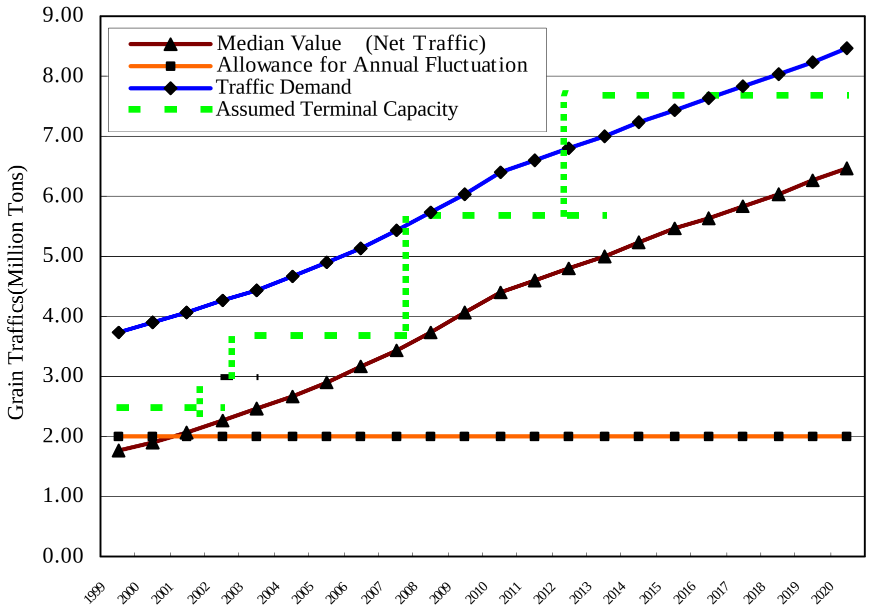


Figure 7.6.1 Cargo Demand and Required Grain Handling Capacity by Proposed Terminal

7.6.2 Grain Terminal Development and Site Selection

(1) Alternatives of Development Areas

There are three alternative development areas, namely:

a) Development at the existing Berth 31/33 at the north port.
b) Development at existing Pier S1 close to the existing 2 million ton terminal
c) Development at the new Pier S3 next to S2 container terminal pier.

Basic facilities required are terminal facilities on the yard of 5 ha and 600m long wharf and supporting quay wall.

The major difference of facilities among these is minor because each terminal should handle about 2 million tons of bulk grains. The S3 terminal however will require the construction of a new quay wall and some land reclamation to form the operation and silo yard. As explained in PART III Chapter 2, S3 Site was finally selected mainly due to the land availability.

(2) Area S3 Development and Layout Conditions

The Grain Terminal at the Pier S3 should consist of a 250 m long unloading berth and a 300 m long loading berth and five ha of land at least. The existing Pier S3 was planned by MOT in 1980s and partially constructed at the end of 1980s.

Pier S3 area is not completed but is rather at the beginning of its construction. The quay wall foundations at berth area are partially built, however the land is not shaped yet. No pavement or reclamation or crane foundations are provided. This indicates that: 1) the terminal construction here is more expensive than those on reclaimed land like a Pier S1, and 2) the terminal arrangement could, however, be carried out rather freely.

Grain Terminal and Barge Terminal were selected of the First Priority Projects. Both terminals are located at the South Port. The general arrangement of these two terminals is shown in Figure 7.6.3.

From the east direction through the port entrance, there is one approach channel to these areas, namely South Approach Channel. This channel is also vital to the On-going Container Terminal at Pier S2 and existing grain terminal located at Pier S1. This channel bends twice before reaching these terminals. This is due to the shape of the existing groin detached from the South-eastern end of Mid-Island. It is assumed that this is for protecting the North-eastern quay of Pier S2 against waves approaching from the East. If this groin can be removed without any disturbance to Pier S2, vessel maneuvering would be easier since it would give the channel a straight alignment as shown in Figure 7.6.4.

Fig. 7.6.5 shows the present physical situation and surroundings of Pier S3.

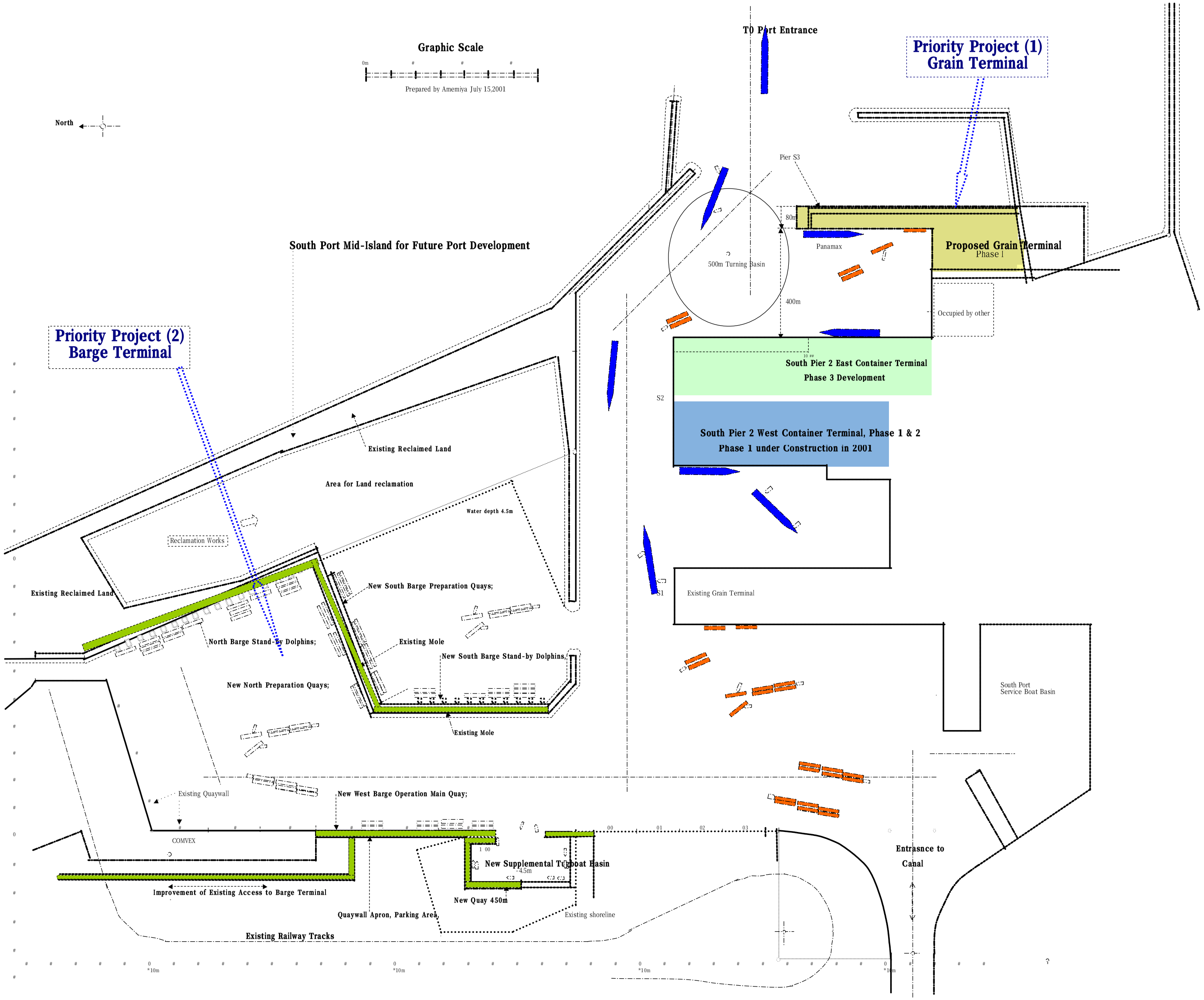


Figure 7.6.3 General Arrangement of Two Priority Projects

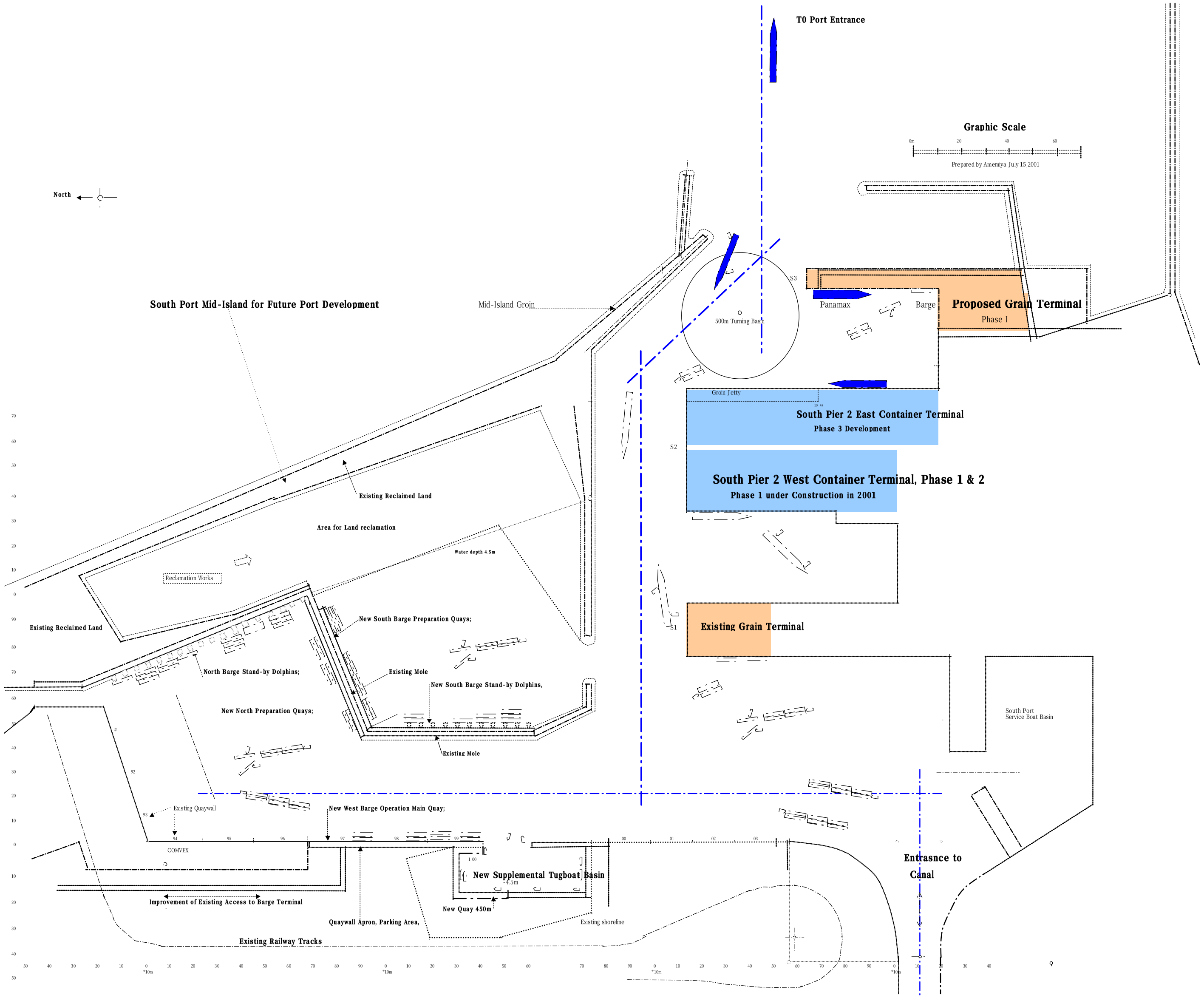


Figure 7.6.4 General Layout of South Channel and Terminals

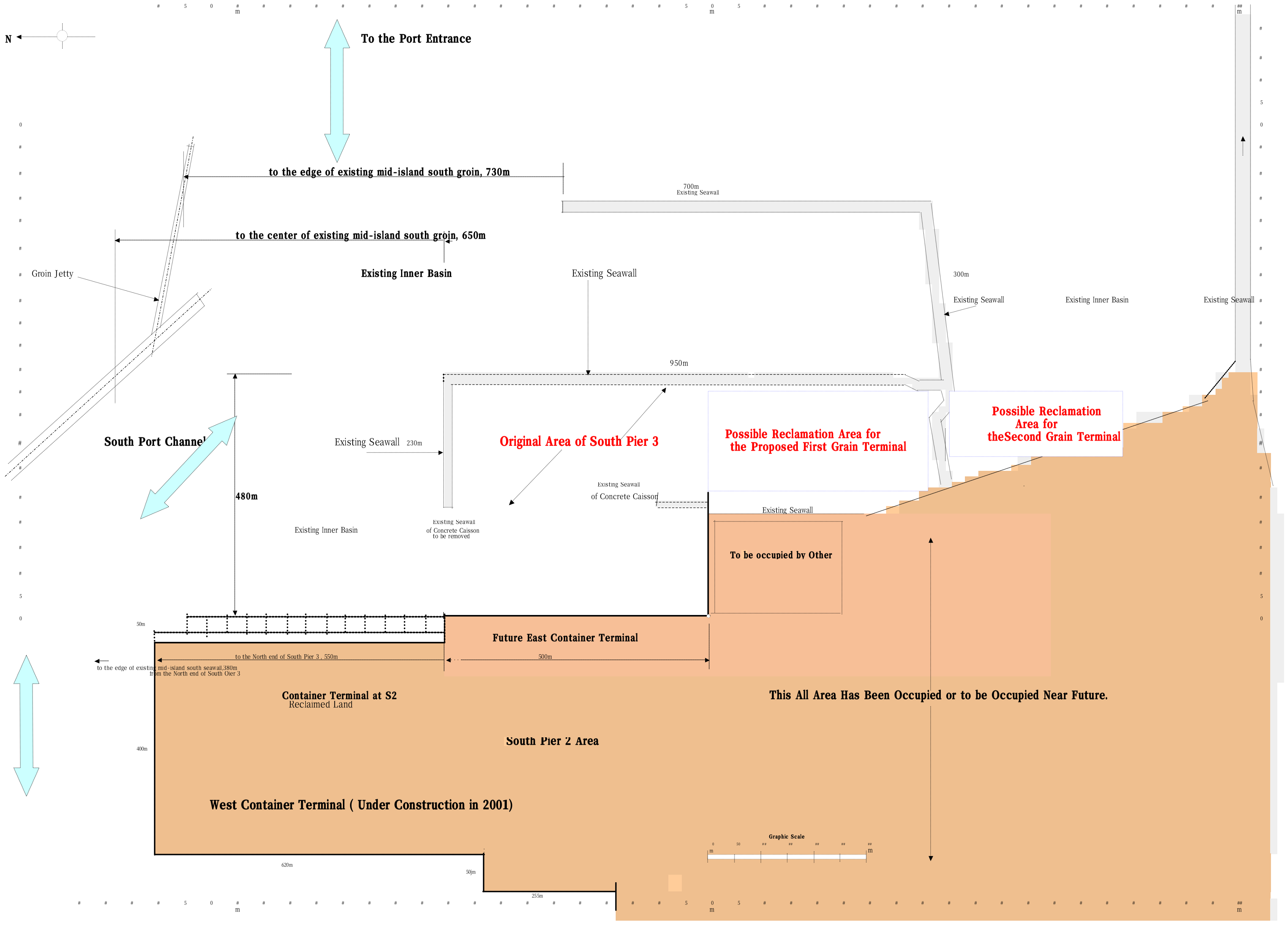


Figure 7.6.5 Existing Land Use and Physical Conditions at S2, S3 and its Neighbors

Most of the reclaimed land in the port has been already assigned to a project or operator, whereas the new project which needs a 600 m long water front and five Ha of land requires basically newly reclaimed land. As seen in figure, S3 area consists of water surface and only partial construction of a quay wall or temporary mole by dike reclamation. The total length of waterfront is about 2440 m as follows:

Part 1:	West most	80 m quay wall
Part 2:	West wall of S3 area	1,360 m (1180 quay wall, 180 m mole)
Part 3:	East wall of S3 area	1,000 m mole

This indicates that land reclamation works should be implemented for the terminal.

The works will consist of the civil works and provision of cargo handling equipment. The former are for the silo with handling equipment, pavement works, supplemental quay strengthening, and others. The later includes two quayside unloaders for receiving grain from barges and two quayside loaders to service the ocean-going dry bulk carriers.

The silo capacity is 100,000 tons as recommended in PART III Chapter 6.

The major work components for the proposed grain terminal are:

a) Quay Construction including removing half-constructed concrete caisson
b) Reclamation and Site Development
c) Terminal Yard Development
d) Yard Utilities (Power, Water, Sewage, Telephone, etc.)
e) Road, Rail Access
f) Silo and related facilities
g) Mechanical tower
h) Terminal Control Office
i) Export Equipment (Loader: 2 x 400 ton/hr, Unloader: 2 x 800 ton/hr, etc)
j) Import Equipment
k) Connecting conveyor system and
l) Fumigation, oiling, Grain dust facilities
m) Others

SOGREAH's Report (World Bank report) for S3 terminal design has been referred to for site selection and preliminary design. A plan and the cross sections of the terminal, as indicated in the report, are shown in PART II Chapter 7, Figures 7.6.4 and_7.6.5.

(3) Area S 3 Grain Terminal Development Alternatives

Original Pier S3 is planned by MOT as a rectangle of 260 m width by 500 m length. Its area is approximately 13.0 ha which is sufficient for two units of two million ton grain terminal. Thus, the first choice is the use of the original layout (Alternative L220), even though it is formulated with only partial boundary quay wall.

Note: Construction of a quay wall structure planned 1260m long (500 m + 500 m + 260 m). However it was suspended when a subsection of 860m quay wall (500 m + 260 m + 100 m) was completed

Other than this MOT original layout, the master plan proposed Alternative L400 providing a wide slip development scheme between the S2 and S3. This new arrangement aims at providing ship maneuvering space enough for the large ocean-going vessels including Panamax type of 65,000tons. Taking these two different schemes, the study team prepared the grain terminal development alternative.There are two alternatives: namely,

Alternative L220
Alternative L400

The former alternative is MOT's original layout for S3 which has 220 m width slip and 260m section generating 13 ha area of reclaimed land. The latter alternative is a modified layout with a 400m width of slip with 80m land section. Alternative L220 can be constructed at ten % lower cost than Alternative L400 since it makes full utilization of the suspended quay wall construction.

Refer to Figure 7.6.9.L220 for the Alternative L220.
Refer to Figure 7.6.9 for the Alternative L400.

Advantage of Plan L400 is to provide an enough space to the safety maundering of the large ocean-going vessels. Advantage of Plan220 is the construction economy, or ten % less cost than those of L400.

Plan L400 has another technical privilege that it can built its silo bins on the good soil condition area. According to the elevation data of bearing stratum of earth, the Pier S3 locates the worse location. Elevation of the stratum (Limestone) is generally observed –35m or deeper. While the southern part of this pier rests on the shallow limestone layer, -25m or higher. Shallow hard stratum generally means better condition due to lower possibility of existence of soft layers which may be cause the settlement.

This indicates there were old valley under the Piers, S1, S2 and S3. It is reported that the canal was excavated on the soft layers such as old submerged valley. Thus this submerged valley is continuing from the canal entrance towards the east to offshore site. It is also reported that heavy structures at the S1 were affected by irregular settlement due to soil consolidation under the heavy weight.

Refer to Figure 6.5.3b in Part I.

As seen in PART III Chapter 2, Alternative L400 was finally selected.

The alternatives to this plan are shown below:

Figure 7.6.6	General Layout of Grain Terminal Alternative A1: South Pier 3
Figure 7.6.7	General Layout of Grain Terminal Alternative A2: South Pier 3
Figure 7.6.8	General Layout of Grain Terminal Alternative B1: South Pier 3
Figure 7.6.9	General Layout of Grain Terminal Alternative B2: South Pier 3
Figure 7.6.9 L220	General Layout of Grain Terminal Alternative L220: South Pier 3

Among these, first four figure are for Plan L400.

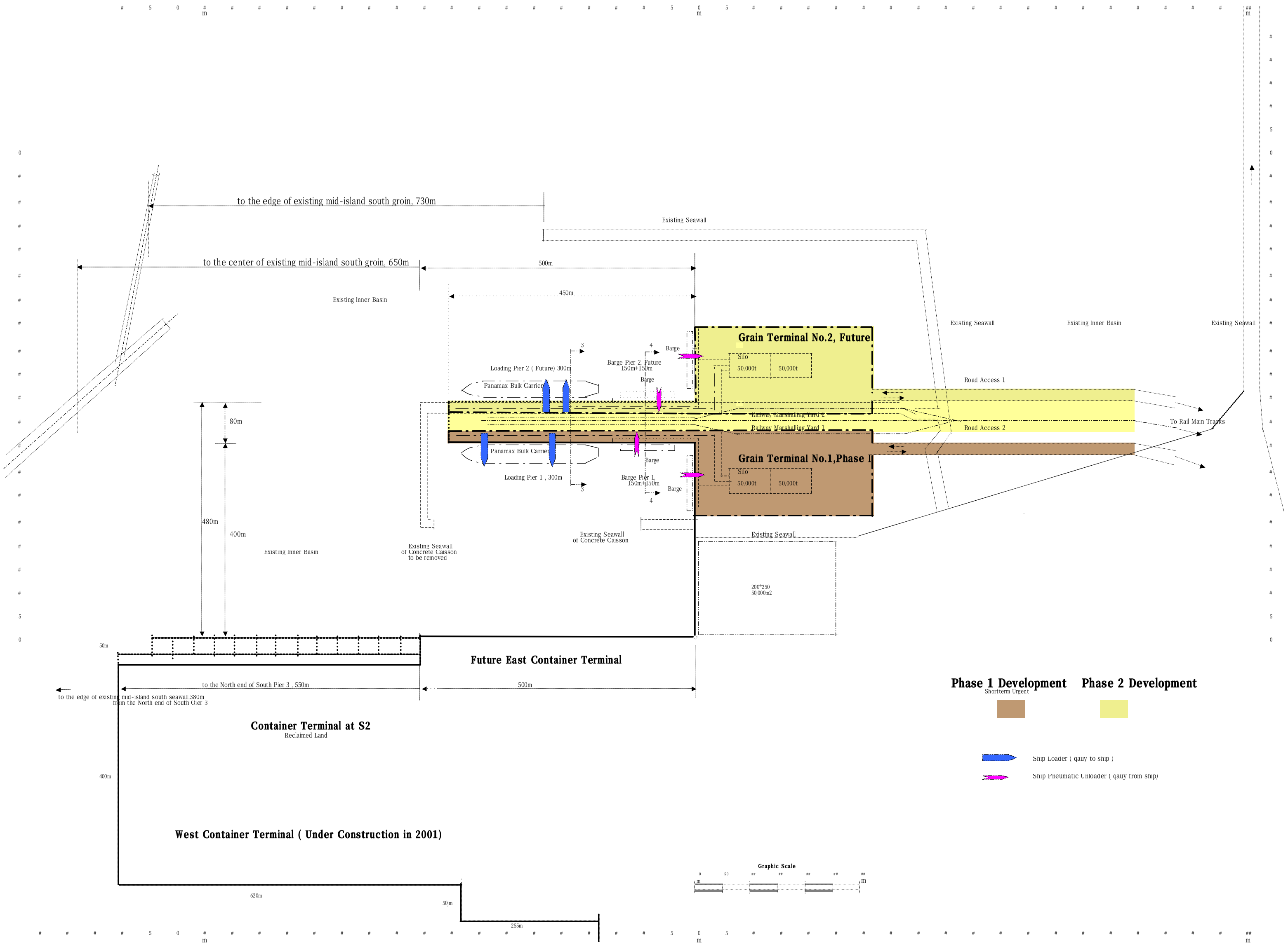


Figure 7.6.6 General Layout Grain Terminal, Alternative A1: South Pier 3

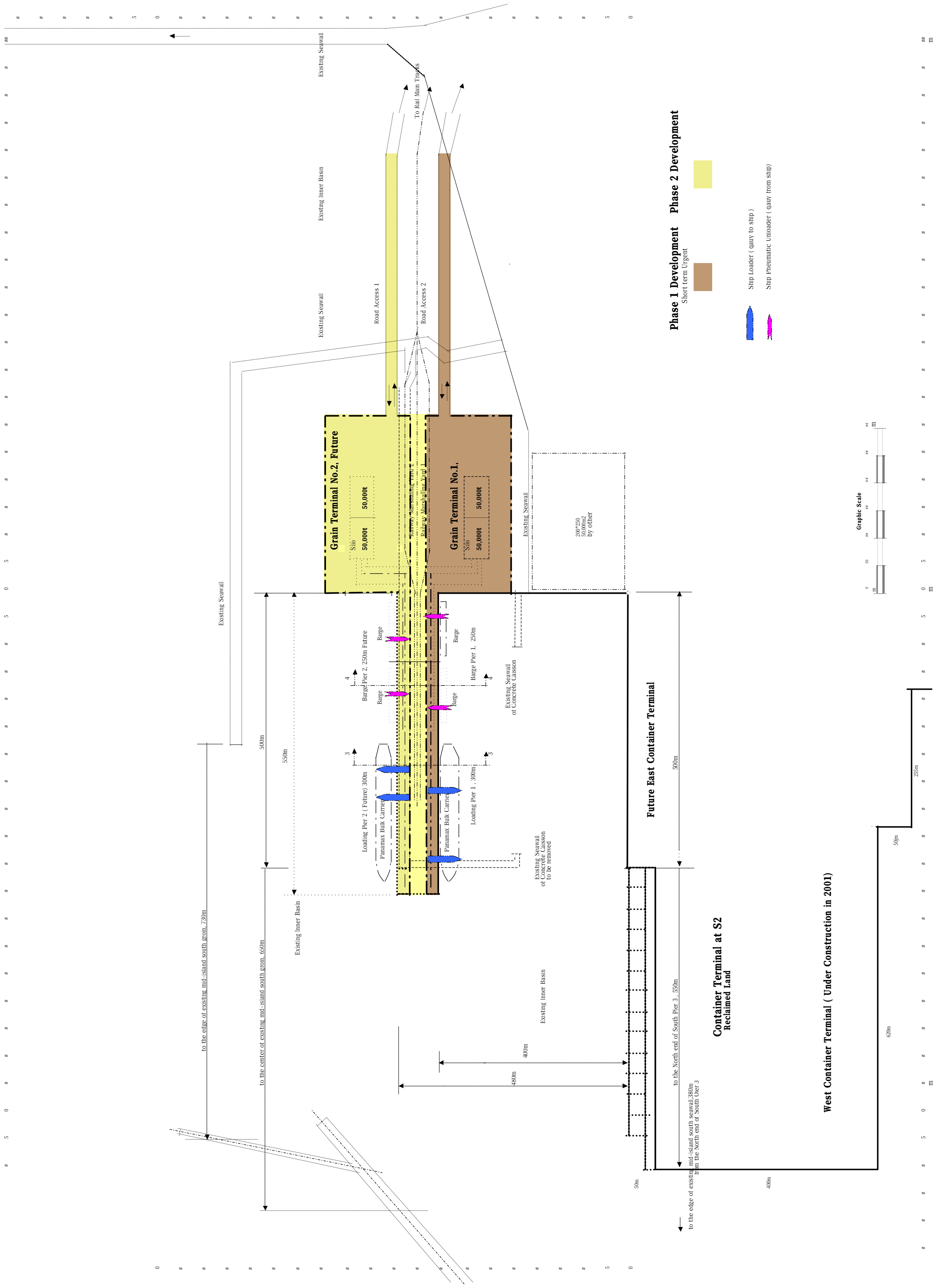


Figure 7.6.7 General Layout Grain Terminal, Alternative A2: South Pier 3

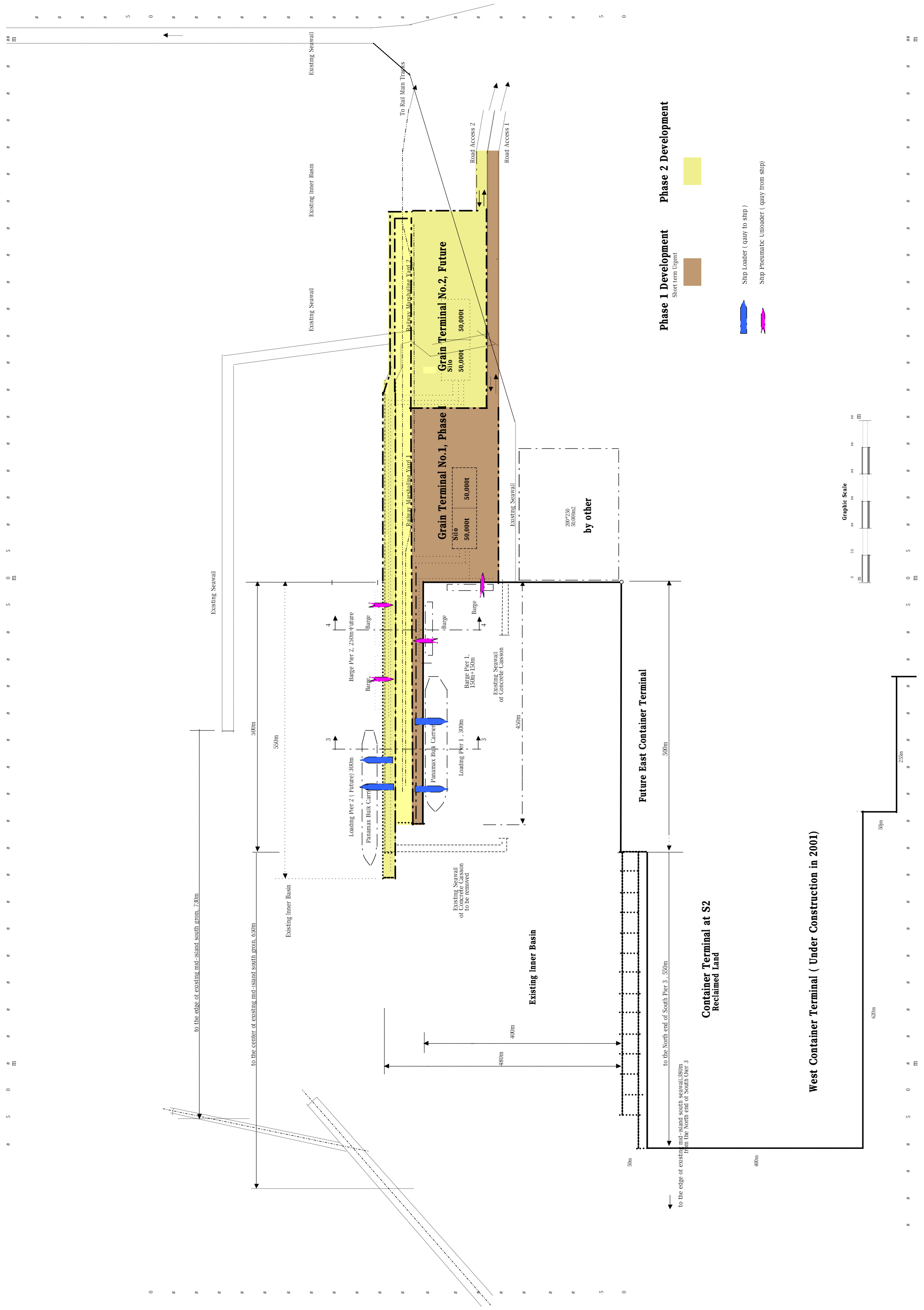


Figure 7.6.8 General Plan of Grain Terminal , Alternative B1: South Pier 3

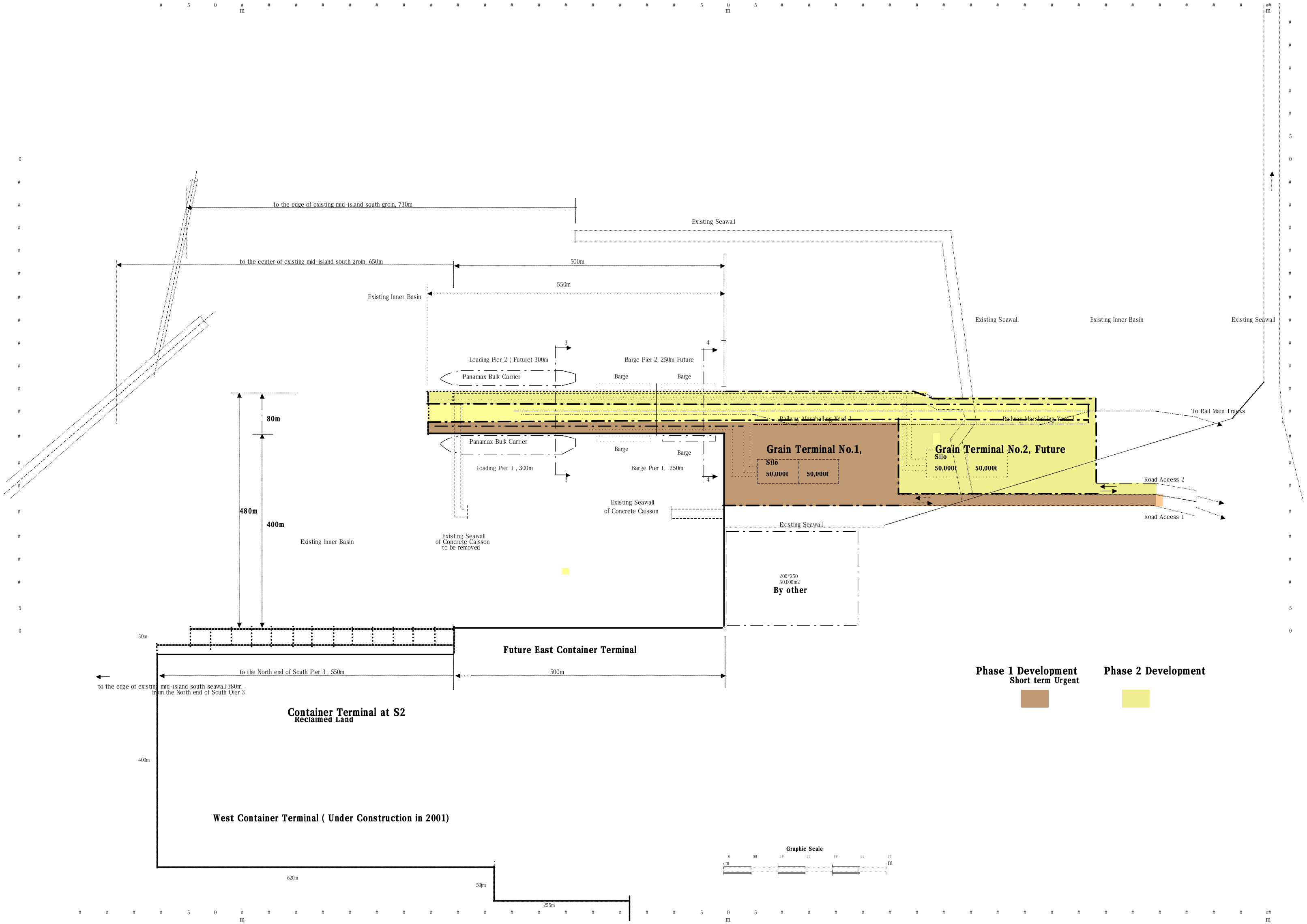


Figure 7.6.9 General Plan of Grain Terminal , Alternative B2: South Pier 3

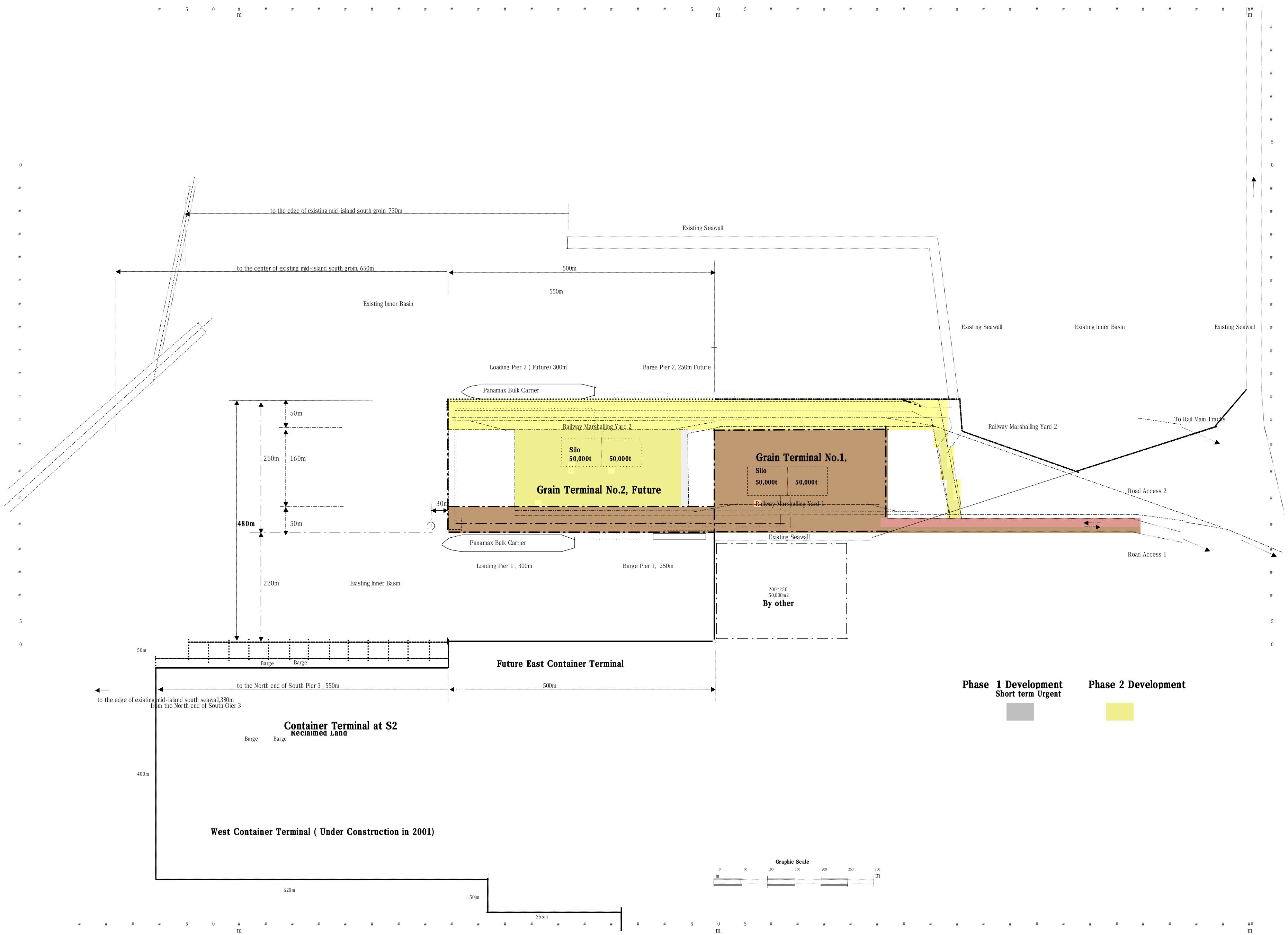


Fig 7.6.9L220 General Plan of Grain Terminal , Alternative L220: South Pier 3

(4) Selection of Best Alternative as Alternative Scenario L400

As shown in Figures 7.6.6 to 7.6.9, there are four alternative in Plan L400. Evaluation of these scheme were carried out by two different view points, namely, the cargo handling arrangement and port planning.

The evaluation sheet of these alternatives carried out by the Cargo Handling Expert of the Study Team is shown in Table 7.6.1a. The table indicates both the advantages and disadvantages of the four alternatives in regards to the equipment alignment economy and terminal operation points.

It clearly suggests that Alternative A2 is the better scheme.

The evaluation sheet of these alternatives carried out by the port Planner of the Study Team is shown in Table 7.6.1b. The table shows both the advantages and disadvantages of the four alternatives in regards to the terminal construction economy and the terminal allocation points.

It clearly suggests that Alternative B1 is the better scheme.

Alternative B2 which is an intermediate idea between A2 and B1 was considered to be the best scheme for the proposed Grain Terminal of this feasibility study.

Table 7.6.1a Comparison Table of Grain Terminal Alternative Layouts (1)
By Equipment Alignment and Terminal Operation

Alt. Plan	**Phase**	**Advantages**	**Disadvantages**	**Evaluation**
A 1	1st	Vessels & barges can berth at inland side quay.	Unloading quays are not straight.	3rd Ranking
	2nd	Conveyors do not cross roads and railways. Conveyors are not excessive	Vessels & barges berth at open-sea side quay. Unloading quays are not straight.	
A 2	1st	Vessels & barges can berth at inland side quay.		**1st Ranking**
	2nd	Conveyors do not cross roads and railways. Conveyors are not excessive	Vessels & barges berth at open-sea side quay.	
B 1	1st	Vessels & barges can berth at inland side quay.	Unloading quays are not straight.	4th Ranking
	2nd		Unloading quays are not straight. Vessels & barges berth at open-sea side quay. Conveyors cross roads and railways. Conveyors are excessively long. Power cost increase.	
B 2 **Proposed**	1st	Vessels & barges can berth at inland side quay.		**2nd Ranking**
	2nd		Vessels & barges berth at open-sea side quay. Conveyors cross roads and railways. Conveyors are excessively long. Power cost increase.	

Notes. 1 Phase one means the Short term Development Plan Stage to 2010.

2 Phase two indicatesin further terminal investment after the Phase One and is not included in this study.

Table 7.6.1b Comparison Table of Grain Terminal Alternative Layouts (2) By Terminal Construction Economy and Terminal Allocation

Alt. Plan	Phase	Advantages	Disadvantages	Evaluation
A 1	1st	Lowest Construction Costs		3rd Ranking
	2nd		*Most expensive *Occupying further long of valuable waterfront than B	
A 2	1st	Moderate Construction Costs		4th Ranking
	2nd		*Most expensive *Occupying further long faceline of valuable waterfront than B	
B 1	1st	Lowest Construction Costs		**1st Ranking**
	2nd	*Minimum Construction Costs *Minimum use of valuable waterfront		
B 2 Proposed	1st	Moderate Construction Costs		**2nd Ranking**
	2nd	*Moderate Construction Costs *Minimum use of valuable waterfront		

Notes. 1 Phase one means the Short term Development Plan Stage to 2010.

2 Phase two indicatesin further terminal investment after the Phase One and is not included in this study.

7.6.3 Proposed Grain Handling Equipment System

The grain handling system is an ordinary one consisting of some Loaders/Unloaders and a Silo for the transit function, all the elements being connected by belt conveyors or chain conveyors. The summary description of the entire system for grain is as follows:

The Grain Terminal will be newly constructed at Pier S3, and is designed based on the following system planning concepts:

a. Cargo volume to be handled:

    i. Export and transit (export): 2.0 million tons
    ii. Import and transit (import): 0.5 million tons

b. Grain receiving facilities:

    i. From barges and/or vessels: 2 units of 400 ton/hr pneumatic unloader
    ii. From railway wagons: 2 units of 400 ton/hr receiving hopper
    iii. From road trucks: 1 unit of 100 ton/hr receiving hopper

c. Silos

    Main silos: 20 bins each with 5,000 ton storage capacity
    Three supplemental bins of 3000 ton each also provided.

d. Grain delivery facilities:

    i. To vessels and/or barges: 2 units of 800 ton/hr loaders
    ii. From railway wagons: 1 unit of 200 ton/hr loading chute
    iii. From road trucks: 1 unit of 100 ton/hr loading chute

The planning capacity of the silo is based on all cargo of the estimated traffic for 2010, that is about two million tons exports or 0.5 million tons imports.

The planning concept is to receive all cargo to the silo once. However a direct delivery line is provided for the measuring equipment requirements; this is not the main system.

Refer to PART III Chapter 6 “Cargo Handling Equipment”.

7.6.4 Civil Works : General Provision

(1) General Description

Civil works for the Proposed Grain Terminal are presented for the feasibility study. The terminal should have an annual grain cargo handling capacity of about 2 million ton exports and 0.5 million ton imports. The terminal will be constructed at the specified site at the South Pier 3. Refer to Sub-Section 7.6.2.(3).

Taking into account the nature of the proposed site, the design of the civil facilities will be carried out. The existing site generally consists of water and partial construction of quay wall/ moles/ dikes. These walls were part of permanent works scheduled for future reclamation works and a waterfront structure for the future quay wall which is not completed yet. The suspended construction site looks like it has gone through several incomplete construction sessions.

The site is wide enough in terms of irrelevant-to-land area. This space is mainly occupied by surface water, whereas most of the terminal area and access route should be newly reclaimed. However this situation gives the construction works some advantages in terms of easy access from the sea for floating construction equipment. It is also noted that some landward access is also available. Road access is also available via the mole and dikes.

As recommended in PART III Chapter 2, the required space of the Phase II terminal, (it is also a 2 million ton grain terminal.), will be considered when selecting the best general layout of the first terminal (Phase I terminal). This is one of the most important conditions of the first grain terminal preliminary design. The utility and access systems, as common facilities for both, could be planed together although the construction would be carried out separately.

Table 7.6.2 indicates the estimated civil work quantities for the proposed first grain terminal (or Phase I).

These work items were classified in two categories as follow.

- ✓ Infrastructure (Public Investment): Items No.1 to 7
- ✓ Superstructure (Private Investment): Items No.8 to 10

Refer to PART III Section 9.5 and Table 9.5.2.

Table 7.6.2 Major Civil Construction Work Items : Grain Terminal

No.	Works		Specifications	Unit	Quantity
1	Mobilization and Demobilization			LS	1
2	Temporary Works			LS	1
3	Site Preparation				
	3.1	Demolishing and Removal	Obstacles	LS	1
	3.2	Removal and Reuse	North Grion. 7 caissons	unit	7
	3.3	Removal and Reuse	South Grion. 4 caissons	unit	4
4	Dredging and Reclamation				
	4.1	Borrowing and Reclamation	Borrowing from the canal banks	m3	
	1)	Mid-Pier . 875m*40m*19m		m3	332500
	2)	New Seawall. 675m*50m*19m		m3	320625
	3)	Terminal Site 1. 190m*325m*19m		m3	1173250
	4)	Terminal Site 2. 675m*190m*0.5*19m	25%	m3	304593.75
		Subtotal			2130968.75
	4.2	Dredging and Reclamation		m3	0
5	Soil Improvement				
	5.1	Replacement of Soft Layers		m3	0
	5.2	Preloading and Consolidation	2130969x 5%= 106500m3	m3	106548
6	Main Quaywall				
	6.1	New Caisson	18 Caissons - 6 Caissons	unit	12
	6.2	Recycling Caissons	6 Caissons	unit	6
	6.3	Caisson Foundation by Rocks	20m*3m*540m	m3	32400
	6.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*540m	m3	179550
	6.5	Concrete capping and apron	16m	m2	8800
	6.6	Asphalt Pavement	9m	m2	4950
	6.7	Railways	3 Tracks for 300m	m	900
	6.8	Fittings	Fender and Moorings	m	550
	6.9	Utilities		m	550
7	Supplemental Quaywall				
	7.1	New Caisson	5 Caissons - 5 Caissons	unit	0
	7.2	Recycling Caissons	5 Caissons	unit	5
	7.3	Caisson Rock Foundation	20m*3m*200m	m3	12000
	7.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*200m	m3	66500
	7.5	Concrete capping and apron	16m	m2	3200
	7.6	Asphalt Pavement	9m	m2	1800
	7.7	Railways		m	0
	7.8	Fittings	Fender and Moorings	m	170
	7.9	Utilities		m	170
8	West Seawall				
	8.1	Improvement of Existing Seawall	325m	m	325
	8.2	New Seawall	675m	m	675
9	Railway located on-land				
	9.1	Center Tracks	3 Tracks for 300m	m	900
	9.2	Sidings	4 Tracks for 325m	m	1300
	9.3	Connection to outside	Single track for 675m	m	675
10	Terminal Site				
	10.1	Grading	325m*195m	m2	63375
	10.2	Pavement in Asphalt	40%	m2	25110
	10.3	Gravel Pavement	60%	m2	37665
	10.4	Silo, Superstructure : Steel made	See equipment cost		
	10.5	Silo, Concrete pile foundation	40cm*35m, 100000*1.1*0.5/100	ea.	550
	10.6	Supporting Steel Frames	300m2 * 0.15t/m2	ea.	20
	10.7	Machinery Tower, Steel F. Structure	100m * 15m * 6Str.	m2	9000
	10.8	Substructure of Receiving/ L. Station	3*27m*3.5m	m2	283.5
	10.9	Terminal Office(Control/ Laboratory)	200m2 * 4	m2	800
	10.10	Maintenance shop	200m2	m2	200
	10.11	Substructure of Weigh-bridge	See equipment cost	m2	300
	10.12	Substructure of Cleaing Equipment		m2	20
	10.13	Transformer Station House		m2	200
	10.14	Transformer		LS	1
	10.15	Emargency Generator		ea.	1
	10.16	Lighting		unit	1
	10.17	Utilities		unit	1
11	Fence and Gates				
	11.1	Security Fence	Height in 2.1m steel	m	1370
	11.2	Gates		unit	2

Notes
1 Classification 1: Superstructures, Items 8 to 10, by Private investment.
2 Classification 2: Infrastructures, Items 1 to 7, by Public investment.
3 Refer to PART III Table 9.1.1.

(2) Major Civil Construction Works

A summary from the table of the major civil works required at the first terminal (Phase I) is as follows:

① Seawall 1000 m
② Land reclamation 2.2 million m^3
③ Quay wall (37 m standard Caisson) new 12 units and 11 units reuse .
④ Yard Pavement in asphalt, for quay area 6750 m^2 and for terminal site 25,110 m^2 with total 31,860 m^2
⑤ Railway main and sidings, 3775 m
⑥ Buildings including a terminal control office, 1,200 m^2 floor area.
⑦ Steel structural frame and tower to equipment foundations, 9884 m^2
⑧ Silo for 100,000 tons. 10 bins of 5000 tons each.

Note: Among these, items 5 to 8 were classified as facilities suitable for private investment.

(3) Soil Conditions

The sub-soil consists of a mixed structure of natural soil and reclaimed soil that is carried by barges from the dredging works by the canal. According to the soil classification in the previous investigation, the basic characteristics vary between silty-clay to silty-sand. The soft layer is seen partially among the reclamation soil and the natural deposit near the present outlet of the Canal. While the other area contains debris of hard clay and soft rock, this might be caused by the delivered materials coming from canal dredging.

Although the facility foundation type should be designed to meet the sub-soil conditions, a gravity foundation will be the first choice.

Refer to PART I, Chapter 6, Section 6.5 “ Geotechnical Conditions”, PART III Chapter 7, Subsection 7.5.2, and Chapter 8, Subsection 8.4.4.

(4) Past Construction Experience in the Port

Selection of the type of civil facilities structure is based on evaluation of past construction experience in the Constantza Port and the on-going container terminal.
Structurally, the type of piers in the Constantza Port are historically gravity walls consisting of concrete block walls and concrete caisson walls. The maximum water depth of former at Constantza is –14.5 m of Type 6 with capping concrete at level +2.5 m to +3.0 m. A special pier of this is Type 11 which has –19 m water depth.

The minimum water depth of the latter is –14m with capping concrete at level + 3.5m. Type 13 of water depth –16.5m is most widely used for Pier S2 and Pier S3 at the South Port.

Refer to **Appendix IA "Existing Piers and Dredging Plan"**

(5) Major Dimension of Terminal and Section of Pier.

The discussion on the preliminary design of the grain terminal is provided below. The necessary study arrangement is undertaken for the required terminal facilities and the South Pier 3 proposed Alternative B2.

The basic dimension of the proposed terminal and Pier section alternatives are shown in the figures listed below.

Figure 7.6.10	Proposed Grain Terminal Dimension (B2)
Figure 7.6.11	Typical Section of Grain Loading Pier, Section 1-1
Figure 7.6.12	Typical Section of Grain Loading Pier, Alternative B2: Minimum Space.
Figure 7.6.13	Typical Section of Grain Loading Pier, Alternative B2: Section 3-3
Figure 7.6.14	Typical Section of Grain Loading Pier, Alternative B2: Section 4-4

A general layout drawing and a conceptual drawing of proposed grain terminal are presented in Figures 6.2.3A and 6.2.3B Chapter 6. These figures present the basic dimension of terminal and movement of grain among the each facility as follows:

<u>Access and Transport Modes</u>

1) There are three modes, namely, trucks, rail and river barge.
2) Railway connection locates the East Side of terminal.
3) Truck unloading site will locate near the railway dumping site.
4) Weigh-bridge will be provided at the entrance from the on-land access road.

<u>Terminals</u>

1) Storage silo of 100,000 tons is located near the center of terminal, symmetric arrangement by 20 bins. Machinery tower will rest at the center of terminal
2) Silo bins will connect with the quay side by the line of chain conveyors
3) Terminal site is 325m long (NS direction), and 175m width (EW direction).

<u>Quay Wall for the Loading and Unloading</u>

1) Quay wall is detached from the north –east corner towards the north.
2) Total length of quay wall is 550m long straight consisting of southern 250m is for two berths of river barges and 300m at north is for a berth of ocean-going vessels.
3) Width of the pier is 80m consisting of west 25m for the Phase I terminal, central 30m for the railway sidings and remaining east 25m for the Phase Ii terminal.

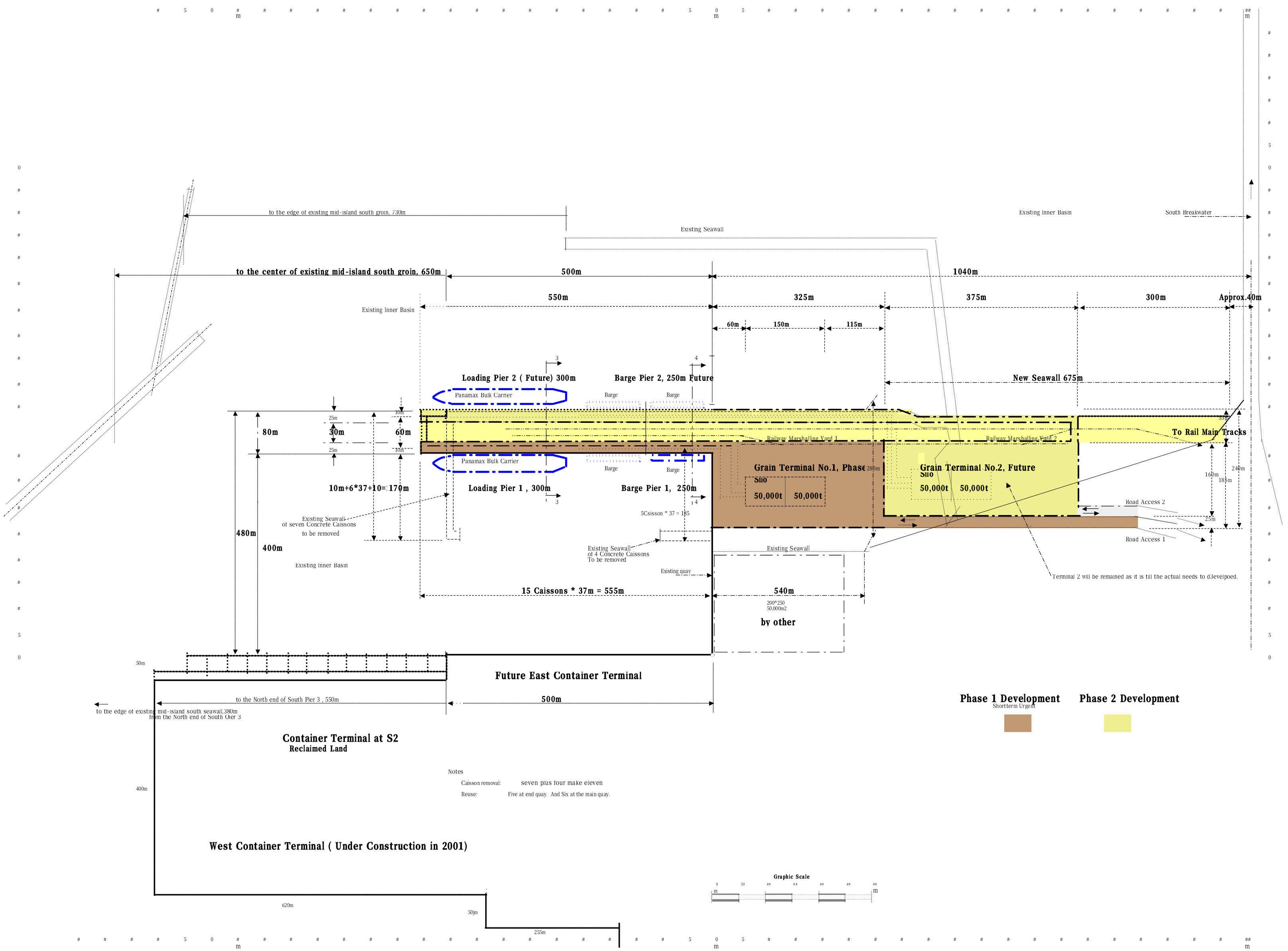


Figure 7.6.10 Dimension of Proposed Grain Terminal, B2

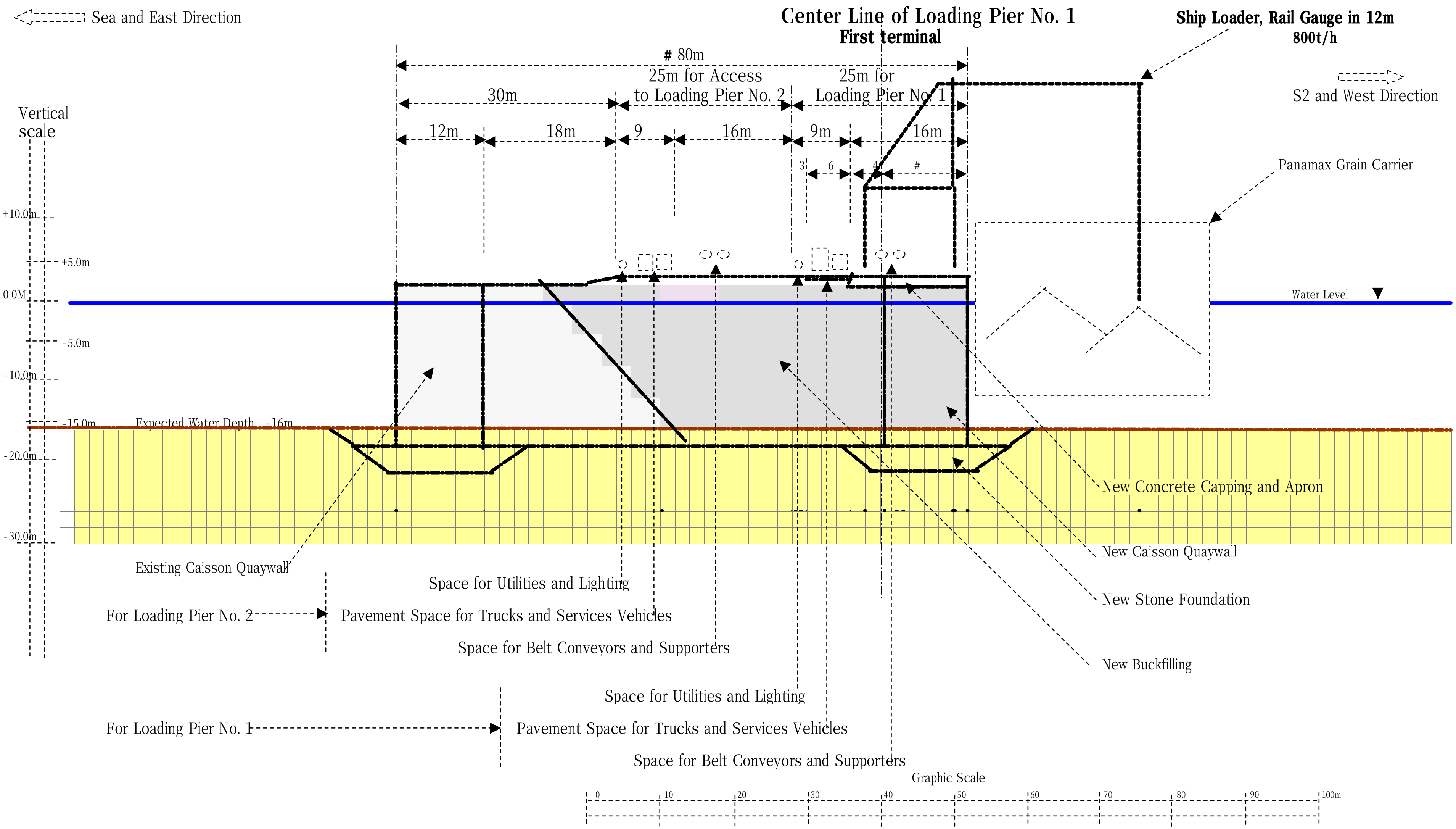


Figure 7.6.11 Typical Section of Grain Loading Pier, Section 1-1

This indicates the pier section when the First Terminal is completed but before the Second Terminal.

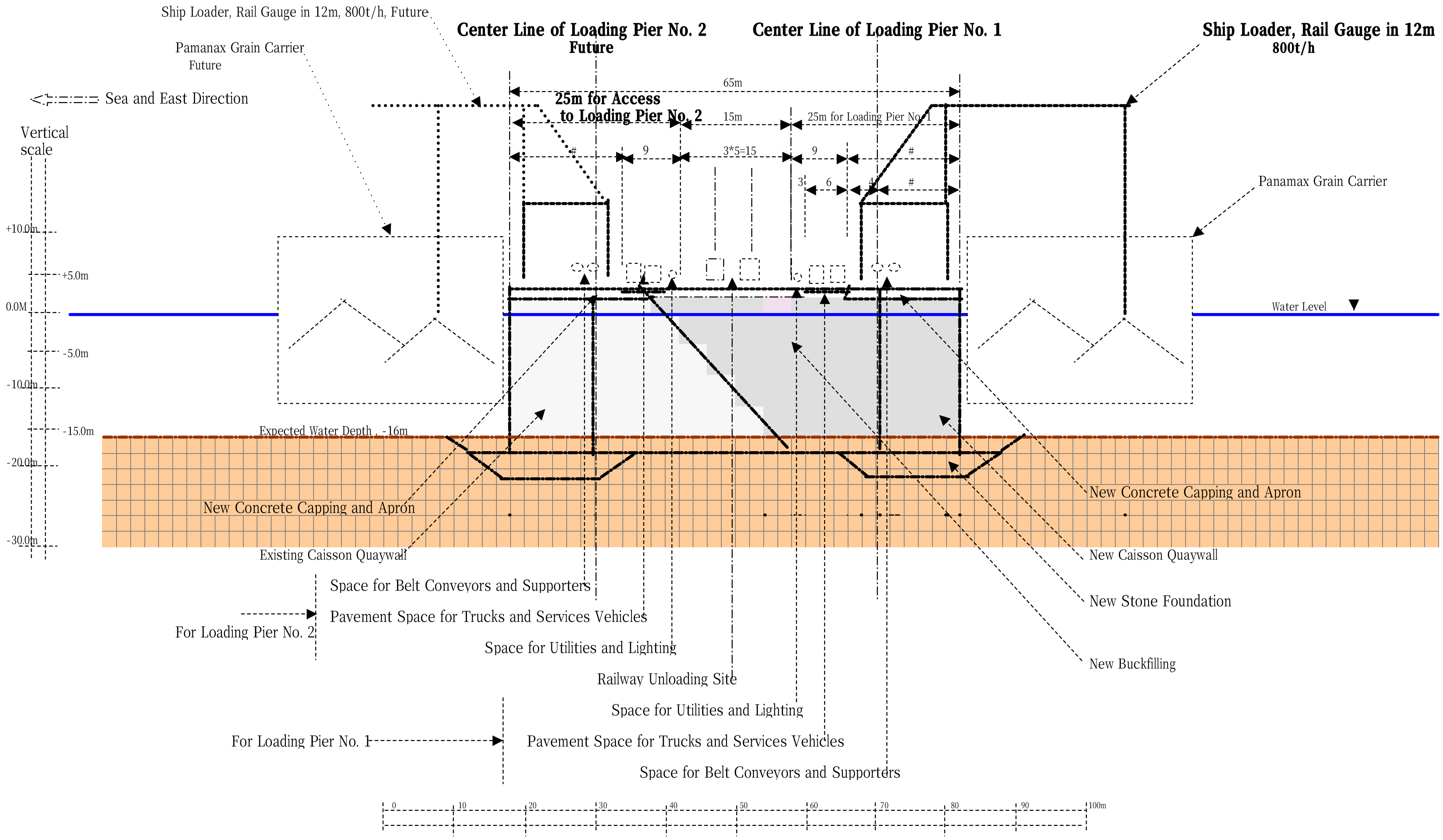


Figure 7.6.12 Typical Section of Grain Loading Pier, Alternative B2: Section 2-2 Minimum Pier Space

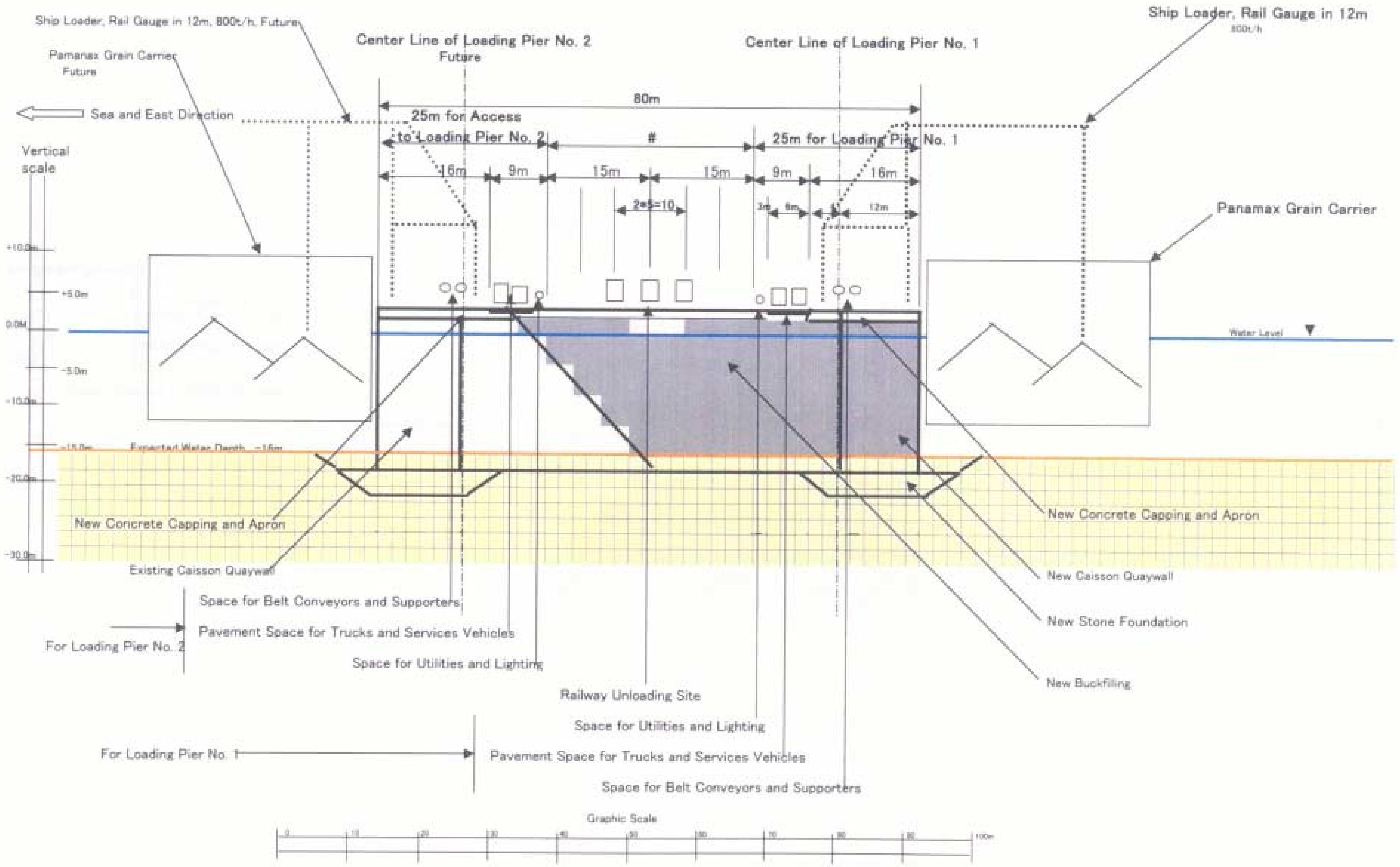


Figure 7.6.13 Typical Section of Grain Loading Pier, Alternative B2: Section 3-3

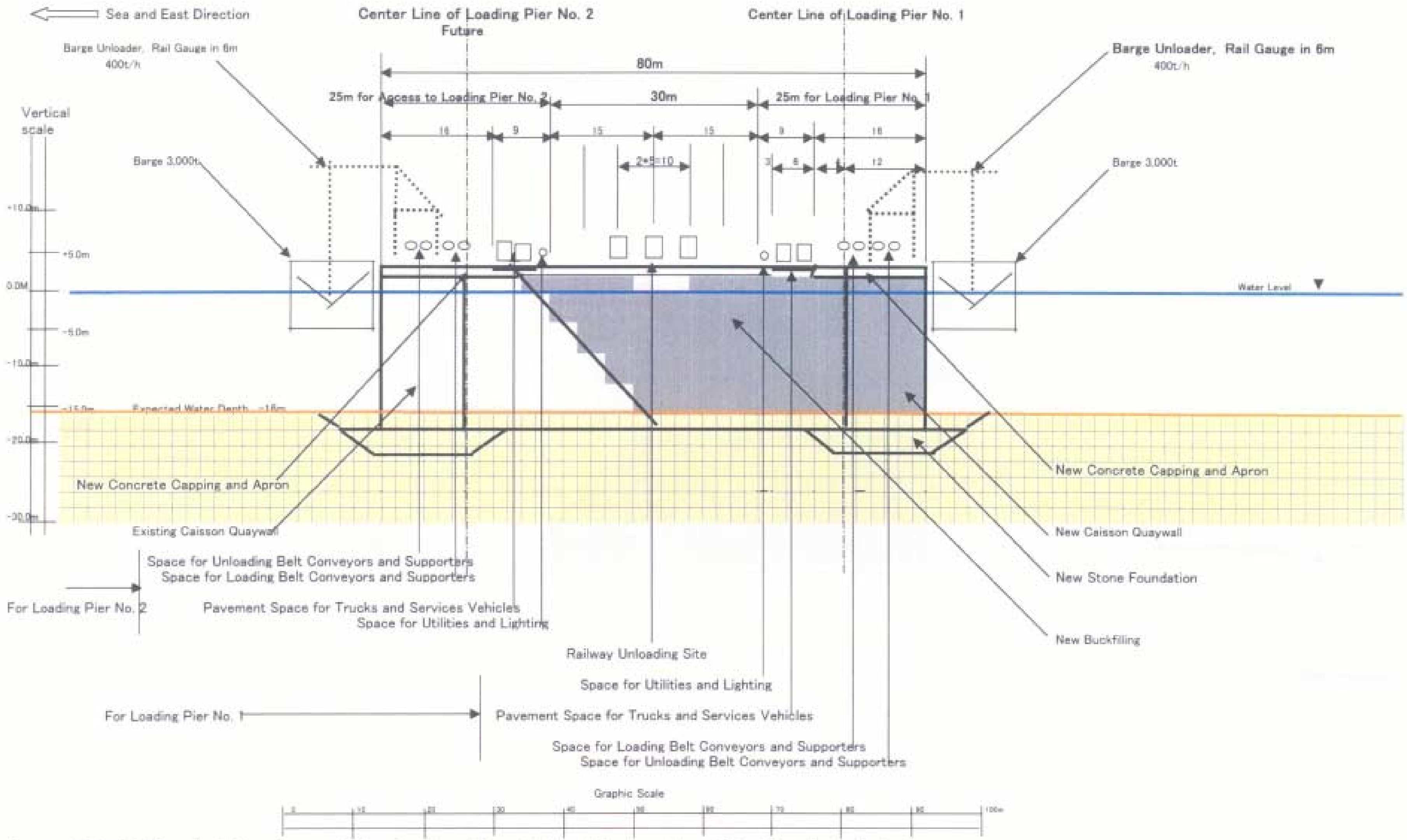


Figure 7.6.14 Typical Section of Grain Loading Pier, Alternative B2: Section 4-4

7.6.5 Civil Works (1) Land Reclamation Works

(1) Preparation Works for the Land Reclamation

Before starting the reclamation works, certain preparation work should be conducted. That includes the walls to contain the reclaimed earth. In this project, these are:

① Quay wall for the end wall by recycling the existing concrete caisson.
② Improved existing seawall.
③ New mole construction with the required revetment.

(2) Formation of Reclamation

Similar to the on-going Container Terminal, the required area should be reclaimed fit for terminal construction. The land will be reclaimed to approximately + 3.0 m. The material comes mainly from piles on the Danube – Black Sea Canal banks and from the dredging spoil around the port and it will be used as described below.

Refer to PART III Section 8.4.4.

(3) Reclamation Materials and Reclamation Works

① General Description

The reclamation cost heavily depends on the materials availability. The typical soil condition is shown in the previous paragraph.

② Reclamation Materials

For reclamation, borrow pits should be found. Possible material sources might be the following:

a) Dredged material stockpiles along the Danube Black Sea Canal
b) South pits –10 m to –20 m, Eforie Nord off shore
c) North pits –5 m to –10 m, near the Capul Singol off shore
d) Future dredging spoil at the port.

These should be investigated so to confirm the quality, volume and influence to nearby beaches.

Of all these, Case a) and Case d) will be the most probable sources.

Case a)

Filling material will be transported from the piled spoil deposits of Danube - Black Sea Canal sites consisting of material which is piled and stored along the banks and from maintenance dredging and capital dredging of the port basins. These materials will be carried to the site and reclaimed by grab bucket.

According to the IPTANA provided drawing, this site is located at a range of 3 km - 10 km - 15 km upstream (Cumpana/ Straja) from the canal entrance and its width is almost 300 m. The total area is about 120 ha. Thus the available volume for the reclamation is about 2.4 million m^3.

$$3{,}000 \text{ m} \times 400 \text{ m} \times 2 \text{ m} = 2{,}400{,}000 \text{ m}^3$$

Case d)

Another possible idea is Case d) where MOT planned rock dredging works will generate about 1.1miliom m^3 of soil.

This means that sufficient soil deposit is ensured, since the total reclamation volume required is only 2.1 million m^3.

For the preliminary design, the soil characteristics are important. According to the soil investigation data of reclaimed soil at Pier S2, silt varies from 48% to 64% and sand or coarser earth than sand ranges from 52% to 36%.
This soil will stabilize after being reclaimed at site since gravity structures are the major design types which normally apply to a site having good soil conditions.

However some soft lenses were found by Pier S1 which might cause some soil settlement under a heavy load condition like a silo.

If so required, a piling to support heavy loads should be conducted. Soil should also be compacted in order to obtain the required strength to carry the specified surcharge loads scheduled.

③ Soil improvement

If necessary, some soil improvement work will be provided to minimize the earth settlement by consolidation of soft soils. According to the soil investigation that was carried by the study team, the layer to consolidate is rather minor, except the surface mud layer about 1 - 2 m thick. The paper drain method could be introduced.

It is assumed that soil improvement work should be undertaken. For this purpose, it is also assumed that 5% of reclaimed soil might require improvement. Soil improvement method should be selected when the post-reclamation borings are carried out. The most possible soil improvement work is so-called " Vertical Fiber Drain" or " Paper Drain" under pre-loading in order to accelerate consolidation of soft layers.

④ Dredging Works

No major dredging work will be required except for limited purposes, that is to take out the soft soil or to replace the seabed by sand or rocky materials. The required cost heavily depends on the soil condition of the seabed. According to the soil investigation performed by the Study Team and according to chart indications, the typical soil condition, by areas, is as follows:

a)	North-most north inner basin:	1 to 1.5 m thick mud layers above silty soil of 2 to 4 m.
b)	Northern end of south basin:	½ to 1 m thick mud layer with shells, very soft, above fine to medium sand of about 6 m to 10 m.
c)	Mid to southern south basin:	Fine and medium sand of about 6 m to 10 m thick
d)	Chart indicates the general characteristics of seabed conditions:	Ns Ag, Ml Ns, and Ns Ml.

In 2000, IPTANA carried out an estimation in the capital dredging study to ensure the water design depth. It reported that there is about 1.1 million m^3 of rock dredging works needed for deepening the water. However this work is out of the project scope. The project may provide dumping sites of dredged materials.

7.6.6 Civil Works (2) Quay Construction

(1) Unloading Berth

In order to widen the split between Pier S2 and S3 to 400 m to achieve modern port operation conditions to accommodate Panamax vessels for both the East Container Terminal and New Grain Terminal, the original location of the West Side quay wall will be relocated to the East (that is about 170 m). As a result, the new grain pier will be formed in the 80 m section with a wide split of 400 m to the East Container Terminal of Pier S2.

After this modification, enough pier space will remain to do grain cargo handling at two terminals simultaneously.

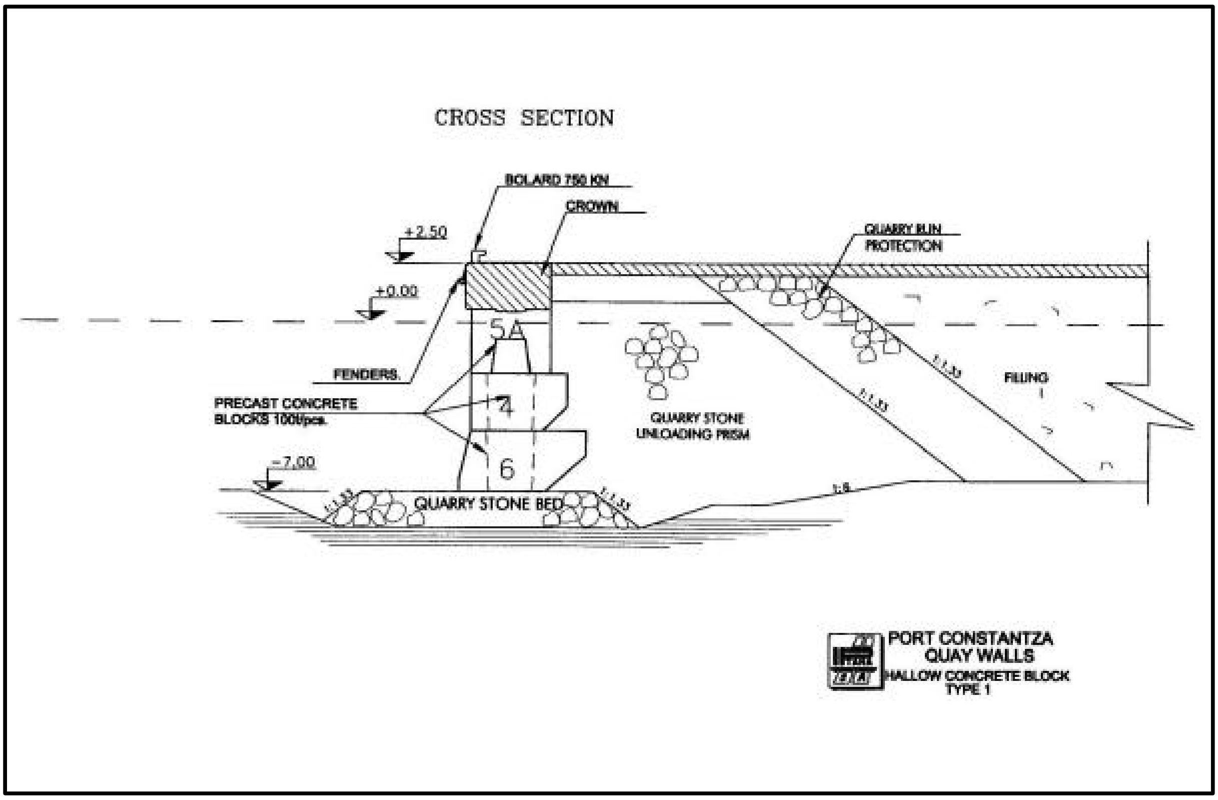
Barge unloading berth is for 3000 tons river barge with 3.8 m draft. Currently no structure is located at the proposed barge unloading berth. Although the main cargo flow is ‘inwards’, it will shift however ‘outwards‘ that is to the ocean going vessel when the imports will become dominant. Thus the barge berth has to provide a deeper-draft import quay of about -12 m for operating Handy Class bulk carriers.

In order to unload river barges and ocean-going ships, a new quay wall will be constructed along the West Side of the new Pier 3S. A minor part of the quay works related to this new quay are already undertaken. The berth depth is -16.5 m (-14m depth is enough for the design Panamax vessel) while the crown elevation is at +3.0 m. Of the total length of the new quay and sea wall, a north section about 500 m long at the east face has been constructed with concrete caissons as well back-filled on the western side. The 450m long south section is made of earth and rock dikes and protected by Wave dissipating concrete blocks for 8 ton to 12 ton class.

For this Short Term Development Plan, required barge berth length is of 250 m. Additionally unloader foundation and the quay accessories, such as bollards and fenders, will be provided. Among the standard piers, Type 6 will be selected and provided.

Type 13 is also a good alternative taking advantage of existing water depth (-17 m) for calling of the larger bulk carriers for grain imports. It is assumed this berth will mainly receive transit grain carried by barge (3.8 m draft maximum). However it is planned to handle a half million tons of import grain, when a low harvest occurs.

In case a separate barge berth is required, Type 1 could be enough since it has a water depth of -7.0 m. Refer to Figure 7.6.14 Standard Pier Type referred to Unloading Berth (Type 1 and Type 6).



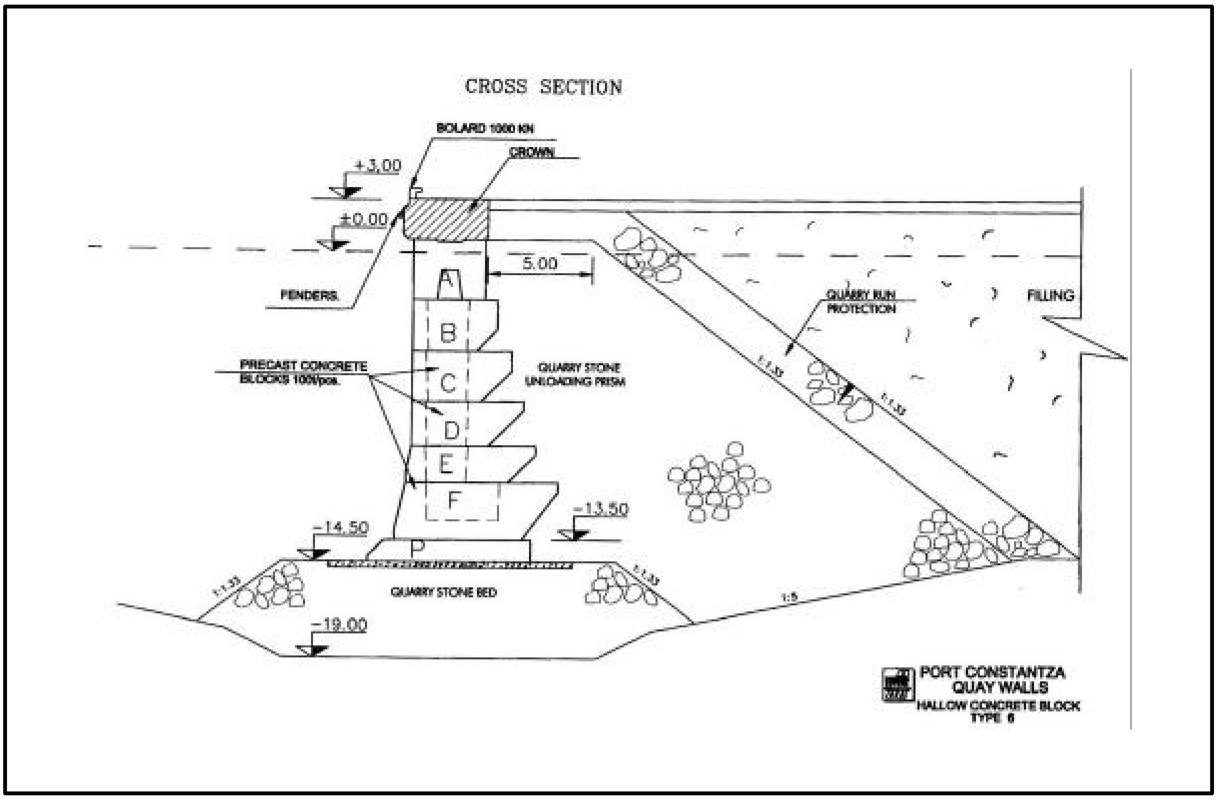


Figure 7.6.14 Standard Pier Type referred to Unloading Berth (Type 1 and Type 6)

(2) Loading Berth

To load the export and transit grain on ocean going vessels, the loading berth will be provided on the same face-line with the barge berth, but at the northern side of the new Pier 3S. Thus the new loading berth will be constructed behind the existing concrete caissons wall East of Pier S3.

Required water depth for the Panamax Grain Carriers is –14 m. In order to satisfy this requirement, Type 6 standard type is sufficient. Type 13 is also acceptable as it has a water depth of -16.5 m. When the existing pier structure at S3 relocates to a new location, Type 13 should be used. Thus the depth of the berth is -14.5 m (or –16.5 m) while the design crown elevation is at +3.0 m.
Refer to Figure 7.6.15 Standard Pier Type Referred to Loading Berth, (Type 13)

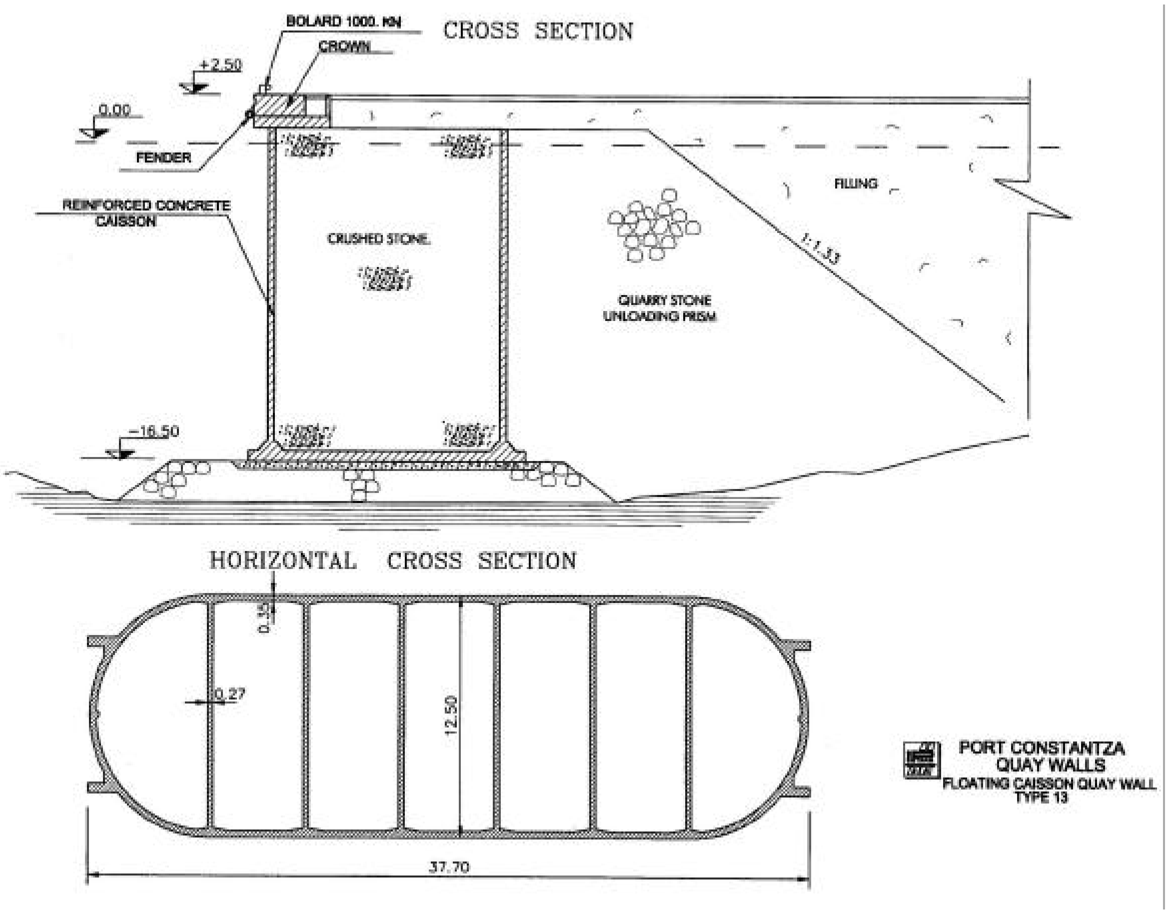


Figure 7.6.15 Standard Pier Type Referred to Loading Berth, (Type 13)

(3) Quay Wall Structures Alternatives

Whenever new quay construction is needed, the best structure type should be meet at least two decisive design factors: the design water depth and sub-soil conditions, including existence of soft layers. At the time when major construction at Constantza was conducted some 20 years ago, pier structures were designed to meet water depths varying from –3 m to –19 m. It is understood that the type of structure was standardized to the family of gravity wall: **either the concrete caisson type or the concrete block type.**
The typical cross section of these alternatives is shown in Figures 7.6.16a and 16b.

It is recommended to follow this historical application of pier structure, because the existing pier structure seems work well. Thus it was proposed to select one among the caisson type and concrete block type. The recommended is to use the caisson type due to high stability against seabed settlement and water depth of –12m or deeper. Concrete caisson can provide large and firm foundations for the quay unloaders and loaders.

(4) Design Condition of Existing Structure

The conditions for the design review are summarised in Table 7.6.3 regardless of the criteria explained in previous chapter. Some of the conditions have been derived from the past information.

Table 7.6.3 Design Condition of Existing Quay Walls at S2

Item	Condition	Remarks
Water Levels	HWL: + 0.6 (m) MSL: ± 0.0 (m) (CDL) LWL: - 0.3 (m)	from the Design Criteria
Surcharge	30 kN/m^2 (Normal) 5 kN/m^2 (Seismic)	-Ditto.-
Seismic Coefficient	Kh: 0.10	-Ditto.-
Residual Water Table	RWL: 0.0 (m)	1/3 (HWL-LWL) + LWL
Backfill Material	We:18, Wa: 10 (kN/m^3) Internal Angle of Friction: 40~42°	from standard values in the Japanese Standards
Frictional Coefficients	Concrete/Concrete: 0.5 Concrete/Stones: 0.6	-Ditto.-

Note: We: Unit weight in air, Wa: Unit weight under water,

The West face quay wall at S2 is the Standard Pier Type 6 as shown in Figure 7.6.14.

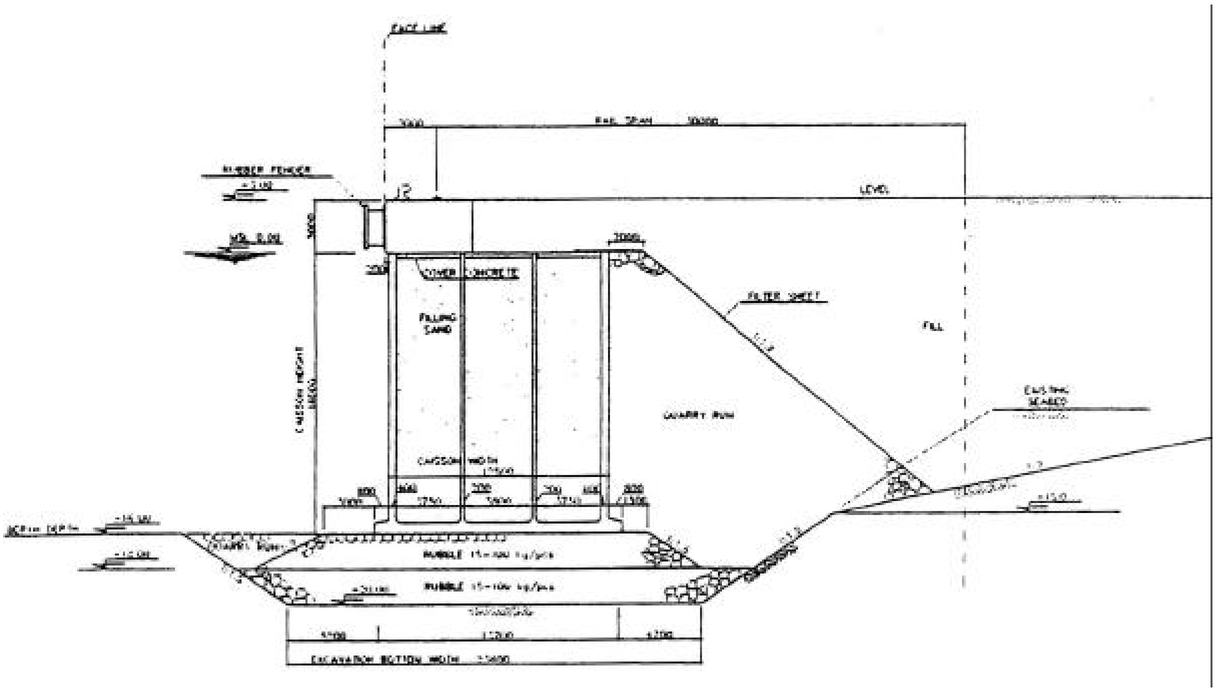


Figure 7.6.16a Proposed Cross-section : Concrete Caisson Type Quay Wall.

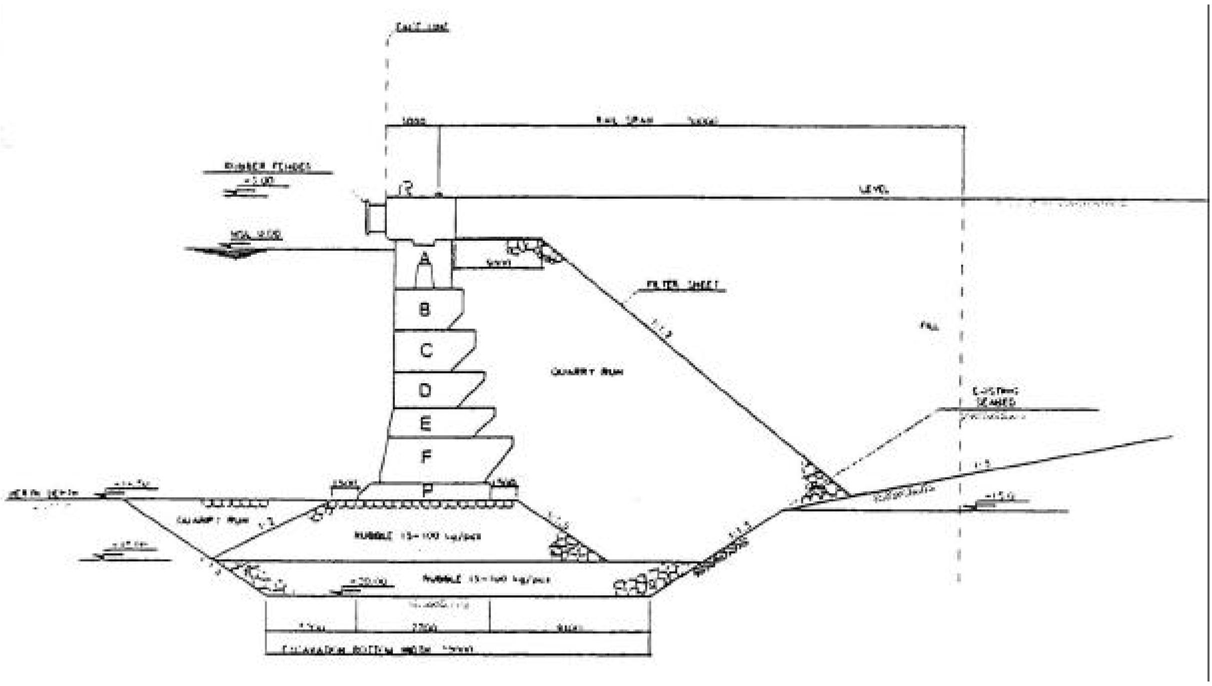


Figure 7.6.16b Proposed Cross-section : Concrete Block Type Quay Wall.

7.6.6 Civil Works (3) Site and Yard Development

(1) Site Development

The reclaimed land will be graded to form the flat area for construction of the super-structures. At this moment no particular facility will be provided.

(2) Terminal Yard

A paving system, a storm drain system, security fence, etc will be provided. Similar to the present pavement method, the pavement type that will be applied will generally be asphalt pavement. The Phase II terminal yard (after Phase I) will not be provided excluding any work that is to be implemented with the project (Phase I).

7.6.7 Civil Works (4): Yard Utilities

(1) General Arrangement

Power, water, sewage, telephone, fire-fighting system, etc will be supplied or obtained by connection to the existing networks. Whenever two grain terminals are in operation, it is supposed that each terminal will be operated by a different operator. Thus the basic distribution lines to the terminal should be provided separately.

1) General Description

The ownership of utilities namely either by MOT/CPA or operators, will be considered to classify the developer of such utilities. Generally only facilities belonging to the MOT/CPA are considered for the design.
Basically the renovation of the existing utilities is not included among the items of the feasibility study, since the detailed data on these is not available.

2) Scope of Works

Although the scope of utilities is based on the actual demand, it is assumed that the basic scope of utilities for the preliminary study includes:

① **Water supply**
② **Fire fighting system**
③ **Power supply**
④ **Lighting**
⑤ **Telecommunications**

(2) Extension of Substation

To supply electricity to silos, equipment and berths 9 MW of power is required. Three units of transformers of 3.0 MW are provided at the Transformer Station. This should be verified during the detailed design stage by more precise information.

7.6.8 Civil Works (5) :Road Access

(1) Introduction

Whenever a new grain terminal development is made at S3, the road and railway access systems will be based on similar planning concepts as the ones used for the on-going container terminal at S2.

There is an independent plan to connect the South Port to the Romanian national road network, DN 39, by means of a four-lane elevated road. In the S3Grain Terminal project a flyover extension between Container Terminal at S2 and Grain Terminal in S3 will be completed together with an access road that connects the flyover to the terminal yard and berths.

(2) Grain Terminal Service Roads

The terminal service roads consist of four categories: namely the Outer access, Inner Heavy Traffic roads, Inner Light Traffic roads and Mid-pier access road. The traffic volume varies by these categories.

First of all, the traffic allocated to the roads should be estimated considering the entire inter-modal transport study. The design traffic on the roads is from the recommendation on the traffic circulation that was proposed by the port planners. The base years of 2010 will be used for the preliminary traffic projection. Refer to Part II Chapter 4.

The Heavy Traffic Road will be provided with basically undivided four-lanes, regardless of the projected traffic volume in order to facilitate a smooth and effective traffic flow, excluding the Main Access, which will be planned to have flyover access. The remaining roads will be undivided two lanes.

a) Dimensions

The lane width will be 3.5m, since it is a standard size for a terminal road. Full shoulders with 2.5m wide are provided to the roads for trailer traffic and half shoulders 1.5m wide are provided to the roads for regular vehicles.

b) Heavy Traffic

Where heavy snow is expected, extra spaces to stack snow are needed. However, Constantza does not belong to a heavy snow area and this issue will be not considered.

Table 7.6.4 shows the summary of the width and capacity of the roads for 2010.

Table 7.6.4 Standard Width and Capacity of Access Roads, 2010

Name of Road	No. of Lanes	Lane Width (m)	Shoulder Width (m)	Sidewalk Width (m)	Total Width (m)	Capacity of Traffic (/hr/direction)
Access Road (1)	2	3.5	2.5	-	12.0	250
Access Road (2)	4	3.5	2.5	-	19.0	700
Rail Terminal Access	2	3.5	2.5	-	-	700
Rail Terminal Loading Area	2	3.5	-	-	-	-
East Access	4	3.5	2.5	-	19.0	700
Office Access	2	3.5	1.5	2.0	12.0	250

Note : The capacity of traffic is described in Technical Standards for Port and Harbor Facilities in Japan as follows.
2-lane road: 500 vehicles/ hour
Wider road: 350 vehicles/ hour / lane

(3) Terminal Truck Cargo Handling Yard

a) Proposed Traffic Circulation

The trailers traffic in Truck Loading Yard was studied not only to achieve efficient operation, but also to avoid congestion and accidents. For one directional flow and a minimal crossing, the study team proposes traffic circulation accordingly.

b) Co-ordination with Railway:

In order to harmonise the traffic on roads with the railway, a coordinated traffic circulation system should be established between them.

(4) Pavement Design

The pavement structures are designed according to the load types, frequency of vehicles, and sub-grade conditions. The preliminary design of pavement was carried out based on assuming that the conditions are regular sub-grade.

a) Loading Conditions

The loading conditions of heavy equipment is summarized when doing the loading grade classification. The design vehicles/equipment and their frequency is estimated when making the design of the pavement foundation.
If the soil under a road is frozen, the pavement gets damaged. This is called a frost heave. In the area where the average temperature goes below zero, the sub-grade layer has to be thick enough to avoid frost heaves. The monthly average January temperature in Constantza goes only slightly below zero, so the proposed thickness is sufficient.

b) Selection of Pavement Type

The pavement type was selected from various choices. This was made considering cost, maintenance ease, suitability to the soil conditions and material availability. Three types of pavement (i.e., asphalt, concrete and interlocking block pavement) are normally used in the port cargo handling and access area of the terminals. The brief characteristics of each type are compared in Table 7.6.5.

Table 7.6.5 Comparison of Pavement Type

Evaluation Items	Asphalt Pavement	Concrete Pavement	Interlocking Block
Initial Cost	◎	○	◎
Maintenance Cost	○	○	◎
Easiness in Construction	○	○	○
Construction Speed	◎	△	◎
Trafficability	◎	○	△
Resistance to Differential Settlement	◎	×	◎
Easiness in Repair	◎	×	○
Resistance to Point Load	×	◎	○
Resistance to Heavy Load	△	◎	◎
Resistance to Oil	×	◎	◎

Marking method: ◎: Best, ○: Better, △: Good, ×: Fair

Asphalt pavement was selected as the most suitable type for the project.:

① **It provides the smoothest surface for trailers to drive on**
② **Small settlement is inevitable in the reclaimed area and asphalt pavement is the most flexible and easiest to repair**
③ **It is easy to obtain the material.**
④ **However, where it has to support heavy loads or large ground subsidence is expected, different types of pavement should be used as presented below.**

(5) Design of Pavement Sections

The pavement design are based on the area usage, vehicle frequency, service period, applied loads and subsoil conditions. The design has to comply with the design code of Romania. However, where it is not applicable or when the Consultant considers it necessary to do an upgrade, other standards such as Technical Standards for Port and Harbour Facilities in Japan will be referred to.

In the preliminary design stage, it is recommended to adopt a simplification of the design to such extent that the following sections will be applied.

Table 7.6.7 Proposed Pavement Design

Marks	Type	Surface (cm)	Base (cm)	Sub-base (cm)	Sub-grade		Applications
					Ordinary	Improved	
A-1	Asphalt	100	400	300	X		Access Road, Yard Circulation Road
A-2	Asphalt	200	350	450	X		Open storage yard
A-3	Asphalt	100	200	250	X		Office Access
A-4	Asphalt	50	200	550	X		Light traffics
IC	Interlocking Block	80	500	600		X	Access Road for Gate House, Rail Terminal
C-1	Concrete	350	400	200	X		Apron of Berth
RC-1	Reinforced Concrete	300	400	200	X		Heavy machine Foundation
RC-2	Reinforced Concrete	300	400	200	X		Repair-shop

(6) Storm Water Drainage

The design of storm water drainage system will be carried out based on the design code of Romania.

1) Calculation of Discharge Volume
Peak discharge volume is calculated by the rational formula as shown below.

$Q_p = m \times S \times F \times i$ (litter / sec)

Where m : Coefficient to reduce the flow (0.8 for t < 40 min and 0.9 for t > 40 min)
S : Catchment area (ha = 10,000 m^2)
F : Coefficient of runoff (see Table 7.6.8)
I : Rainfall intensity for a time of concentration (t minutes) and design return period of f years.

Table 7.6.8 Coefficient of Runoff

No	Nature of Surface	Coefficient of Runoff
1	Asphalt Pavement	0.85 – 0.90
2	Stone pavement with concrete underlay	0.70 – 0.80
3	Stone Pavement with sand underlay	0.55 – 0.60
4	Road of crushed stone - slope of less than 1% - slope of more than 1%	 0.25 – 0.35 0.40 – 0.50
5	Playground, gardens - slope of less than 1% - slope of more than 1%	 0.05 – 0.10 0.10 – 0.15
6	Unpaved Area	0.10 – 0.20
7	Farm (agricultural area)	0.05 – 0.10
8	Parks and Forest - slope of less than 1% - slope of more than 1%	 0.00 – 0.05 0.05 – 0.10

Source: STAS 1846 – 90

Time of concentration is calculated by the following formula:

$$t = tcs + L/va$$

$$t_{cs} = 1.445\left(\frac{N \cdot L_1}{\sqrt{S}}\right)^{0.467}$$

Where *L* : Length of channel (m)
va : Velocity of flow (m/min)
N : Kerby’s roughness coefficient; 0.013 for pavement and 0.4 for grassland.
L1 : Length of between the furthest point in the catchment and channel (m).
S : Slope
t : Time of concentration; minimum value for the plain is 15 minutes.

2) Rainfall Intensity
The rainfall intensity curves are provided by STAS 9470–73. Constantza belongs to zone 5 and its curves are already shown in Section 3.a. The design return period is calculated according to STAS 4273 – 83 and STAS 9470 - 73.

7.6.9 Civil Works (6) : Railway Access

In the South Port, there already exists a railway network that is connected to the national railway system. In order to facilitate the railway access and operation of freight trains, one will need a marshalling yard and some dedicated unloading wagon tracks. Refer to PART III Chapter 2 for more detailed discussion of railway facilities.

7.6.10 Civil Works (7) : Grain Storage Silo and Foundation

A transit silo will be provided in the reclaimed south area of the pier berth. The purpose of the silo is to receive the grains unloaded mainly from barge, trucks or freight train, and for storing them for a short period to get faster loading on ocean-going vessels. Considering the future maximum vessel size and the traffic demand, the capacity of silo is determined at 100,000 tons. Refer to Chapter 6.

The silo will be connected by means of belt conveyors to the unloders or loaders that are to be installed on the quay.

There are basically two structural types of silo bins: namely the galvanized steel structure and the concrete structure. The former was selected taking into account the site conditions and also the construction economy. It is reported that salinity of the Black Sea is just a half of ordinary open oceans. This decreases the corrosion rate of steel and adds longer life to steel structure than those steel structures exposed to the ordinary open sea.

The silo will consist of twenty unit of 5,000 ton bins which can receive different types of grain as required by market demand. The silo will be an integrated system that will include the following facilities:

a) Measurement and weighing system
b) Mechanical room
c) Lift room
d) Operation room
e) Dumping facilities
f) Truck unloading/loading facilities

The selection of the foundation type for silo bins will reflect the design conditions and required costs. The following issues were considered for this preliminary design:

1) General Description

It is assumed that cranes and special equipment will be introduced as required by the projects selected for the feasibility study. The foundation for this heavy equipment should be provided accordingly.

2) Loading Conditions

The loading conditions will be designed after setting up the total equipment system for each terminal as provided by the feasibility study. The loading conditions will include size, wheels, power source and required intensity, loads and nominal capacity.

3) Alternative Study

The foundation type for the heavy equipment will be selected from the following:

- a) Flat foundation
- b) Pile foundation in friction piling
- c) Pile foundation in point bearing piling

Pile foundation in point bearing piling will be selected basically.

7.6.11 Civil Works (8) : Supporting Frame and Structure Foundations of Equipment

Frame structures will be provided for equipment supports:

- ① Supporting frame of silo bins.
- ② Machinery tower
- ③ Supporting frame for the belt conveyors
- ④ Others

These are designed of steel structures assembled at the site.

7.6.12 Civil Works (9) : Common Buildings

(1) Introduction

The building works are divided into two groups: namely, Common Building and System Building. The former have 1500m^2 of floor areas and will include a terminal office, a maintenance shop, two weigh-bridges and a transformer station.

(2) Basic Structures

Terminal office : Concrete
Transformer station : Concrete
Weigh-bridge : Concrete
Maintenance shop : Steel

(3) Foundations

Basically flat foundation are provided.

(4) Fence and Gates

Both the customs fence and security fence will secure the terminal areas. Gate facilities should also be provided.

7.6.13 Civil Works (10) : System Buildings

(1) Introduction

The System Building will have 1,184 m^2 of floor area and will provide a super-structure for the 284 m^2 receiving and loading structure and a 9,000 m^2 machinery tower.

(2) Basic Structures

Super-structure of receiving and loading structure Maintenance shop: Steel
Machinery tower: Steel

(3) Foundations

Basically flat foundations are provided.

7.6.14 Equipment Procurement (1) : Receiving System

The equipment for ship-loading/unloading, truck receiving, railway wagon receiving and transfer system is provided. The major items are the following:

- Ship Unloader: 2 x 400 ton/hour
- Chain Conveyers

This equipment will be located on the best route of the grain flow, that is through belt conveyor and by other means. The most important equipment should be the equipment provided in and around the silo bins. Other key equipment is unloaders which will carry grain from barges onto the belt conveyors leading to the silo. The loaders will carry the grain delivered from the silo to the ocean going vessel. Crane rails will be provided on the rail beam which may be supported by pile foundations.

For more details, refer to PART III Chapter 6.

7.6.15 Equipment Procurement (2) : Storage System

(1) Introduction

Storage system will include the following:

① **Bucket elevator**
② **Distribution conveyor and receiving conveyor**
③ **Weighing system**
④ **Fumigation system**
⑤ **Drying system**
⑥ **Sampling system**
⑦ **Dust correcting system and**
⑧ **Explosion Preventing system**

(2) Silo system

Silo system will include the following:

① Main silos : Steel silo bins 5,000 ton capacity,
Diameter. 18.3 m, height = 36 m
20 units
② Buffer silos : 500t capacity
Diameter. 9 m, height = 16 m
3 units

7.6.16 Equipment Procurement (3) : Delivery System

The loaders will carry the grain delivered from the silo to the ocean going vessel. Two ship unloaders will be provided:

Bucket elevator with swing type with dust-proof telescopic chute
800ton/hr two Units

Table 7.6.9 Major Cargo Handling Equipment Items : Grain Terminal, 2006/2007

Systems		Equipment		Outline Specifications	Number	Unit
1	**Unloading / Receiving System**	1	Barge/Vessel Unloader (For vessels up to 55,000 DWT)	Pneumatic type, with metal detector/ magnet separator 400 t/h capacity (2 x 200 t/h nozzles), with 10 t winch at boom top	2	units
		2	Railway Wagon Receiving System (Length x Breadth = 27.0 x 3.5 m)	400 t/h capacity with chain conveyors 1 line x 30m with metal detector/ iron separator	2	units
		3	Road Truck Receiving System (Length x Breadth = 18.0 x 3.0 m)	200 t/h capacity with chain conveyors x 70m with metal detector/ iron separator	1	units
2	**Receiving Conveyor Line System**	1	Conveyor System From Barge/Vessel Unloaders to the Grain Storage System	Chain conveyors, 1 line x (250m+25m+135m+125m), 800 t/h	560	m
				Bucket elevator, 800 t/h	1	units
				Screening Device, 800 t/h	1	units
		2	Conveyor System From Railway Wagon Receiving Sys. to Grain Storage System	Chain conveyors, 1 linex(35m+15m), 800 t/h	50	m
				Bucket elevator, 800 t/h	1	units
				Screening Device, 800 t/h	1	units
		3	Conveyor System From Road Truck Receiving System to Grain Storage System	Chain conveyors, 1 linex(25m+70m), 200 t/h	95	m
				Bucket elevator, 200 t/h	1	units
				Screening Device, 200 t/h	1	units
3	**Grain Storage System**	1	Bucket Elevators	800 t/h, chain bucket	6	units
				200 t/h, chain bucket	2	units
		2	Distributing Conveyors over Silos	800 t/h, chain conveyor, 6 line x 90m	540	m
				800 t/h, chain conveyor, 2 line x 45m	90	m
		3	Retrieving Conveyors under Silos	800 t/h, chain conveyor, 6 line x 90m	540	m
				800 t/h, chain conveyor, 2 line x 45m	90	m
		4	Weighing System	Bulk weighers/electronical, 800 t/h	4	units
				Bulk weighers/electronical, 200 t/h	2	units
		5	Fumigation System	Spraying of insecticide liquid and/or tablets for grains 800 t/h	1	units
		6	Drying System	Tower dryer, 100 t/h for reducing 5% of moisture	1	units
				200 t/h, bucket elevator	1	units
				100 t/h, bucket elevator	2	units
				100 t/h, conveyor, 1 line x 70m	70	m
		7	Sampling System	Automatic rotary cross cut type samplers (800 t/h)	3	units
				Core type truck probe (200 t/h)	1	units
		8	Dust Collecting System	Dust emission prevention	1	units
		9	Explosion Preventing System	Dust suppression	1	units
		10	Temperature Sensing System	Sensing temperature of grains in silos	1	units
4	**Silos**	1	Main Silos	Steel silo bins (excl. concrete cone bottom), 5,000 t capacity, Dia.18.3 m; H = 36.0 m	20	units
		2	Buffer Silos	Steel silo bins (cone btm), 500 t cap. each Diameter = 9.00 m; total height = 16 m	3	units
5	**Delivery Conveyor Line System**	1	Conveyor System From Silo System to Ship Loader	Chain conveyors, 2 lines x (110m+45m+30m+550m), 800 t/h	1,470	m
				Bucket elevator, 800 t/h	2	units
		2	Conveyor System From Silo System to Wagon Loading Chute	Chain conveyors, 1 line x 30m, 200 t/h	30	m
				Bucket elevator, 200 t/h	1	units
		3	Conveyor System From Silo System to Truck Loading Chute	Chain conveyors, 1 line x 15m, 100 t/h	15	m
				Bucket elevator, 100 t/h	1	units
6	**Loading / Delivery System**	1	Ship Loader	Bucket elevator, with swing type dustless telescopic chute 800 t/h, vessels up to 65,000 DWT	2	units
		2	Railway Wagon Loading System	Dustless telescopic chute, 200 t/h capacity	2	units
		3	Road Truck Loading System	Dustless telescopic chute, 100 t/h capacity	1	units
7	**Common System**	1	Truck Scale System	Weigh bridge, electronic, 100 t	2	units
		1	Control System	Equipment/system control, automatic/sequential operation	1	units
				Inventory management		
		2	Communication System	Internal communication system	1	units
				External communication system		
		3	Fire Fighting System	Hydrants	1	units
8	**Assisting Equipment**	1	Front bucket wheel loader	"Bobcat" For barge/vessel hold bottom cleaning	3	units
		2	Forklift	5 t lifting capacity For maintenance work, etc., general use	1	units
9	**Others**	1	Auxiliary Equipment	-	1	units
10	**Spare Parts**	1	Spare Parts, etc.		1	units

7.7 Barge Terminal

7.7.1 Introduction

The barge terminal is one of the core projects among the Short Term Development Plan components and one of terminals to be verified by the feasibility study. The present cargo handling is mainly for dry bulk and is performed through the neighboring dry bulk berths.

One of the advantages of this port is its location close to a river canal which connects the port to the Central and Western Europe. No other port neighboring to Constantza has these privileges.

According to port construction history, it was undertaken together with the development of the Canal.

7.7.2 Background Information

Physically, the barge operation area and waiting zone are divided into two parts: namely the "River Basin Area" and "Island Basin Area". The former (80 Ha, 800 m x 1000 m) is located near the narrow channel that connects to the North Port and is equipped with 18 berthing dolphins. While the latter (48 Ha, 600 m x 800 m) is a closed basin that opens towards the south Piers and has actually no berthing facilities. The former is surrounded by four waterfront perimeters, whereas the North and West quay walls belong to the mainland since the East and South waterfronts are located along the island.

These areas are called **"River Basin"**. Refer to Figure 7.7.2.

According to the IPTANA of the associated consultants reported estimation that the canal capacity may increase to 20 million tons if eight convoys with six 1,500 tons barge units are operated through the canal every day. The daily barge arrivals totalling 20 million tons a year translate to 50 units a day. If the dwelling time is 3 days, then 150 barges would have to be berthed elsewhere within the port.

The loaded returning barges discharge their cargo at the specified berths then they have to stand-by at the waiting basin to load other cargo. The empty barges that are returning will also stay in the waiting basin. These empty barges in waiting basin will go to the loading berths for getting loaded and then they will stand-by at the laden barge stay-basin. Then and finally laden barges and also the empty barges, if so needed, will go to the assembly basin for grouping into a convoy for the next trip up-stream.

Currently the barge berths basin and dolphins at the south port area are used as waiting basins. However the increased demand in barge transport would also imply an increase of the capacity of the basin. This situation is accelerated by the low efficiency of use of the present basin due to the absence of a quay wall which could maintain the barges in a denser formation by tethering them one to another.

According to cargo volume forecast for 2020, barge cargo demand will rise to about 20.3 million tons. This means that about 150 barges should be standing-by for their next trip every day.

One of the planning concepts of barge berths is regrouping the tasks after the identification of each function. Each function will be relocated during the integration process and gathered at one location whereas now the system is physically scattered. This will allow the barge operation easier maintenance, economic operation and efficient use of the wet basins by providing them with berthing structures by function.

7.7.3 Planing and Preliminary Design Concepts

In order to achieve this plan, and taking into account the existing facilities, it is assumed that one specified area from the existing barge terminal in the south port will maintain its present kind of services but with higher efficiency area-use. In addition, it is recommended to provide the berthing facilities and a small boat basin (tug-boat and pusher terminal) with a quay wall.

The required works will only consist of civil works to cover berthing facilities, pavement works and minor utilities. As necessary, supplemental civil works for rehabilitating the existing facilities and dikes should be included.

The purpose of the Barge Terminal, seen in Chapter 2 Short Term Development Plan and Priority Project, Barge Terminal: Feasibility Study Item, is as follows:

(1) To mitigate the present congested state.

(2) To cope with the future increase of barge demand.
The cargo volume to be handled by barges at the Port of Constantza is:

Present: 10.9 million tons
In 2010: 17.2 million tons
In 2020: 20.3 million tons

(3) To increase the present 10 million tons cargo volume carrying by barge to 20 million tons.

(4) To improve the utilization rate of the Danube and of the Danube Black Sea Canal.

(5) To contribute to improving the export and import trades.

For the Barge Terminal Project, the civil work is the main activity due to the berth number increase and to the increase of berthing area for tugboats and pusher boats.

The Terminal does not generally aim at a cargo handling activity. Therefore, no equipment is considered since this terminal is designed mainly as a standby and preparation area for the barges next trip up-stream. Even so, if any equipment is required, the related private sector operators will provide it, and thus no equipment is provided in this project.

7.7.4 Understanding of the Present Problems for Preliminary Design

Transport of cargo by barges through the canal is one of the major means to carry cargoes from the land-wards countries in the Central Europe. As mentioned in the previous sub-section, barges contribute most of the transit cargoes amounting to 10.9 million tons. It is essential to design the required facilities taking present technical problems into account.

The basic understanding of existing conditions and problems to be considered to preliminary design is outlined below.

(1) Present Conditions: Circulation and Operation of Barges in the South Port

The convoys arrive at the river basin of the Constantza Port South in the Agigea area. Presently in order for the barges to get to anchoring and waiting operations, it is observed that they have maneuvering problems, described as follows:

(2) Existing Problems: Regarding the Barge Maneuvers and Convoy Circulation

Based on existing barge operation methods, the cause of present maneuvering problems including the convoy formation is summarized as follows:

1) Unreasonable concentration to a certain area of the basin.
2) Lack of a clear and precise organization that could facilitate the dismantling and forming of convoys.
3) Lack of clear and precise operation rules and regulations with regard to their circulation in the basin.

For instance, the basin’s east bank area is so congested by a mixed maneuvering to and from the connection canal that convoy maneuvering is often disorderly. As can be seen on the site, barges maneuvering operations are performed with difficulty, and if more requests come up simultaneously for barges to go to different operating points, then tugboats can not simultaneously manage the maneuvering. In the same way, these elements also affect convoy departing formation. Actually, the barges anchored in the interior of the island basin are also facing the same kind of problems.

(3) Possible Improvement Measures for Preliminary Design

This situation can be solved ① by improving the East and South quay to handle raw materials and others, ② and by improving the island basin itself, that is turning it into an anchorage for the cereal transporting barges or by better preparing the Pier I S area for handling steel products.

These improvements will lead to some decongestion of the river basin to allow better maneuvering of the barges and convoys as well as to a decrease of the waiting times of the barge staying at the operating berth.

Presently in the river basin, for instance, it takes 1-1.5 hours to bring a barge from the basin to the waiting point at berth 94. After improving the east/south area, it is estimated that this time will decrease by 30 minutes.

Another example is bringing a barge from the basin to berth 65 to unload steel products. Presently, due to complicated maneuvers, this work would take approx. 2 hours. After implementing the project, this time would probably be reduced in half.

7.7.5 Proposed Civil Works

(1) Introduction

The preliminary design of the Barge Terminal was carried out taking present problems into consideration. Terminal improvement should be implemented accordingly to provide efficient operation and systematic management of the terminal itself.

As seen in the above discussion, it is important to prepare the rules and regulations for utilization of terminal. This is essential for ensuring to provide improvement to the operators.

(2) Major Works

The major works can be grouped and classified by utilization and locations as follows:

Main Quay: Mother Land Side.

1) New West Barge Operation Main Quay, 700 m -4.5m depth
2) New Supplemental Tugboat Basin

B-37, 38 and 39
Quay wall 450 m

3) Apron pavement
4) Utility
5) Improvement of existing access to Barge Terminal
   About 3,000 m for two lanes
6) Others

River Basin: East Face and South Face: Island Side

1) New North Preparation Quay, 600 m -4.5 m depth
2) Improvement of Existing Mole: 600 m
3) Improvement of Existing 18 Dolphins.
   Length 850 m
4) Apron pavement to Quay and Dolphin Berth
5) Others

Island Basin: Island Side

1) New South Preparation Quay, 500 m -4.5 m depth
2) New South Dolphins. 11 units
   Length 500 m
3) Apron pavement to Quay and Dolphin Berth
4) Others

(3) Quay Wall Structures.

1) Gravity type wall consisting of concrete block type is recommended for continuity at neighboring sites and construction economy.
2) Dredging work is required to deepening and to provide firm foundation.
3) Apron should be paved of reinforced concrete in 25cm
4) Fender and mooring fittings are provided.
5) Minimum utilities including lighting and water supply are provided at the main quay wall at the mother land side.
6) No utility is provided to the Island.

(4) New Berthing Dolphin Structure

1) Gravity type structure of concrete is recommended for continuity at neighboring sites and construction economy.
2) Catway is provided for access to mooring line works
3) Dredging work is required to deepen and to provide firm foundation.
4) Apron should be paved of reinforced concrete in 25cm
5) Fender and mooring fittings are provided.
6) No utilities are provided.

(5) Improvement of Existing Berthing Dolphin Structure

1) Upgrading of existing 18 dolphin units providing stability reinforcement by foot protection.
2) Catway is provided to access to mooring line works
3) Dredging work is required to deepen the water for the design depth and strengthen the foundation
4) Apron should be paved of reinforced concrete in 25cm
5) Fender and mooring fittings are reinstalled.
6) No utilities are provided.

Refer to Figure 7.7.1 for the General Layout of Priority Projects in the South Port.
Refer to Figure 7.7.2 for the General Arrangement of Barge Terminal.
See Table 7.7.1 for the Major Civil Construction Works required for the Barge Terminal.

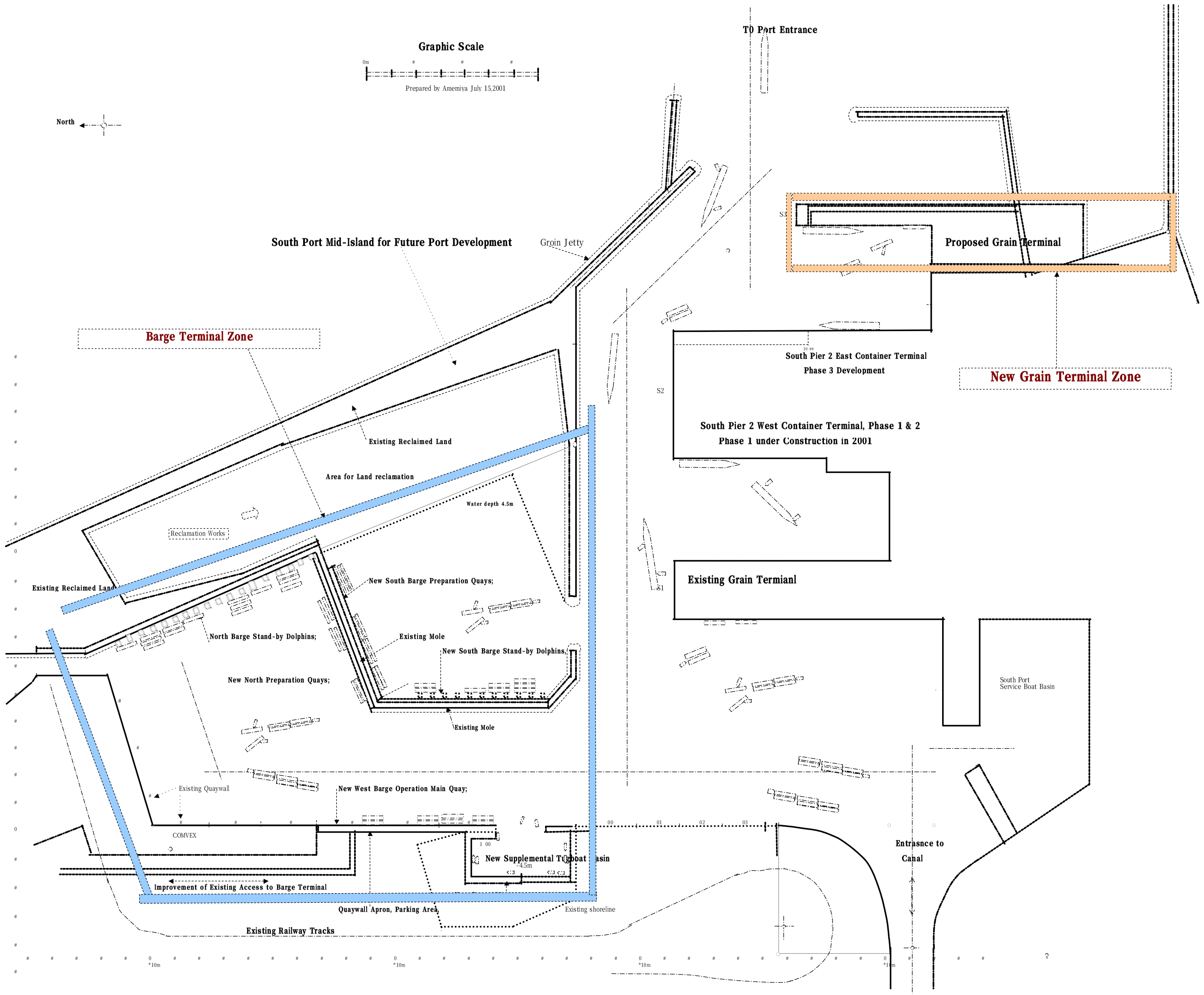


Figure 7.7.1 General Layout of Priority Projects in South Port

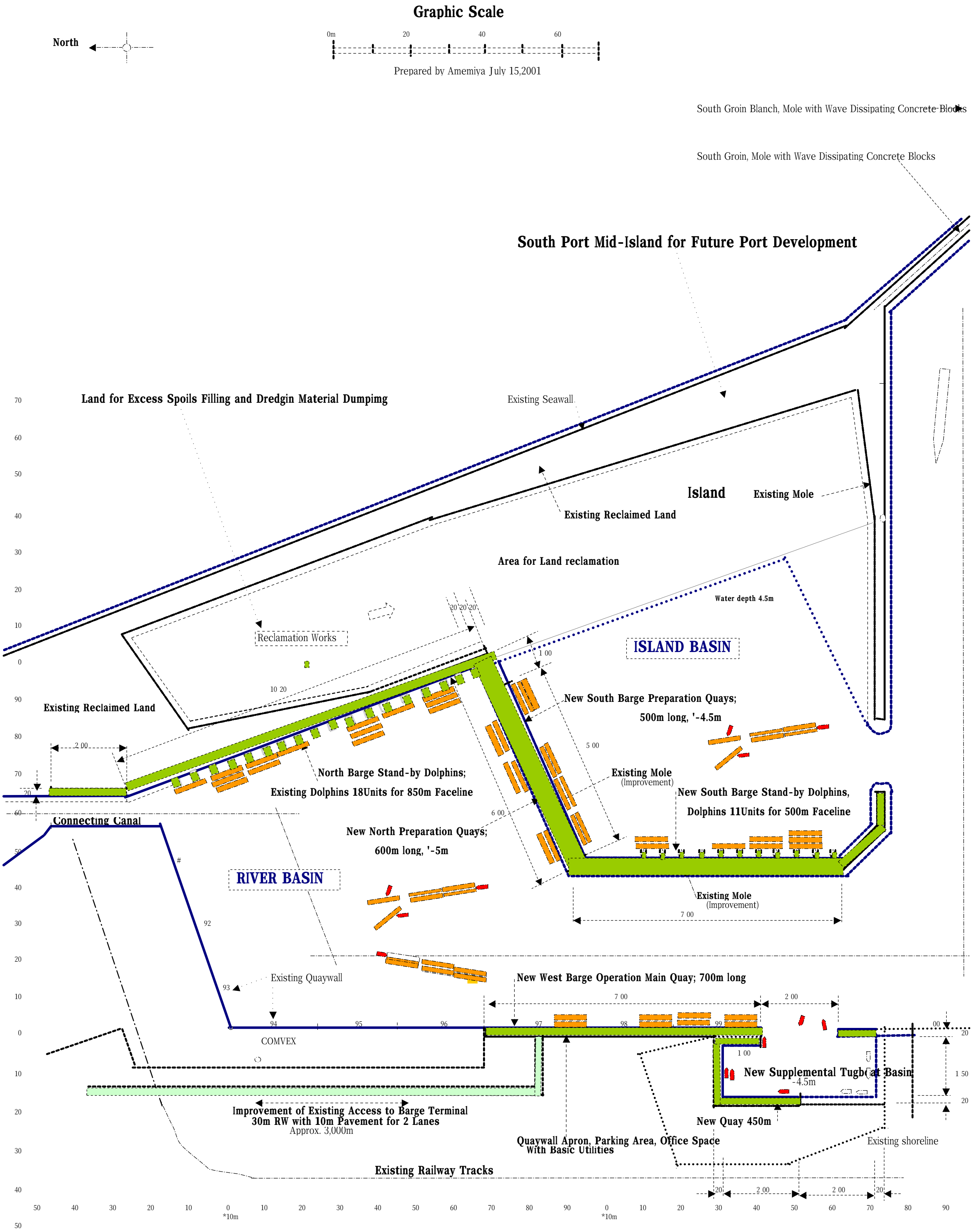


Figure 7.7.2 General Layout of Barge Terminal

Table 7.7.1 Major Civil Construction Work Items: Barge Terminal

No.	Works		Specifications	Unit	Quantity
1	Mobilization and Demobilization			LS	1
2	Temporary Works			LS	1
3	Site Preparation				
	3.1	Demolishing and Removal	Sunk vessels	LS	1
	3.2	Removal and Reuse		LS	0
4	Dredging and Reclamation				
	4.1	Borrowing and Reclamation	Borrowing from the canal banks	m3	0
	4.2	Dredging and Reclamation		mj3	0
5	Soil Improvement				
	5.1	Replacement of Soft Layers		m3	0
	5.2	Preloading and Consolidation		m3	0
6	Supplemental Tugboat Basin				
	6.1	Dredging and Disposal	150*300*2m	m3	90000
	6.2	Quaywall	Gravity wall type: -4.5m	m	450
	6.3	Apron Pavement	20m wide, Concrete: 25cm	m2	9000
	6.4	Utilities	Lighting, Water supply	m	450
	6.5	Drainage	Storm water	m	450
	6.6	Fittings	Fenders and Mooring Fittings	m	450
	6.7	Others		m	450
7	West Barge Operation Main Quay				
	7.1	Dredging and Disposal	700*10	m3	7000
	7.2	Quaywall	Gravity wall type: -4.5m	m	700
	7.3	Apron Pavement	20m wide, Concrete: 25cm	m2	14000
	7.4	Utilities	Lighting, Water supply	m	700
	7.5	Drainage		m	700
	7.6	Fittings	Fenders and Mooring Fittings	m	700
	7.7	Others		m	700
8	Improvement of West Access Road				
	8.1	Pavement, Overlay	Asphalt, 3,000m*12m	m2	36000
	8.2	Lighting		m	3000
9	North Barge Stand-by Dolphins				
	9.1	Dredging and Disposal	1020*10	m3	10200
	9.2	Improvement of Existing Dolphins	Gravity wall type: -4.5m	Unit	18
	9.3	Apron Pavement	20m wide, Concrete: 25cm	m2	24400
	9.4	Utilities	Lighting, Water supply	Unit	0
	9.5	Drainage		Unit	0
	9.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	Unit	18
	9.7	Others		Unit	18
		Subtotal			
10	North Barge Preparation Quays				
	10.1	Dredging and Disposal	600*10	m3	6000
	10.2	Quay	Gravity wall type: -4.5m	m	600
	10.3	Apron Pavement	20m wide, Concrete: 25cm	m2	12000
	10.4	Utilities	Lighting, Water supply	m	0
	10.5	Drainage		m	0
	10.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	m	0
	10.7	Improvement of Existing Mole	Grading and Pavement	m2	6000
	10.8	Others		m	600
		Subtotal			
11	South Barge Stand-by Dolphins				
	11.1	Dredging and Disposal	700*10	m3	7000
	11.2	Dolphins	Gravity wall type: -4.5m	Unit	11
	11.3	Apron Pavement	20m wide, Concrete: 25cm	m2	7000
	11.4	Utilities	Lighting, Water supply	Unit	0
	11.5	Drainage		Unit	0
	11.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	Unit	11
	11.7	Others		Unit	11
12	South Barge Preparation Quays				
	12.1	Dredging and Disposal	500*10	m3	5000
	12.2	Quay	Gravity wall type: -4.5m	m	500
	12.3	Apron Pavement	20m wide, Concrete: 25cm	m2	10000
	12.4	Utilities	Lighting, Water supply	m	0
	12.5	Drainage		m	0
	12.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	m	0
	12.7	Improvement of Existing Mole	Grading and Pavement	m2	7000
	12.7	Others		m	600

7.8 Inland Transport Facilities

7.8.1 General Description

As shown in PART II, the Master Plan outlined the necessity to improve inland transport facilities which include railway, roads and barge transport through the canal. These systems connect the cargo flow between the quayside and the inland transport systems of the port hinterland. One of existing problems which are urgently required is to improve access near the Gate No.5.

This Section deals with the proposed land access within the port area to realise efficient traffic flow based on the Short Term Development Plan. This is one of project components to be implemented urgently.

Both the inbound and outbound traffic at the gates require a smooth connection with their origin and destination, and consignees and consignors.

7.8.2 Road Improvement

Based on inspection of the port access roads by the Study Team, the present road access does not meet modern port access planning concepts as follows:

a) Access to the quay is not sufficient.
b) Access to the open storage areas is not sufficient.
c) Access road alignment is not well prepared, for example there are steep slopes at the port boundary and also some sharp road corners. This can be attributed to staged development at unscheduled times.
d) Limited car parking areas
e) No truck terminal

Works required in the Development Plan are:

a) Widening the existing access
b) Provision of parking areas
c) Realignment and classification of roads
d) Smoothing the road alignment especially near the gates
e) Improving connection between the North and South

The study of the road network planning in the Master Plan Study has been carried out.

The work will generally consist of civil works with no provision of cargo handling equipment. The former will cover the road works, bridges and improvement pavement overlay works. Roads proposed in the Master Plan are based on the preliminary design concepts as follow:

a) Separation of traffic
b) Smooth connecting access over the boundary
c) Rearrangement of road alignment at the North Port
d) Rearrangement of road alignment at the South Port
e) Connection between the North and South
f) Connection to new High Ways

Scope of Works proposed in the Master Plan are as follows:

1)	Roads (North Port Area)	C-A	25 m	4,000 m
2)	Roads (North Port Area)	C-B	20 m	3,000 m
3)	Roads (North Port Area)	C-C	15 m	3,00 m
4)	Bridges (North Port Area :	Gate No.5)		
	Fry-over bridge:	10m wide,	500 m	
5)	Roads (South Port Area)	C-A	25 m	5,000 m
6)	Roads (South Port Area)	C-B	20 m	4,000 m
7)	Bridges (South Port Area)			
	A long span bridge		20 m	200 m
8)	Bridges (South Port Area)			
			15 m	300 m

7.8.3 Gate 5 Access Improvement in Short Term Development

(1) General Description of Required Civil Works

It is proposed to provide a new access at the existing Gate No.5 to improve the present access. Works will be installed over the railway siding yard and the steep cliff to the port boundary. Total road length including the gate house area is about 600 m as follows:

✓	Gate Platform	L =220 m
✓	Flyover Bridges in nine spans	L =330 m
✓	Landing zone	L = 50 m
✓	Total Length	600 m

(2) Gate Platform

The proposed gate platform is provided for a junction area at the access exit to the city road. The location is near the present Gate No.5 and connects with the city road on port boundary.

This platform will consists of reinforced concrete deck structure supported by piles. Piles will be driven into the slope after machine drilling of the subsoil.

Gatehouse area of 150m^2 and security fence 2.1m high will be provided on this deck.

(3) Flyover Bridges

A series of flyover bridges will be provided between the raised platform (at 21m to 25m) and the earth mound road at about 8 meter ground height. They consist of nine spans including following combination:

✓ 30m Span Flyover Bridge	6 units
✓ 45m Span Flyover Bridge	2 units
✓ 60m Span Flyover Bridge	one unit
✓ Total	9 units

Spanning arrangement was based on the railway tracks and existing road access. Bridge structure will be steel truss for 45 m span bridge for larger span and concrete structure for 30m short span.

All the bridges will be supported by abutment with pile foundation.

Total height difference between the top of platform (+25.0 m) and the landing zone (+8.8 m) is 16.2 m. The largest height clearance between the ground and bridges formation will be about 17 m and located at the last span of the flyover. (FL.+21.0 m to GL.+4.0 m)

Clearance between the existing bridge and the new flyover in Alternative C is 6.6 m (+18.6 down to + 12 m).

(4) Landing Zone

Landing zone to the port area is ordinary earth bank structure similar to construction at the site.

(5) Land Stability Counter Weight

There are two technical points which should be studied carefully: (1) Bridge construction in 15 m rising, and (2) countermeasures to ensure the safety of facilities against the earth failure.

In order to deal with the latter, earth works are added.
Earth dike of 36,000m^3 of soil will be provided along the toe of the slope under the platform. This will increase the stability as a counter weight preventing slope failure.

(6) Alignment Alternatives

There two alternative route alignments, namely;

Alternative C : Crossover Bridge on the existing one.
Alternative S : Side Bridge along the existing one.

In terms of ease of construction, Alternative C is recommended.

Table 7.8.1 Major Civil Construction Work Items: Inland Transport Facilities

Description of work	Quantity	Unit	Notes
1. INDIRECT CONSTRUCTION			
1.1. Mobilization, Temporary Facilities, etc.	1	ls	
2. CIVIL WORK			
2.1. Gate Platform , L=220m			
(1) Connection zone (10m wide x 110m)	1,100	m	to the boundary
(2) Gate Area Zone, (20m wide x 100m)	2,000	m	
(3) Gate House	150	m^2	concrete
(4) Gate	1	ls	steel
(5) Fence , (2.1m steel)	210	m	steel
(6) Utility	1	ls	lighting
Subtotal			
2.2. Fly-over Bridges, L=330m			
(1) Bridge Section a), (45mx10mxH20m)	45	m	steel
(2) Bridge Section b), (2x30mx10mxH17m)	60	m	concrete
(3) Bridge Section c), (60mx10mxH13m)	60	m	steel
(4) Bridge Section d), (45mx10mxH12m)	45	m	steel
(5) Bridge Section e), (4x30mx10mxH10m)	120	m	concrete
(6) Utility: Lighting	1	ls	
Subtotal			
2.3 Landing Zone to Port Area, L= 50m			
(1) Earth Mound (15m wide x 4mH)	50	m	
(2) Asphalt Pavement (12m wide x 50m)	50	m	
(3) Utility: Lighting	1	ls	
Subtotal			
2.4 Supplemental Works			
(1) Slope Protection (150m x 80m x 3mH)	150	m	slope protection
(2) Others	1	ls	
Subtotal			
Total for Civil Works			

Note. 1. This is for the Alternative C.

CHAPTER 8 CONSTRUCTION PROGRAM AND PROJECT IMPLEMENTATION

This chapter deals with the project implementation of the Short Term Development Plan. Discussion will start the implementation plan of the Master Plan.

8.1.1 General Description of the Master Plan

The Master Plan is presented in PART II Chapter 6 “Master Plan of Port of Constantza”. The Master Plan contains the future cargo traffic forecasts and the General Layout of the port for 2020, the target year of the Master Plan. Proposed plan takes account of the existing facilities, present port operation, inland access and cargo handling method.

The purpose Master Plan study is not only to prepare the plan itself, but also to recommend the Short Term Development Plan which outlines the projects that should be urgently implemented before 2010.

The Master Plan of the Constantza Port provides a clear guideline for the future, indicating the port shape and facilities as they would be in 2020. On the other hand, the Short Term Development Plan proposes priority projects that should be implemented by 2010 to meet urgent needs.
Present contract conditions that are in place between CPA and the private operators have been considered to the maximum degree possible, especially with regard to the land use.

Among the first priority projects, namely the grain terminal and barge terminals, are located at non-occupied area by private operator nor CFR, Thus construction could be conducted without any physical obstructions.

PART II Chapters 6 and 7 present a detailed discussion of the Short Term Development Plan.

8.1.2 Master Plan Schedule

As indicated in the PART II “ MASTER PLAN 2020 ”, the implementation schedule of Master Plan is provided and compared with several alternative Layouts, in order to select the optimum Layout for Constantza Port Master Plan,

The proposed Construction Schedule of Master Plan is shown below. Refer to **Table 8.1.1.**

This table can be summarized as follows:

(1) At present (Feb. 2002) container terminal phase 1 is undertaken for the construction after contract.

(2) Container terminal development will be followed by its phase 2 & 3.

(3) Grain terminal phase 1 will start its procurement in 2004 by undertaking of detailed design. This terminal is an essential facility to support the export of grain by agriculture industries which is the leading industry in Romania. Decision making of the investment of it should be initiated by MOT/CPA not by private investors.

(4) Grain terminal phase 2 will commence its procurement 2009.

(5) Steel Product Terminal and Timber Terminal will start the procurement in 2014. However it is recommended in confirm the cargo demands, since the present port facilities can handle such cargoes. It is also assumed that the required investment should be carried out by the private investor.

(6) Barge terminal should be implemented as soon as possible in order to accelerate calling the transit cargoes through the canal.

(7) Phase 1 development of inland transport facilities should be implemented. Its construction method should be clarified either if it is realistic value or not.

Table 8.1.1 Construction Schedule of Project Components in Master Plan

		Project Components			Present						Calendar Year									Notes
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
A	**High Revenue Project Components**																			
A1		Container Terminal: Phase I					Financed by JBIC													South Port S2
	1)	Detailed Design	▬																	West Terminal
	2)	Tender and Contract		▬																
	3)	Construction and Procurement			▬	▬														
A1		Container Terminal: Phase II																		South Port S2
	1)	Detailed Design							▬											West Terminal
	2)	Tender and Contract								▬										
	3)	Construction and Procurement									▬	▬								
A1		Container Terminal: Phase III																		South Port S2
	1)	Detailed Design												▬						East Terminal
	2)	Tender and Contract													▬					
	3)	Construction and Procurement														▬	▬			
A2		Grain Terminal: Phase I																		South Port S3
	1)	Detailed Design					▬													
	2)	Tender and Contract						▬												
	3)	Construction and Procurement							▬	▬										
A2		Grain Terminal: Phase II																		South Port S3
	1)	Detailed Design										▬								
	2)	Tender and Contract											▬							
	3)	Construction and Procurement												▬	▬					
B	**Low Revenue Project Components**																			
B1		Steel Product Terminal				Cargo Demand should be carefully monitored by 2010.														Privatization
	1)	Detailed Design													▬					
	2)	Tender and Contract														▬				
	3)	Construction and Procurement															▬			
B2		Timber Terminal				Cargo Demand should be carefully monitored by 2010.														Timber export
	1)	Detailed Design													▬					
	2)	Tender and Contract														▬				
	3)	Construction and Procurement															▬			
B3		Barge Terminal																		South Port
	1)	Detailed Design					▬													
	2)	Tender and Contract						▬												
	3)	Construction and Procurement							▬	▬										
B4		Inland Transport Facilities: Phase I																		Port access
		: Road Access																		Gate 5 Access
	1)	Detailed Design					▬													
	2)	Tender and Contract						▬												
	3)	Construction and Procurement							▬	▬										
B4		Inland Transport Facilities: Phase II																		Port Access
		: Road Access																		
	1)	Detailed Design												▬						
	2)	Tender and Contract													▬					
	3)	Construction and Procurement														▬	▬			

8.2 Implementation Plan of Short Term Development Plan

8.2.1 Short Term Development Plan

The main project components and terminals proposed in the Short Term Development Plan are listed below.

(1) Grain Terminal
(2) Barge Terminal
and
(3) Inland Transport Facilities: Gate 5 Access

Although the first two items are classified as First Priority Projects, their necessity should actually be verified by feasibility study, both in technical aspect and economic aspects.
The implementation schedule for the Short Term Development Plan is prepared based on the proposed Layout proposed by the Study Team to be the optimum Plan after holding constructive discussions among MOT, CPA, Operators and the Study Team.

8.2.2 Integrated Program of Short Term Development Plan

The implementation schedule of Short Term Development Plan was studied taking into consideration various activities including financial program arrangement, detailed design period, time span to prepare the pre-qualification and bidding schedule of the construction works.

Table 8.2.1 summarizes the main reasons for each project and the benefits that each project is expected to generate.

Table 8.2.2 shows the integrated Construction Schedule of the Short Term Development Plan.

It is understood that:

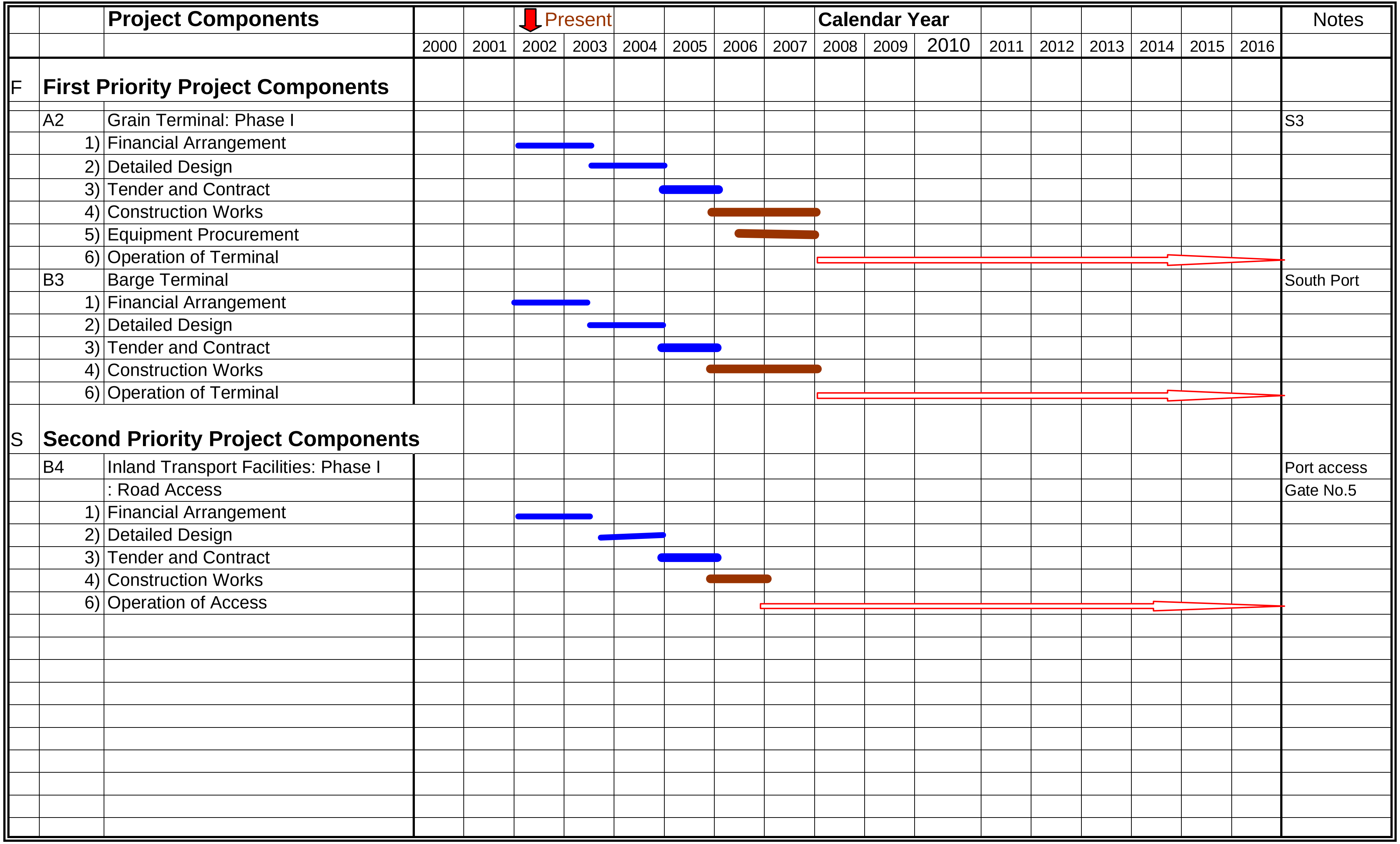
a) Two first priority projects should be implemented by the decision making by the public sector, MOT/CPA. Grain cargo demands are high and grain terminal contributes heavily to the grain export industries. Barge terminal will refresh the utilization of barges to transport bulk cargoes. For these two projects, it is expected that the public sectors initiative, not by private sectors.

b) Inland transport facilities: Phase 1, for improving the existing Gate No.5 should be also implemented.

Table 8.2.1 Expected Benefits by Each Project

Terminals	Reasons and Major Benefits
(1) Grain Terminal	Increase silo storage. Increase exports capacity. Provide import facility. Accommodate large bulk carriers. To support high growth of grain exports To contribute to agriculture industries.
(2) Barge Terminal	Minimize Congestion. Increase river transport capacity by barge.
and	
(3) Inland Transport Facilities	Minimize Congestion of Gate 5 Access. Increase capacity of inner port road. (Construction method should be carefully studies not to disturb the existing port operation)

Table 8.2.2 Construction Schedule of Project Components Proposed in Short Term Development Plan



		Project Components			Present						Calendar Year									Notes
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	
F	**First Priority Project Components**																			
	A2	Grain Terminal: Phase I																		S3
	1)	Financial Arrangement			■	■														
	2)	Detailed Design				■	■													
	3)	Tender and Contract						■												
	4)	Construction Works							■	■										
	5)	Equipment Procurement							■	■										
	6)	Operation of Terminal									→	→	→	→	→	→	→	→	→	
	B3	Barge Terminal																		South Port
	1)	Financial Arrangement			■	■														
	2)	Detailed Design				■	■													
	3)	Tender and Contract						■												
	4)	Construction Works							■	■										
	6)	Operation of Terminal									→	→	→	→	→	→	→	→	→	
S	**Second Priority Project Components**																			
	B4	Inland Transport Facilities: Phase I																		Port access
		: Road Access																		Gate No.5
	1)	Financial Arrangement			■	■														
	2)	Detailed Design				■	■													
	3)	Tender and Contract						■												
	4)	Construction Works							■											
	6)	Operation of Access								→	→	→	→	→	→	→	→	→	→	

8.3 Implementation Schedule of Selected Priority Projects

From the Short Term Development Plan components, the Study Team and the MOT selected certain projects in order of necessity.
From the three candidate Project components, two projects (namely the Grain Terminal and Barge Terminal) were selected as the most urgently required projects, and hence they should be studied in detail. The selected projects were further studied and verified to check whether they are worth investment or not. The feasibility of these projects should be verified by means of economic evaluation and financial analysis.

This section deals with the implementation schedule of the first priority project development.

This section also deals with major construction schedule components of the two priority projects to meet the urgent requirements. For technical verification, a construction plan is prepared based on the assumed construction method of the major works.

8.3.1 Implementation Schedule

The various activities in the project can be summarized into nine stages: namely,

1) Preparation Stage
2) Planning Stage
3) Financial Arrangement Stage
4) Detailed Design Stage
5) Tender and Contract Stage
6) Construction Stage
7) Maintenance Period Stage
8) Post Project Evaluation and Feedback Stage
9) Concession Contract Stage

Refer to Table 8.3.1 for the major contents and activities of these stages.
An explanation to these is given below.

a) Preparation stage is for project finding stage in the Ministry. The Ministry will list up the project candidates based on the previously developed project and long term transport sector national development plan like a National Development Plan. Screening the project will be carried out either it goes further or not.
b) Planing stage is for the decision making to implement the project. Thus it is important to clarify the scale of project, including the financial requirements. Feasibility study should be carried out. Initial Environment Assessment will be undertaken.
c) Financial arrangement stage is to make sure the finance resources to implement the project. This stage is the most important one among others. There is no government with excess

monetary resources in the world. The Ministry should insist the proposed project is urgently required and high priority. Project without any financial support will not be implemented.

d) Detailed design stage contains the preparation of detailed design with tender documents. Pre-qualification of tenderers might be included.

e) Tender and contract stage is for selection of contractor.

f) Construction stage is for execution and procurement based on the contract.

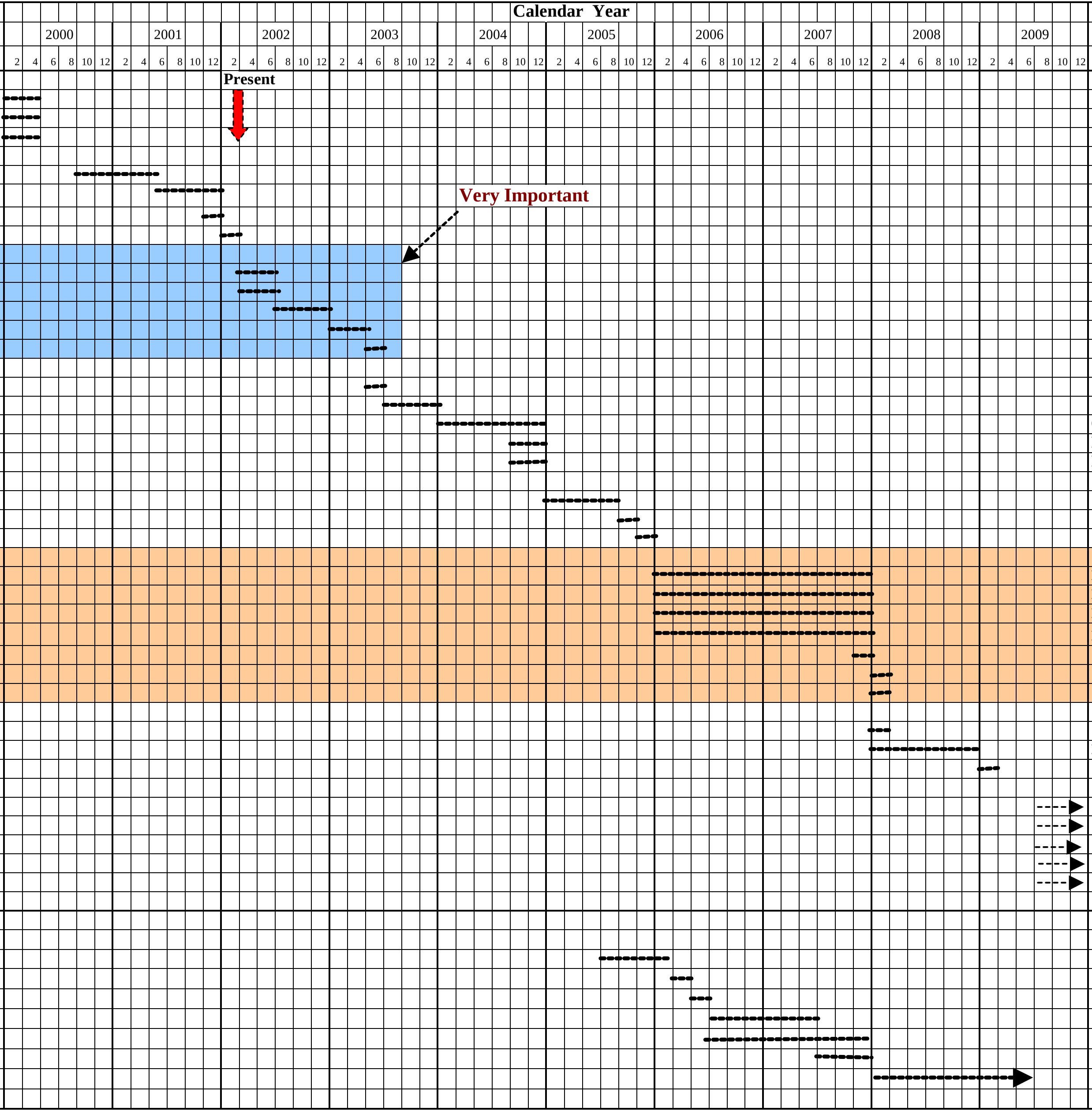
g) Maintenance period will be one year during which the contractor should mend the facility if it has any deficiency due to the contractor's faults or negligence.

h) Post evaluation and feed-back will be carried out in order to confirm the effect of the project, comparing the actual ones and estimated ones during feasibility study.

i) Concession contract stage is for selection the private operators. During this period, tender for the concession contract will take place accordingly. Time of tender for operator will depend on the required period for procurement works to be carried out by operators.

Table 8.3.1 Implementation Program of Grain Terminal and Barge Terminal

No.	Works in Stage	Avarege Length Month	Notes
1	**Prepapretion Stage**		
1.1	Prefeasibility Study		
1.2	Preliminary Study of Financial Sources		
1.3	Discussion among the Government Agencies		
2	**Planning Stage**		
2.1	Preparation of Master Plan		
2.2	Undertaking Feasibiity Study		
2.3	Evaluation of the Proposed Project by Priority		
2.4	Decision Making to Implement the Proposed		
3	**Financial Arrangement Stage**		
3.1	**Finding Budgetary Resources**		
3.2	**Finding External Resources**		
3.3	**Application**		
3.4	**Acceptance of Financial Support**		
3.5	**Concluding Loan Agreement or Similar**		
4	**Detailed Design Stage**		
4.1	Preparation of TOR for the Engineering Services	2	
4.2	Tender for the Consultants	6	
4.3	Undertaking Detailed Design	12	6 to 12 months
4.4	Undertaking the Pre-qualification of Contractors	(4)	During design
4.5	Preparation of Tender Document for Construction	(4)	During design
5	**Tender and Contract Stage**		
5.1	Tender for Construction	8	
5.2	Construction Contract	2	
5.3	Issue a Notice of Proceed	2	
6	**Construction Stage**		
6.1	Construction Works based on Contract	24	Based on the Project
6.2	Equipment Procurement based on Contract	24	Based on the Project
6.3	Environmental Monitoring	24	Based on the Project
6.4	Payment	24	Based on the Project
6.5	Final Test and Final Acceptance	2	
6.6	Issuance of Work Acceptance Certificate	2	
6.7	Final Payment	2	
7	**Maintenance Period**		
7.1	Checking the Outstanding Works at the Final Test	2	
7.2	Contractors Works and Checks	12	Normally 12 months
7.3	Issuance of Maitenance Certificate	2	
8	**Post Evaluation and Feed-back**		
8.1	Technical Evaluation	later	
8.2	Financial Evaluation	later	
8.3	Ecomomic Evaluation	later	
8.4	Environmental Evaluation	later	
8.5	Operation and Managemant Evaluation	later	
9	**Concession Stage for Operation**		
9.1	Tender for the concession contract		
9.2	Negociation and Discussion		
9.3	Cocession Contract		
9.4	Installation Works (Civil Works)		
9.5	Procurement and Installation (Equipment)		
9.6	Preparetion works for Starting		
9.7	Start of Operation		



8.3.2 Basic Pattern of Disbursement Schedule

Detailed discussion of the disbursement schedule of the project will be presented in Chapters 10 & 11. This subsection deals with the basic pattern of disbursement schedule based on the possible investment pattern.

a) Investment for the project will be carried out following the schedule established and based on traffic demand and availability of financial resources.
b) Capital costs will be invested in two years, 2006 and 2007.
c) As a basic consideration, a separate contractor should implement each of the two selected terminal projects.
d) Each project is to be contracted as one single contract package.
e) All these works will be directly implemented by MOT/CPA.
f) However it is recommended to evaluate the benefits and advantages since it is assumed that the equipment will be purchased by MOT/CPA investment, and will not be rendered to the operators.
g) Thereafter an appointed private operator under a concession contract will carry out the operation of each terminal.

Refer to Table 8.3.2 for the basic disbursement schedule for the grain terminal and barge terminal.

Important aspects among these are the scope of private sector involvement and those of public sector participation to the project.

Barge Terminal:

It is assumed the construction of terminal will be invested by the public sectors. There is no investment of cargo handling equipment. It is assumed that operation of barge terminal will be privatized.

Grain Terminal:

Grain terminal consists of the civil works and procurement of cargo handling equipment. It is assumed that these will be invested separately either the public sector or the private sector. However it is also assumed that both will be implemented simultaneously as if it were one contract package.

Table 8.3.2 Basic Pattern of Disbursement Schedule for Grain Terminal and Barge Terminal: First Priority Project in Short Term Development

Unit in Million US$

Capital Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (50%,50%)	mil US$							▨	▨																									
Equipment (50%,50%)	mil US$							▨	▨																									
Physical Contingency (50%,50%	mil US$							▨	▨																									
Engineering Fee (50%,25%,25%	mil US$					▨		▨	▨																									
Total	mil US$					▨		▨	▨																									
Maintenance Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (0.3%)	mil US$								-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Equipment (3.0%)	mil US$								-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total	mil US$								-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Replacement Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Equipment																																		
A. 30 year Life,	mil US$																																	▨
B. 20 year Life,	mil US$																												▨					
C. 15 year Life,	mil US$																							▨										
D. 5 year Life,	mil US$													▨					▨					▨					▨					▨
Total	mil US$													▨					▨					▨					▨					▨
Operation Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Operation,	mil US$									▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Total	mil US$									▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨
Total Costs	mil US$					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes 1 ▨ This indicates the area where expenditure will be inserted.
2 Refer to Table 8.3.2.

8.3.3 Detailed Design Stage and Tender/Contract Stage

In order to prepare the key schedule before the construction stage, all works are classified into four groups: two main groups plus other two that include the engineering services and the bidding procedure.

- **(a) Detailed Design Stage**
- **(b) Tender and Contract Stage**

The basic schedule of these two stages is based on the staged implementation schedule.

The Detailed Design and the Bidding Procedure are preparation works prior to each construction and equipment procurement.

According to experience, the average period needed for design services on this type of project is from eight months to one year. This should be maintained to meet the international open tender requirements if so required. In this schedule it is assumed that the design services period is one year.

The tender and contract stage, required before the works commence basically consists of the following components.

(1) Pre-qualification of Applicants
  - Prequalification applications
  - Evaluation
  - Short listing of qualified applicants

(2) Bidding
  - Bid documents purchase and distribution
  - Bid preparation by the bidders
  - Issuance of addendum
  - Bids evaluation

(3) Contract
  - Contract negotiation
  - Contract

(4) Contract Commencement
  - Notice to proceed

It is estimated that the required time for the bidding procedure will be one year.

8.4 Detailed Discussion on Major Construction Method

8.4.1 General Description

In order to implement smoothly the grain terminal and barge terminal, there are three kinds of critical works: namely, on-land civil construction works, equipment procurement and marine works. The on-land civil works are 20% of the total costs since there is no specialized work in the ordinary marine terminal. Depending on project requirements, equipment procurement , might need 20% to 40% of the cost, and the marine works are half of the total capital cost.

Since the marine works will require specialized work operations and some complicated processes, the construction schedule should be firstly arranged to take methods of marine construction works into consideration.

This subsection covers the required works during the construction stage and detailed construction methods for the two priority project components of the major marine works. Grain terminal will be analyzed mainly accordingly, since it contains wider scope of works than the barge terminal.

Construction works of selected projects is further subdivided into types of construction as follows:

(1) Marine Works
(2) On-land Civil Works including Utilities
(3) Cargo handling equipment procurement and installation

(1) Milestones of the Priority Projects

In order to meet traffic demand forecast to the project, the milestones are set up. Milestones include the time of work commencement and the time of work completion or start of terminal operation.

The time of beginning and end of each step should be studied and established in order to carry out the project systematically. These timings will be affected by various factors. It is assumed that the barge terminal will be constructed by a contract package. The operator will be selected one year before the commencement of improved terminal.
Thus scheduling the barge terminal construction is simple.

While those of the grain terminal are complicated, because it contains so-called superstructures, namely cargo handling equipment and storage silo bins.

It is recommended let the private operator invest the superstructure, although so-called infrastructures, covering the civil works and buildings, should be invested by the public sectors.

(2) Critical Works

Reclamation works will be one of decisive items in terms of construction cost and schedule due the fact that most of the on-land works in the area should be implemented only after the completion of the reclamation works. Hence, these reclamation works should be completed within the shortest time possible.
In order to verify this shortest required time for these works, the following items have been analyzed in detail:

1) Dredging and Reclamation
2) Fine Material Removal and Soil Improvement
3) Revetment, Slope Protection and Dike
4) Quay walls (Main wharves)
5) Other marine works.

(3) Particulars Construction Aspects.

1) Temporary work site.

It is recommended to provide the contractor with a short-term temporary site in the project area, but out of customs fence, before the contractor prepares the site in the project area.

2) Environment Considerations

The monitoring of the environmental impacts and to the natural element quality will be evaluated by periodic monitoring.

3) Experience of Past Construction

In order to maintain the smooth implementation of the project, the Bid Documents should be prepared carefully. Past experience, including construction claims, should be reviewed.

4) Co-operation between the Private Sector and Public Sector

It is assumed that the works may be divided into two groups: for private investment and for public investment. These two investments should be in harmony.

8.4.2 Detailed Discussion on Major Marine Works

Preliminary design of major port facilities was carried out to meet facility requirements based on natural conditions which are represented at the site and its surroundings.

All of the proposed facilities can be constructed within a reasonable time length and cost scale. This subsection deals with schedule items and cost aspects during the construction stage.

(1) "Site Preparation Works"

Based on the agreed contract terms, the contractor will commence the works at the site within certain days after the issuing date and upon receiving the Notice to Proceed. The construction period length will start from the date of Notice to Proceed.

The site preparation works will generally consist of the following items:

a. Preparation works
   - Preparation of site office
   - Preparation of data and information to be accomplished by the Contractor.
   - Setting-up of site laboratory
   - Confirmation of survey equipment and survey points
   - Setting-up of facilities and equipment for use by the Engineer and the Employer.

Note: Engineer means the Consultants. Employer means MOT/CPA

b. Formalities
   - Work permits of the related governmental agencies.
   - Discussion on the work commencement between the contractor, the Engineer and the Employer

c. Mobilization
   - Temporary works
   - Constructional plan

d. Temporary facilities
   The purpose of this work is to provide working vessels with temporary working basins and quay for unloading the construction plant and materials.

Demobilization will be carried out in accordance with the Contract.

(2) “Removal of obstacles that are obstructing the construction”

Removal of obstacles should be carried out if they obstruct construction. Existing concrete caisson out of the proposed face-line of quay wall will be relocated from the existing site to the new location. Refer to subsection 8.4.3.

(3) “Revetment, Slope Protection and Dike”

“Revetment” is a paramount work since this structure is exposed to the sea and will actually protect the reclaimed area against waves and currents. Revetment works in the grain terminal site are not required; however, improvement of existing armor concrete blocks is required.

“Slope protection” is a temporary structure since it contains the reclaimed soil until the quay wall is provided. Slope protection in the grain terminal site is not required, since the most of existing boundary has already been protected.

“Dike” is a temporary structure since it serves only for construction purposes and will thereafter be covered or surrounded by reclaimed soil. Dike construction may be required in the grain terminal reclamation works.

(4) “Dredging and Reclamation”

Required reclamation volume is estimated at about 2.1 million m^3 for yard preparation at the grain terminal. Source of earth for such reclaiming will mainly be the existing dredged earth which is stockpiled along the connecting canal. Total estimated volume is at least three million m^3.

Other than this, MOT will schedule dredging works in the port area to deepen the designed water depth; expected volume estimated by IPTANA is about 1.1 million m^3.

Refer to subsection 8.4.4.

(5) “Removal of Existing Soft Layer”

There is soft layer at SI and SII where reclamation works were undertaken using the earth of canal dredging. Since the same earth source will be used for the grain terminal, it is not possible to completely ignore the generating soft layer.

It is tentatively assumed that 5% of reclaimed earth would be soft layer and should be improved. Thus the required cost of this is included in the cost estimation.

(6) “Wharf and Quay wall”

1) General Arrangement at Grain Terminal

23 concrete caissons, each 37m long should be provided. Of these, 11 caissons could be recycled from the existing caisson wall. 11 caissons are available but incomplete since they are without capping concrete and pavement. Refer to subsection 8.4.4.

2) New caisson

The balance of 12 concrete caissons should be newly prefabricated.

The Quay wall structure will consist of a concrete caisson gravity wall together with concrete coping and pavement. The total wharf length will be fixed in the Plan. The wharf crane foundation for its rear rail (landward) will consist of a reinforced concrete beam, and be supported by piles that should be driven to approx. –20 to 30 m MSL.

In case of choosing the caisson type, it will be set on the foundation rock layers that consisting of a lower layer one-meter thick weighing about 50 - 150 kg and a two-meter thick upper layer weighing 10 - 25 kg which should be dredged down to the required depth.

There are four basic methods of the concrete caisson fabrication: namely,

a) Dry dock
b) Slipway
c) Floating dock
d) Others (Synchrolift or Lifting Crane Method)

Among these, the floating dock method is recommended based on the following conditions:

- Availability in the port thus Quick mobilization
- No fixed facility requirement
- Economy of construction

(7) “Breakwater Extension, if any”

The recommended breakwater type is selected to be a rock mound structure, which is similar to the existing or combined type of rock mound and gravity wall. However if the water depth on site goes down to approximately 20m below MSL, the structural type will have to be the combined type.

Navigation aids may be included at the following installations;

1) Lighted buoy
2) Unlighted buoy
3) Harbour entrance light Beacon
4) Transit line light Beacon
5) Sector light

(8) “Coastal Protection”

CPA has reported that there is no significant change in protection in the coastal area. However, countermeasure works to protect the coastal area should be undertaken when so required.

(9) “Quarry Site/Rock Materials”

Based on the design volume of the basic required materials, the quarry site should be maintained to receive the necessary volume of materials.
According to these requirements, both rocks and quarry run should be collected, when executing revetment slope protection, and the dike and the breakwater extension.
According to the construction material survey made by the study team, it is assumed that the following three existing quarry sites are the possible candidates since they are located within 40 km of the site.

- Quarry. Dobromin
- Quarry. Ovidiu
- Quarry. Uranus

These quarries are serviced by national the railway, CFR.

The following three other quarry sites are also possible candidates although located more than 40 km from the site. Except Turcoaia, that can be serviced by barge, the railway is to be the main means of transport for carrying the rocks.

- Quarry. Sitorman
- Quarry. Balcescu
- Quarry. Turcoaia

8.4.3 Recycling the Existing Concrete Caisson for Grain Terminal

As shown in subsection 2.2.4, proposed layout with 400m slip, Plan L400, was selected. This automatically forces certain concrete caisson installed at site should be removed to new location. Thus the question to be answered is "Can such caisson quay wall remove to other site for recycling?"

This subsection deals with relocation method of existing concrete caissons to the new site. The goal is not only to save cost, but also to provide a wider slip between Pier S2 and Pier S3 for safety maneuvering by ocean-going vessels.

The proposed grain terminal will have a jetty where grain handling between vessels and conveyors will be carried out. It is proposed that the shape of the original Pier S3 should be rearranged to provide a wider wet basin as mentioned above.

According to the information provided by IPTANA, the existing quay structures are Type 6 and Type 13: the former is the concrete block gravity wall for –14.5m depth and the latter is the concrete caisson box gravity wall for -16.5m depth. Both structures are planned for the quay wall of Pier S3 which is however not yet completed. Work at Pier S3 is suspended pier and to be completed.

Technical study of recycling these quay wall i9s conducted only for the concrete caisson since its weight is so large comparing to the concrete block quay wall.
According to field observation, the existing water depth surrounding these quay wall, is –17m to –19m. Quay walls rest on stone mat to –16.5m. No testing data is available, but structural conditions of them look good and the quality of concrete and steel seems good.

Basic Conditions of Concrete Caisson by Site Observation:

- This caisson has an age of 10 years or more, however it seems healthy.
- Concrete surface is good and even an exposed steel-bar seems still good.
- Actual weight of concrete caisson is about **2,130 tons in air and 1,277 tons underwater**.
- No capping concrete has been provided, thus the caissons are just left there.
- All caissons are filled by crushed stone to maintain stabilization and sit on the rock mound foundation.
- Top of caissons is about 90cm above the low water

Note: Concrete caisson is a box type vessel made by reinforced concrete. It can be floated as towed by tugboat to the site.

Thus, wall thickness is about 0.3m in order to maintain its weight is lower enough to float by buoyancy. Gravel and rock base mat will be prepared at the site where the caisson locates. When it arrives at the site., water will be poured in the holds in order to increase the weight against the buoyancy.

After the settlement at the scheduled position, counter weight like a crushed stone or similar will be filled in. At last, concrete cover of capping will be provided to make a flat surface at the grade formation.

(1) Recycling or Demolishing Existing Structures

There are two basic systems to remove these caissons: namely,

System A: Demolishing and removal
System B: Removing and re-use as quay wall

It is assumed that System B should be adopted in order to minimize the project cost of the grain terminal. The existing conditions of concrete caissons seem good and support the possibility of System B.

(2) Removing Method

Existing caisson rests on the stone-bed foundation according to the design drawings provided by IPTANA. The weight of caisson is 2130 tons in air and 1277 tons underwater with the advantage of full buoyancy. There are seven compartments in which crushed stone of 6652 m^3 has been filled to increase the structural stability of the caissons.

Caisson’s best advantage is “Floating Body”. It can float and be carried to any place provided the water depth is sufficient.
Method of caisson removal was studied based on caisson characteristics, surrounding conditions and natural conditions. Removing works will be undertaken by following steps:

Step 1. Investigate existing concrete caisson
Step 2. Provide supporting barges
Step 3. Replace the crushed stone filled in the caisson compartment.
Step 4. Investigate caisson and mending damaged parts
Step 5. Pump the water out and floating caisson up
Step 6. Tow caisson to the new site of the grain terminal and settle on the rock mound foundation
Step 7. Fill the crush stone in the caisson compartment.
Step 8. Back-fill behind the caisson
Step 9. Provide capping concrete

Refer to Figure 8.4.1 for the basic construction methods of caisson recycling.

(3) Required Construction Fleet and Construction Speed

It is assumed that replacing one caisson could be carried out within 15 days. There are four groups of construction vessels that should be provided.

Group 1: To fill dredged stone
- ✓ Barge: 1500 tons: two units
- ✓ Dredger Grab dredger one ton: two units

Group 2: To support caisson
- ✓ Barge: 1500 tons: two units
- ✓ Tugboat 500 Hp: one unit

Group 3: To tow and set caisson
- ✓ Barge: 1500 tons (same as group 2) two units
- ✓ Tugboat 500 Hp: (same as group 2) one unit
- ✓ Service boat

Group 4: To re-fill crushed stone into caisson compartment
- ✓ Barge: 1500tons (same as group 1) two units
- ✓ Dredger Grab dredger one ton: one unit
- ✓ Service boat

(4) Basic Condition of the Concrete Caisson at the Type 13 Pier Quay Wall

<u>Volume of Concrete of Caisson: Vc: Type 13 of Concrete Caisson</u>

End wall : (12.5 x 3.14) x 0.35 x (16.5 + 0.9 - 0.5)
=39.3 x 0.35x 16.9
=232.5 m^3

Middle partition walls : 6 x (12.5 - 2 x 0.35) x 0.27 x (16.5 + 0.9 - 0.5)
=1.62 x 11.8 x 16.9
=323.1 m^3

Connection Wall : 4x 1.20x 0.50x 16.9
=40.6 m^3

Middle Basement : (12.5 + 1 x 2) x (37.5 - 2 x 12.5) x 0.50
=14.5x 12.5x 0.50
=90.6 m^3

Side Basement : {(12.5 + 2 x 1.0) x 1/2} ^ 2 x 3.14
=52.56 x 3.14
=165.1 m^3

Total Concrete Volume ; Vc= 851.9 m^3

<u>Weight of Caisson: W</u>

Uc: 2.5 tons /m^3, unit weight of reinforced concrete

Weight in air : Wa = Vc x Uc

=851.9 x 2.5

= 2,130.0 tons

Weight under water : Ww =Vc x (Uc - 1.0)

= 851.9 x 1.5

= 1,277.0 tons

Crushed Stone Volume per meter: Vso

Vso = (12.5 - 2 x 0.35) ^ 2 x 1/4 x 3.14 + (37.7 - 12.5 - 4x 0.27) x (12.5-2 x 035)

= 109.2+ 24.1 x 11.8

= 109.2 + 284.4

= 393.6 m^3/m

Total Volume : Vst

Vst = 393.6 x 16.9

= 6652.0 m^3

Buoyancy per meter: Bo

Bo = 12.5 ^ 2 x 1/4 x 3.14 + (37.5 - 12.5) x 12.5

= 122.7 + 312.5

= 435.2 tons/m

Total Buoyancy: Bt

Bt = 453.2 tons/m x 16.9m

= 7,355.0 tons

Balance Conditions by Stone Weight: H

Bt = Wa + Vso x Us x H

Us : Unit weight of saturated crushed stone; 2.0 ton/m^3

7355.0= 2130.0 + 393.6 x 2.0 x H

H = (7,355 - 2,130) / 787.2

= 5225 / 787.2

= 6.63 m

In case of 70% draft: Required stone height: h

70% x Bt = Wa + Vso x Us x h

0.7 x 7,355.0 = 2130.0 + 393.6 x 2.0 x h

h = (0.7 x 7,355 - 2,130) / 787.2

= 3,019 / 787.2

= 3.85 m

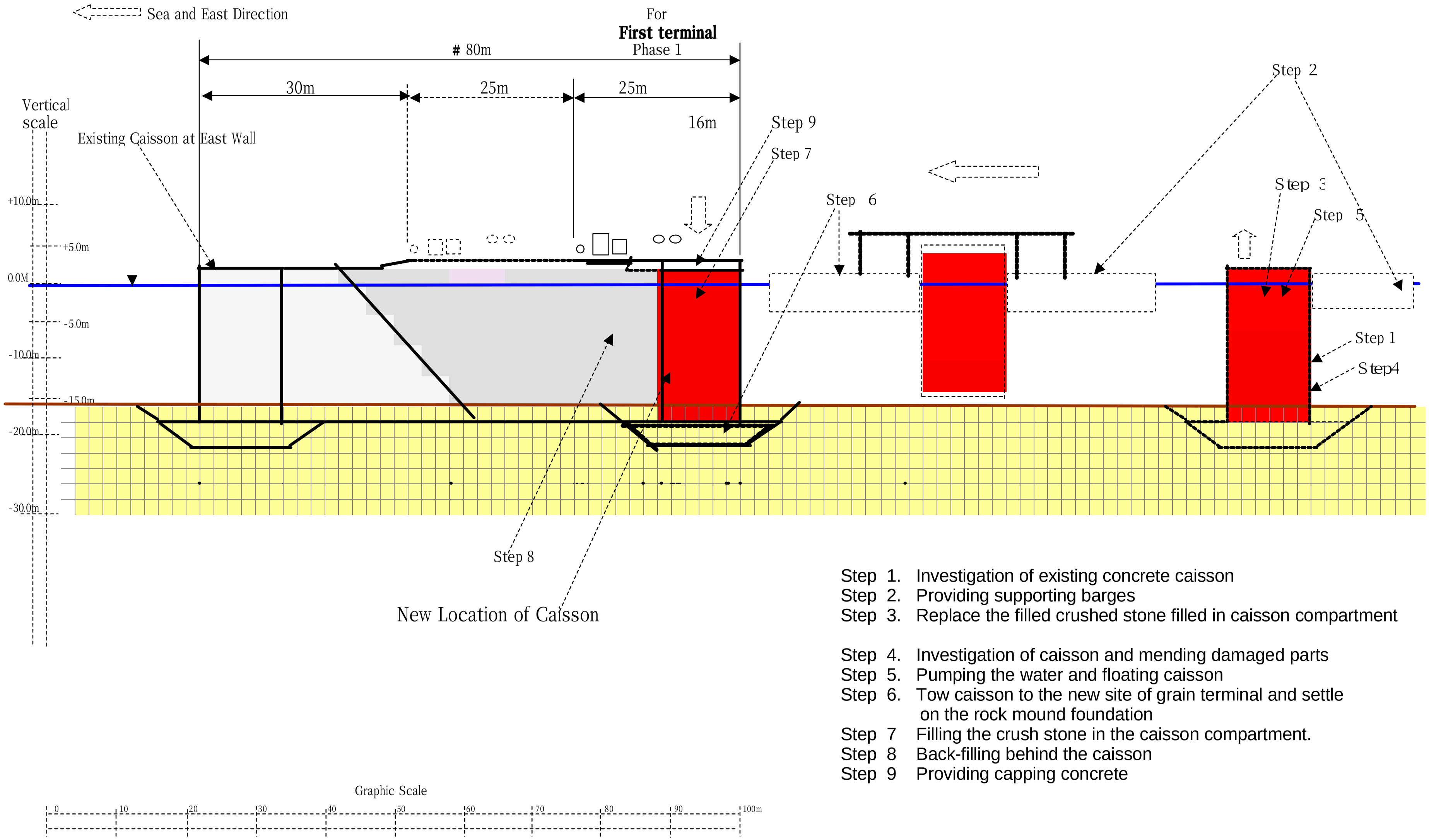
Required Excavation Volume of Crushed Stone for Re-floating Caisson: Es

Es = Vso x h

= 393.6 x (16.9 - 3.85)

= 5,136.5 m^3

Refer to Figure 8.4.2 for the Concrete Caisson Quay Wall Type 13.



Step 1. Investigation of existing concrete caisson
Step 2. Providing supporting barges
Step 3. Replace the filled crushed stone filled in caisson compartment

Step 4. Investigation of caisson and mending damaged parts
Step 5. Pumping the water and floating caisson
Step 6. Tow caisson to the new site of grain terminal and settle on the rock mound foundation
Step 7 Filling the crush stone in the caisson compartment.
Step 8 Back-filling behind the caisson
Step 9 Providing capping concrete

Figure 8.4.1 Existing Concrete Caisson Removing Method for Grain Loading Pier

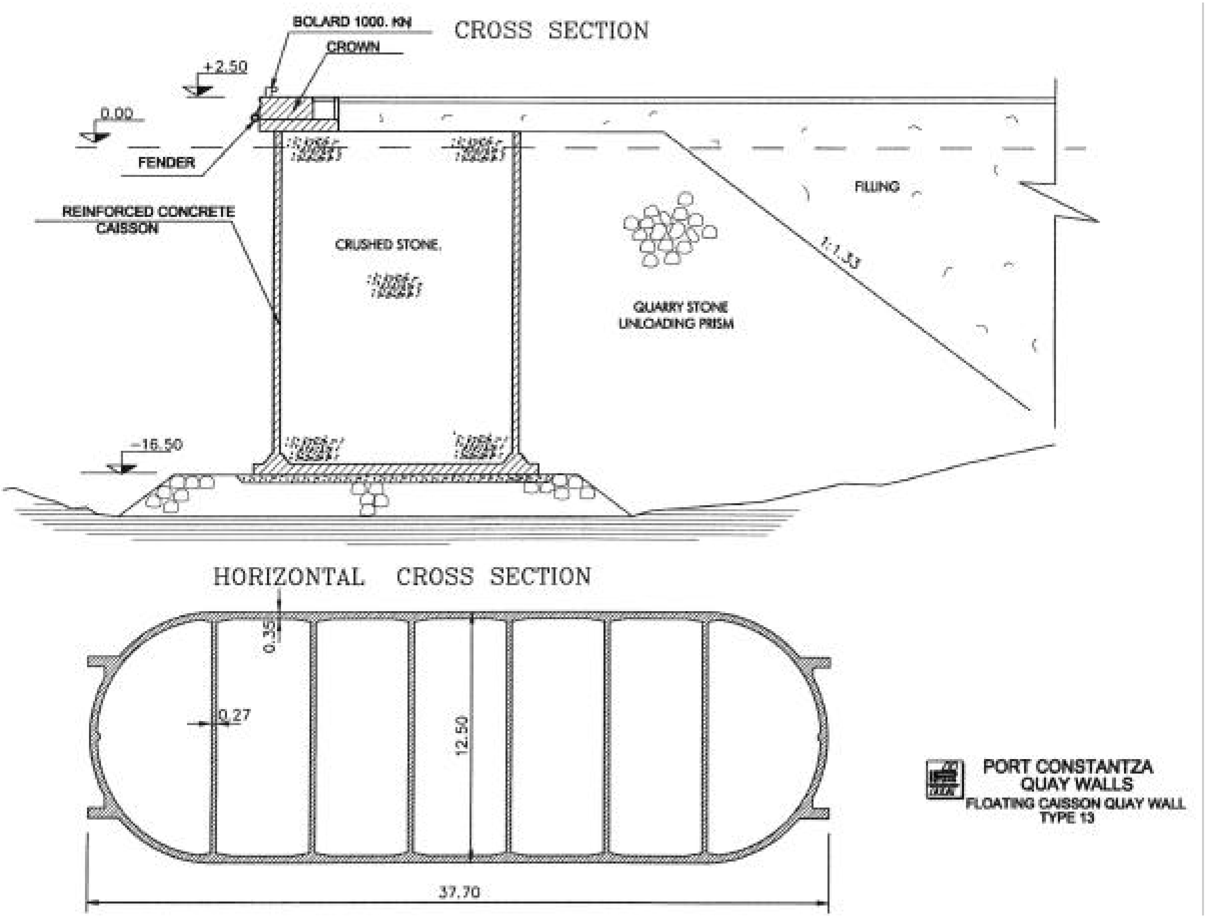


Figure 8.4.2 Typical Section of Existing Concrete Caisson Type 13

8.4.4 Reclamation: Grain Terminal

(1) Source of Material

Two sources are taken in account for reclamation materials as follows:

✓ **Canal Bank Deposit-piling**	**1.05 million m^3**
✓ **Port deepening dredging**	**1.05 million m^3**
✓ **Total volume of earth**	**2.10 million m^3**

Cost estimation for the grain terminal was carried out based on this assumption. If port dredging material is not available at the proper time, all the earth could be carried from earth piled at the Canal Bank.

(2) Required Transport Capacity per Month: Q

For the evaluation of environmental impact of reclamation works, the required period of this reclamation is assumed as seven to fourteen months.

<u>In case reclamation works in 7 months</u>

Q = 2,100,000 / 2 /7
= 150,000 m^3/month

<u>In case reclamation works in 14 months</u>

Q = 2,100,000 /2 / 14
= 75,000 m^3/month

<u>If the source is available only at the canal bank,</u>

Q = 2,100,000 / 14
= 150,000 m^3/month

Thus the study will be carried out with 150,000 m^3/month removal from the canal bank.

(3) Study Conditions

• Carrying distance:	10 km
• Navigation speed:	5 knots down, / 8 knots up
• Loading earth at the canal bank:	Backhoe plus dump truck
• Unloading earth at the grain terminal site:	Grab-bucket
• No major navigation constrains	

Cycle Time Estimation

- Navigation time of Barge
  Down to the site: 10 km/(5 knots x 1.852 km) = 1 hr 5 minutes
  Up to canal site: 10 km/(8 knots x 1.852 km) = 40 minutes

- Loading time (Backhoe $2m^3$ and dump truck $10m^3$)
  $10m^3$ x 12trips = $120m^3$/hr
  barge: $3,000m^3$ / $120m^3$/hr = 25hr

* Unloading at the grain terminal site by grab bucket in $3m^3$:
  $3m^3$ x 0.9 x 20cycles/hr x 24hr = $1,300m^3$/day one unit
  2 units x $1,300m^3$/day for one unit = $2,600m^3$/day for two units
  $3,000m^3$ / $2,600m^3$ = 27hr 40minutes

(4) Required Time and Capacity Estimation

The required time for one cycle (Canal bank to port site and back to canal bank)

1.	Berthing at canal bank	10 minutes
2.	Loading	25 hr 00 minutes
3.	De-berthing	10 minutes
4.	Sailing (loaded) to the terminal site	1 hr 5 minutes
5.	Berthing at grain terminal	10 minutes
6.	Unloading	27 hr 40 minutes
7.	De-berthing	10 minutes
8.	Sailing (empty) to canal site	40 minutes
	Total Required Time	55 hr 05 minutes

Estimated Work Progress

$3,000m^3$ of earth can be transported within 55 hr 05 minutes

$3,000m^3$ / (55 hr 05 minutes) x 24hr = $1,300m^3$/day for 1 barge
$1,300m^3$/day 1 barge x 4 barges $5,200m^3$/day 4 barge
5,200 m^3 /day 4 barges x 30 day = $156,000m^3$/month for 4 barges :
Acceptable, since this is smaller than $150,000m^3$/month
Required Equipment is listed below.

1.	Tug Boat	1,500HP	2 units

2.	Barge	3,000m^3	4 units
3.	Grab bucket	3.0m^3	4 units
4.	Backhoe	2.0m^3	2 units
5.	Dump Truck	10m^3	6 units

Required Temporary Facilities will be as follows.

1. Temporary Jetty at loading site : 2 berths (L=150m/berth)
2. Silt Fence: Installation of submerged fence preventing the natural water from serious contamination.

(5) Considerations

During detailed design stage, the following considerations should be examined:.

a) According to the soil investigation results, earth for reclamation contains a large amount of silt and clay; hence, earth after dumping to site will have more than the original volume at the canal site.

b) Leakage of silt to the open sea can mostly be prevented by submerging a silt fence located at the outer outlet of the spillway.

c) When dumping the earth to the grain terminal site, excess water will over-flow to the open sea. This water should go out through a spillway and not overflow the dike or similar structure.

d) Water content in dumped earth will vary by construction equipment. Evaluation on the typical equipment for the earth dumping is made as follows:

Methods	Efficiency	Cost	Soil Improvement
Bottom-opening Barge	Best	Best	Fair
Backhoe	Good	Good	Good
Grab-bucket	Fair	Fair	Best

Note: Bucket should be opened near the sea bottom.

e) It is recommended to undertake the soil investigation when the reclamation works have been completed in order to verify the soil condition and existence of soft layers.

(6) Dredging in the Port Area

The dredging and reclamation works will be undertaken simultaneously by the appropriate dredging machines, including a pump dredger of the required capacity. The dredging volume per month, needed for the works, will be estimated accordingly.

The total dredging volume will be estimated by the soil and area that is to be dredged, for example, by the existing fairway, or fairway extension and basin. According to IPTANA' estimation, there is about 1.1 million m3 in the port area to dredge to the base rock.

(7) Soil Indicators

Soil conditions of canal bank are not known; however, they are based on the soil investigation data at the south port Piers I and II. The Study Team also received various soil data which IPTANA compiled previously.

Refer to Table 8.4.1 for the geotechnical information at the grain terminal site.

Contamination of existing clean seawater by fine materials leaking from reclamation works, (under high SS contents) is one of the most sensitive issues during reclamation work. Hence, the content of fine materials (clay and silt) should be evaluated carefully.

As seen in the table, the fine materials range between 48% to 61%.

Table 8.4.1 Assuming the Soil Character of Reclaiming Materials by Existing Soil Data

Material Taking from the Canal Bed Dredging

Case 1 Representing by Two Layers per Hole									
Hole		in m		Clay	Silt	Sand	Gravel	Cobbles	Notes
	Upper	Lower	Thick	%	%	%	%	%	
F4	0	3	3	54	18	23	5	0	
	3	11.5	8.5	31	22	24	23	0	
	11.5	14.5	3	44	24	20	11	1	
F5	0	4.1	4.1	44	49	7			
	4.1	5.2	1.1	42	52	6			
	5.2	10.2	5	12	18	50	20		
	10.2	13	2.8	22	52	26			
F6	0	4	4	42	51	7			
	4	7.5	3.5	24	35	23	18		
	7.5	13	5.5	44	46	10			
	Average		28.1	33	31	23	13	0	100
Case 1 Representing by One Layer per Hole									
F4	0	3	3	54	18	23	5	0	
	3	11.5	8.5	31	22	24	23	0	
	11.5	14.5	3	44	24	20	11	1	
F5	0	4.1	4.1	44	49	7			
	4.1	5.2	1.1	42	52	6			
	5.2	10.2	5	12	18	50	20		
	10.2	13	2.8	22	52	26			
F6	0	3.5	3.5	42	51	7			
	3.5	7.5	4	24	35	23	18		
	7.5	13	5.5	44	46	10			
			17.5	24	24	31	21	0	100

Notes
1 All boring holes are located at the reclaimed land at the South Pier No.3.
2 Depth of layer are corresponding only to reclaimed materials.
3 These borings were carried out during the detailed design of container terminal S2.

8.4.5 Environmental Simulation by Land Reclamation at Grain Terminal

Among two priority projects, the grain terminal was on the spot since it may affect the environment by scattering the grain dust. While the barge terminal will be basically environmentally free. Considering above, simulation analysis regarding to environmental impact of the grain terminal was carried out for the possible changes of water quality.
Analysis was carried out in two stages, namely the construction stage and operation stage.

Construction Stage: Suspended Solid (SS) distribution by land reclamation, 2.1 million m3 in seven months or fourteen months

Operation Stage: Waste load (COD) distribution by scattering the grain dust during the handling , 1.0 ton/ day

By the simulation study, it is concluded that expected environmental impact by the priority projects is within the acceptable level.

(1) General Description

It is recommended to undertake simulation analysis on the water quality, SS distribution by the reclamation works. Soil condition is based on the recently surveyed data presented in the previous subsection.

Total reclamation volume is about 2 million m3.

In order to select the most suitable reclamation period, two cases, namely seven months and 14 months are used for simulation. As a conclusion, reclamation in fourteen months was selected for the Implementation.

Refer to detailed data in **Appendix III B.**

(2) Estimation of the Fine Material Contents

Estimation of the Fine Material Contents during the reclamation works is carried out in order to undertake the water quality simulation.

<u>Estimation of Discharge Volume of High Fine Material</u>

a) Density of Discharge through spillway: D
   Assuming D = 5,000ppm of fine materials
b) Volume of Fine Material Discharging: Vf
   Vf = V x Ca x Cb x Cc m^3

Where, V: Total Reclamation volume: 2,000,000m^3

Ca: Average fine contents (clay and silt content) of reclamation soil: 25% plus 25%

Cb: Separation rate of fine materials from mother soil by transportation: 5% (grab) to 50% (pump) taking 20%

Cc: Reduction rate by construction method: 10% (chemical additive spillway) to 50% (Simple dike or mole) taking 30%

Thus,

Vf = V x Ca x Cb x Cc

= 2,000,000 x 0.50 x 0.20 x 0.30

= 2,000,000 x 0.030

= 60,000 m^3

c) Daily Fine Material Discharging: Df

In case of Reclamation Period: T, seven months or 210 days.

Df7 = Vf / T7

= 60,000 / 210

= 285.7 m^3/day

In case of Reclamation Period: T, 14 months or 420 days.

Df14 = Vf / T14

= 60,000 / 420

= 142.9 m^3/day

d) Daily Total Volume Discharging: Dd

In case of seven months reclamation,

Dd7 = Df7 / D

= 285.7 / 0.005

= 57,140 m^3 say 60,000 m^3

In case of 14 months reclamation,

Dd14 = Df14 / D

= 142.9 / 0.005

= 28,580 m^3 say 30,000 m^3

e) Thus, 30,000 m^3 to 60,000 m^3 of high SS water (5,000) will be discharged daily for 14 months reclamation and seven months reclamation respectively. According to the results of simulation, 14 months reclamation is recommended in order to minimize environmental impact by the project.

8.4.6 Detailed Information of Simulation Study at grain Terminal

Refer to Appendix IIIB.

8.5 Construction Schedule

The Study Team prepared and proposed the construction schedules of project components. Each schedule is based on the project characteristics, including the type of structures, volume of works, sequence of works and natural conditions..

The schedule covers three project components: the Grain Terminal and Barge Terminal as the first priority projects, and Inland Transport Facilities as the second priority projects.

Required work volumes are estimated based on the results of the preliminary design and from the experience in similar projects in the past. The general specifications of each of the major works were included in the evaluation and all details were taken into account the schedule preparation.

The works are subdivided into two categories: namely, site preparation works and construction works. The latter is further subdivided into major work components as follows:

Table 8.5.1 Construction Schedule, Inland Transport Facilities: Gate 5 Access
Table 8.5.2 Construction Schedule, Grain Terminal: Total Construction
Table 8.5.3 Equipment Procurement Schedule, Grain Terminal
Table 8.5.4 Construction Schedule, Barge Terminal

Construction of the grain terminal and barge terminal should be led by strong initiative presented by the public sectors without any hesitation, considering the priority of the projects. Construction schedule of grain terminal was prepared assuming both the civil works and cargo handling equipment will be implemented as if it were one contract package.

Table 8.5.1 Construction Schedule (Inland Transport Facilities, Gate No. 5 Access; Between 2006 and 2007)

No.		Works	Specifications	Unit	Quantity	Perform per Month	Required Month	Notes
1		**1. INDIRECT CONSTRUCTION**						
	1.1	Mobilization, Temporary Facilities, etc.		%	5		3 + 3	
2		CIVIL WORK						
	2.1	Gate Platform , L=220m						
		(1) Connection zone (10m wide x 110m)		m	1,100	20	6	
		(2) Gate Area Zone, (20m wide x 100m)		m	2,000	20	10	
		(3) Gate House		m2	150	50	3	
		(4) Gate		ls	1		2	
		(5) Fence , (2.1m steel)		m	210	70	3	
		(6) Utility		ls	1		2	
		Subtotal						
	2.2	Fly-over Bridges, L=330m						
		(1) Bridge Section a), (45mx10mxH20m)		m	45	10	4	
		(2) Bridge Section b), (2x30mx10mxH17m)		m	60	10	6	
		(3) Bridge Section c), (60mx10mxH13m)		m	60	10	6	
		(4) Bridge Section d), (45mx10mxH12m)		m	45	10	5	
		(5) Bridge Section e), (4x30mx10mxH10m)		m	120	20	6	
		(6) Utility: Lighting		ls	1		2	
		Subtotal						
	2.3	Landing Zone to Port Area, L= 50m						
		(1) Earth Mound (15m wide x 4mH)		m	50	10	4	
		(2) Asphalt Pavement (12m wide x 50m)		m	50	15	3	
		(3) Utility: Lighting		ls	1		3	
		Subtotal						
	2.4	Supplemental Works						
		(1) Slope Protection (150m x 80m x 3mH)		m	150	40	4	
		(2) Others		ls	1		3	

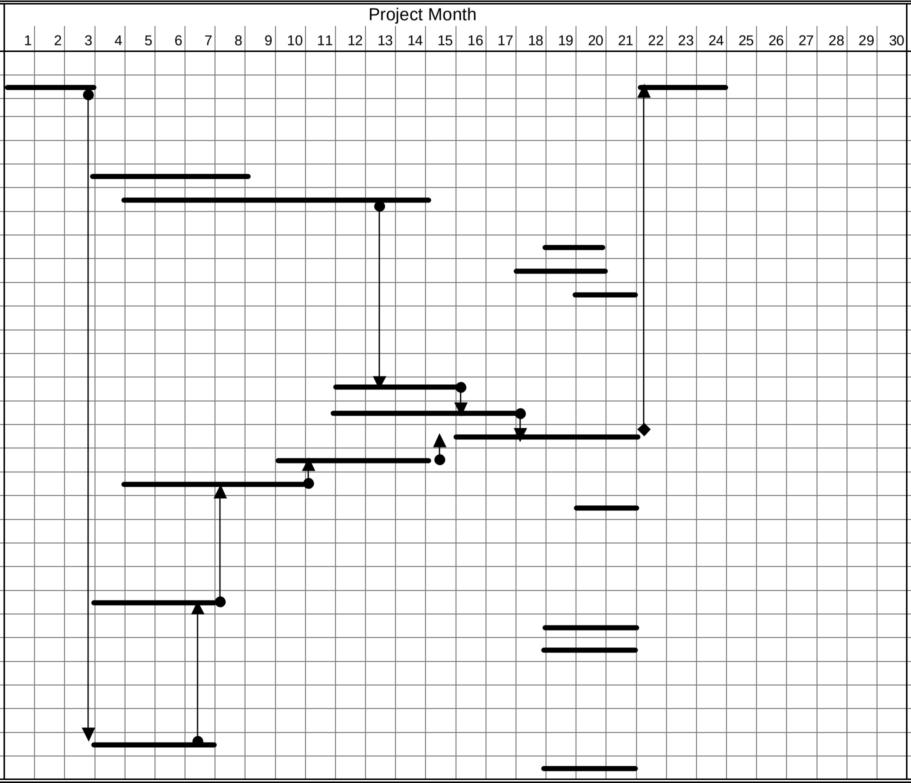


Table 8.5.2 Construction Schedule (Grain Terminal, Total Construction: 2006/2007)2

No	Works		Specifications	Unit	Quantity	Perform per Month	Required Month	Notes
1	Mobilization and Demobilization			LS	1		3	
2	Temporary Works			LS	1		2	
3	Site Preparation							
	3.1	Demolishing and Removal	Obstacles	LS	1			
	3.2	Removal and Reuse	North Grion. 7 caissons	unit	7		3	
	3.3	Removal and Reuse	South Grion. 4 caissons	unit	4		3	
4	Dredging and Reclamation							
	4.1	Borrowing and Reclamation	Borrowing from the canal banks	m3				
	1)	Mid-Pier . 875m*40m*19m		m3	332500	150000	2.3	Critical Works
	2)	New Seawall. 675m*50m*19m		m3	320625	150000	2.1	Critical Works
	3)	Terminal Site 1. 190m*325m*19m		m3	1173250	150000	7.8	Critical Works
	4)	Terminal Site 2. 675m*190m*0.5*19m	25%	m3	304594	150000	2	Critical Works
	4.2	Dredging and Reclamation		m3	0			
5	Soil Improvement							
	5.1	Replacement of Soft Layers		m3	0			
	5.2	Preloading and Consolidation		m3	106548	15000	6	
6	Main Quaywall							
	6.1	New Caisson	18 Caissons - 6 Caissons	unit	12		3 + 2	
	6.2	Recycling Caissons	6 Caissons	unit	6		3	
	6.3	Caisson Foundation by Rocks	20m*3m*540m	m3	32400	4000	8	
	6.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*540m	m3	179550	20000	9	Critical Works
	6.5	Concrete capping and apron	16m	m2	8800	1600	5.5	
	6.6	Asphalt Pavement	9m	m2	4950	1500	3.3	
	6.7	Railways	3 Tracks for 300m	m	900	300	3	
	6.8	Fittings	Fender and Moorings	m	550		3	
	6.9	Utilities		m	550		3	
7	Supplemental Quaywall							
	7.1	New Caisson	5 Caissons - 5 Caissons	unit	0			
	7.2	Recycling Caissons	5 Caissons	unit	5	2.5	2	
	7.3	Caisson Rock Foundation	20m*3m*200m	m3	12000	4000	3	
	7.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*200m	m3	66500	10000	6.7	
	7.5	Concrete capping and apron	16m	m2	3200	1600	2	
	7.6	Asphalt Pavement	9m	m2	1800	1000	2	
	7.7	Railways		m	0			
	7.8	Fittings	Fender and Moorings	m	170		2	
	7.9	Utilities		m	170		2	
8	West Seawall							
	8.1	Improvement of Existing Seawall	325m	m	325	200	2.1	
	8.2	New Seawall	675m	m	675	100	6.8	
9	Railway located on-land							
	9.1	Center Tracks	3 Tracks for 300m	m	900	300	3	
	9.2	Sidings	4 Tracks for 325m	m	1300	300	4.3	
	9.3	Connection to outside	Single track for 675m	m	675	300	2.3	
10	Terminal Site							
	10.1	Grading	325m*195m	m2	63375	5000	12.6	
	10.2	Pavement in Asphalt	40%	m2	25110	2500	10	
	10.3	Gravel Pavement	60%	m2	37665	10000	3.7	
	10.4	Silo, Superstructure : Steel made	See equipment cost					
	10.5	Silo, Concrete pile foundation	40cm*35m, 100000*1.1*0.5/100	ea.	550	50	11	
	10.6	Supporting Steel Frames	300m2 * 0.15t/m2	ea.	20		3	
	10.7	Machinery Tower, Steel F. Structure	100m * 15m * 6Str.	m2	9000		3	
	10.8	Substructure of Receiving/ L. Station	3*27m*3.5m	m2	284		2	
	10.9	Terminal Office(Control/ Laboratory)	200m2 * 4	m2	800	150	5.3	
	####	Maintenance shop	200m2	m2	200	50	4	
	10.1	Substructure of Weigh-bridge	See equipment cost	m2	300	150	2	
	####	Substructure of Clearing Equipment		m2	20		2	
	10.1	Transformer Station House		m2	200		3	
	####	Transformer and Generator		LS	1		6	
	10.2	Lighting and Utilities		LS	1		4	
11	Fence and Gates							
12	**Cargo Handling Equipment**		See Table 8.5.5 for details					
	12.1	Silo		LS	1		15	
	12.2	Equipment	Fabrication and transport	LS	1		12 + 2	
	12.3	Equipment	Installation and Commissioning	LS	1		4 + 2	Critical Works

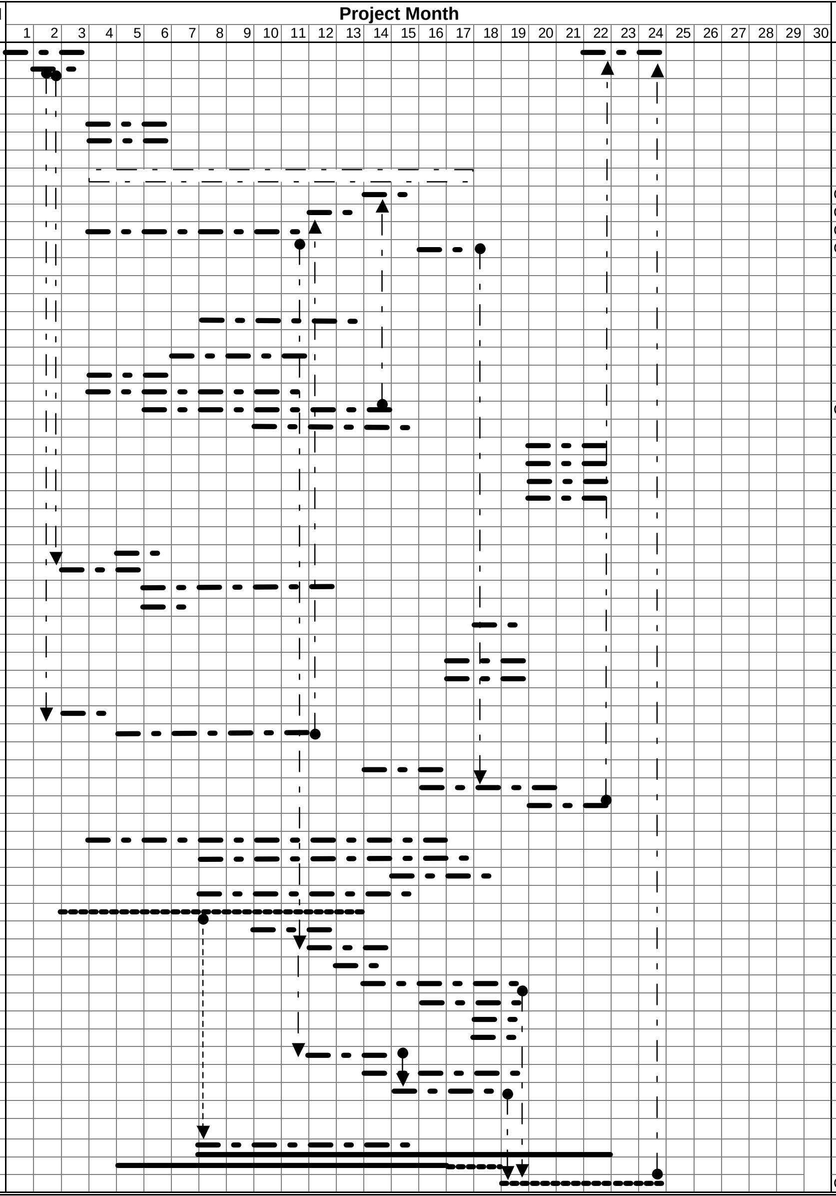
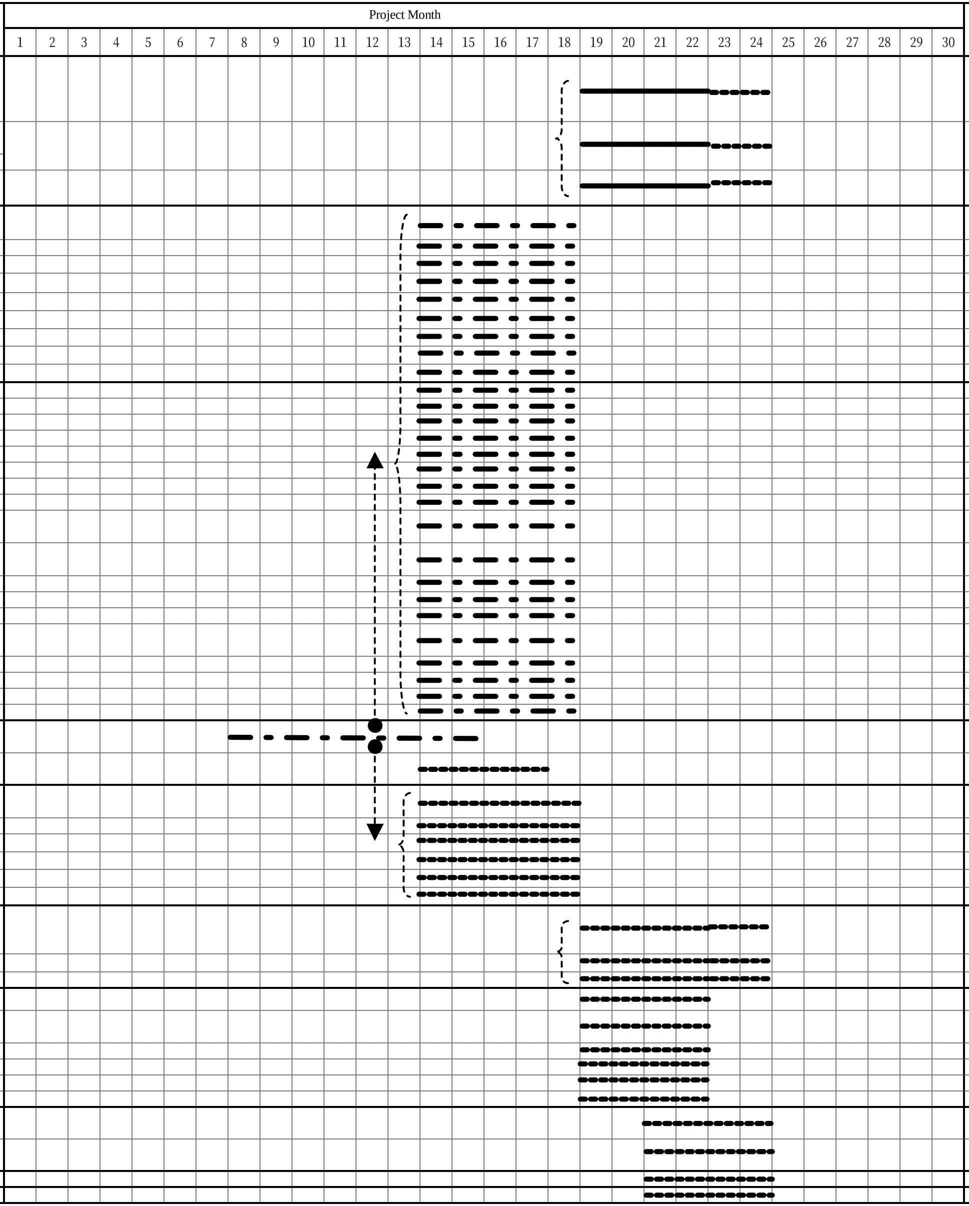


Table 8.5.3 Equipment Procurement Schedule - (Grain Terminal, Cargo Handling Equipment, Between 2006 and 2007)

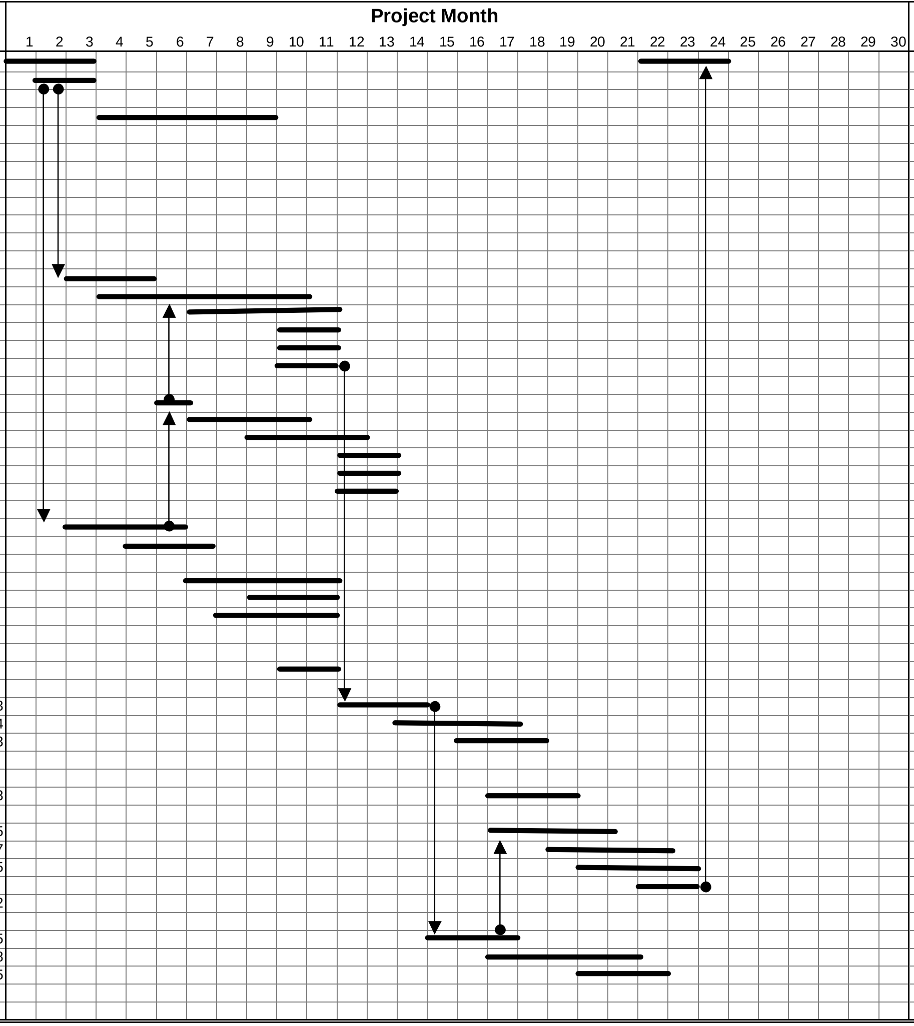
System		Equipment		Outline Specifications	Number	Unit	Perform per Month	Required Month	Notes
1	Unloading / Receiving System	1	Barge/Vessel Unloader (For vessels up to 55,000 DWT)	Pneumatic type, with metal detector/ magnet separator 400 t/h capacity (2 x 200 t/h nozzles), with 10 t winch at boom top	2	units		4 + 2	
		2	Railway Wagon Receiving System (Length x Breadth = 27.0 x 3.5 m)	400 t/h capacity with chain conveyors 1 line x 30m with metal detector/ iron separator	2	units		4 + 2	
		3	Road Truck Receiving System (Length x Breadth = 18.0 x 3.0 m)	200 t/h capacity with chain conveyors x 70m with metal detector/ iron separator	1	units		4 + 2	
2	Receiving Conveyor Line System	1	Conveyor System	Chain conveyors, 1 line x (250m+25m+135m+125m), 800 t/h	560	m		5	
			From Barge/Vessel Unloaders	Bucket elevator, 800 t/h	1	units		5	
			to the Grain Storage System	Screening Device, 800 t/h	1	units		5	
		2	Conveyor System	Chain conveyors, 1 linex(35m+15m), 800 t/h	50	m		5	
			From Railway Wagon Receiving Sys.	Bucket elevator, 800 t/h	1	units		5	
			to Grain Storage System	Screening Device, 800 t/h	1	units		5	
		3	Conveyor System	Chain conveyors, 1 linex(25m+70m), 200 t/h	95	m		5	
			From Road Truck Receiving System	Bucket elevator, 200 t/h	1	units		5	
			to Grain Storage System	Screening Device, 200 t/h	1	units		5	
3	Grain Storage System	1	Bucket Elevators	800 t/h, chain bucket	6	units		5	
				200 t/h, chain bucket	2	units		5	
		2	Distributing Conveyors over Silos	800 t/h, chain conveyor, 6 line x 90m	540	m		5	
				800 t/h, chain conveyor, 2 line x 45m	90	m		5	
		3	Retrieving Conveyors under Silos	800 t/h, chain conveyor, 6 line x 90m	540	m		5	
				800 t/h, chain conveyor, 2 line x 45m	90	m		5	
		4	Weighing System	Bulk weighers/electronical, 800 t/h	4	units		5	
				Bulk weighers/electronical, 200 t/h	2	units		5	
		5	Fumigation System	Spraying of insecticide liquid and/or tablets for grains 800 t/h	1	units		5	
		6	Drying System	Tower dryer, 100 t/h for reducing 5% of moisture	1	units		5	
				200 t/h, bucket elevator	1	units		5	
				100 t/h, bucket elevator	2	units		5	
				100 t/h, conveyor, 1 line x 70m	70	m		5	
		7	Sampling System	Automatic rotary cross cut type samplers (800 t/h)	3	units		5	
				Core type truck probe (200 t/h)	1	units		5	
		8	Dust Collecting System	Dust emission prevention	1	units		5	
		9	Explosion Preventing System	Dust suppression	1	units		5	
		10	Temperature Sensing System	Sensing temperature of grains in silos	1	units		5	
4	Silos	1	Main Silos	Steel silo bins (excl. concrete cone bottom), 5,000 t capacity, Dia.18.3 m; H = 36.0 m	20	units		8	
		2	Buffer Silos	Steel silo bins (cone btm), 5000 t cap. each Diameter = 9.00 m; total height = 16 m	3	units		4	
5	Delivery Conveyor Line System	1	Conveyor System From Silo System to Ship Loader	Chain conveyors, 2 lines x (110m+45m+30m+550m), 800 t/h	1,470	m		5	
				Bucket elevator, 800 t/h	2	units		5	
		2	Conveyor System From Silo System	Chain conveyors, 1 line x 30m, 200 t/h	30	m		5	
			to Wagon Loading Chute	Bucket elevator, 200 t/h	1	units		5	
		3	Conveyor System From Silo System	Chain conveyors, 1 line x 15m, 100 t/h	15	m		5	
			to Truck Loading Chute	Bucket elevator, 100 t/h	1	units		5	
6	Loading / Delivery System	1	Ship Loader	Bucket elevator, with swing type dustless telescopic chute 800 t/h, vessels up to 65,000 DWT	2	units		4 + 2	
		2	Railway Wagon Loading System	Dustless telescopic chute, 200 t/h capacity	2	units		4 + 2	
		3	Road Truck Loading System	Dustless telescopic chute, 100 t/h capacity	1	units		4 + 2	
7	Common System	1	Truck Scale System	Weigh bridge, electronic, 100 t	2	units		4	
		1	Control System	Equipment/system control, automatic/sequential operation	1	units		4	
				Inventory management					
		2	Communication System	Internal communication system	1	units		4	
				External communication system					
		3	Fire Fighting System	Hydrants	1	units		4	
8	Assisting Equipment	1	Front bucket wheel loader	"Bobcat" For barge/vessel hold bottom cleaning	3	units		4	
		2	Forklift	5 t lifting capacity For maintenance work, etc., general use	1	units		4	
9	Others	1	Auxiliary Equipment	-	1	units		4	
10	Spare Parts	1	Spare Parts, etc.		1	units		4	



Legend
▬ ▪ ▬ ▪ ▪ Installation of steel silo bins
▬ ▪ ▬ ▪ ▪ Installation of equipment except steel silo bins
▪▪▪▪▪▪▪▪▪▪ Testing and commissioning

Table 8.5.4 Construction Schedule (Barge Terminal: 2006/2007)

No.		Works	Specifications	Unit	Quantity	Perform per Month	Required Month	Notes
1	Mobilization and Demobilization			LS	1		3	
2	Temporary Works			LS	1		2	
3	Site Preparation							
	3.1	Demolishing and Removal	Sunk vessels	LS	1		6	
	3.2	Removal and Reuse		LS	0			
4	Dredging and Reclamation							
	4.1	Borrowing and Reclamation	Borrowing from the canal bank	m3	0			
	4.2	Dredging and Reclamation		mj3	0			
5	Soil Improvement							
	5.1	Replacement of Soft Layers		m3	0			
	5.2	Preloading and Consolidation		m3	0			
6	Supplemental Tugboat Basin							
	6.1	Dredging and Disposal	150*300*2m	m3	90000	30000	3	
	6.2	Quaywall	Gravity wall type: -4.5m	m	450	70	7	
	6.3	Apron Pavement	20m wide, Concrete: 25cm	m2	9000	2000	4.5	
	6.4	Utilities	Lighting, Water supply	m	450		2	
	6.5	Drainage		m	450		2	
	6.6	Fittings	Fenders and Mooring Fittings	m	450		2	
7	West Barge Operation Main Quay							
	7.1	Dredging and Disposal	700*10	m3	7000		1	
	7.2	Quaywall	Gravity wall type: -4.5m	m	700	200	3.5	
	7.3	Apron Pavement	20m wide, Concrete: 25cm	m2	14000	3500	4	
	7.4	Utilities	Lighting, Water supply	m	700		2	
	7.5	Drainage		m	700		2	
	7.6	Fittings	Fenders and Mooring Fittings	m	700		2	
8	Improvement of West Access Road							
	8.1	Pavement, Overlay	Asphalt, 3,000m*12m	m2	36000	9000	4	
	8.2	Lighting		m	3000	1000	3	
9	North Barge Stand-by Dolphins							
	9.1	Dredging and Disposal	1020*10	m3	10200	2000	5.1	
	9.2	Improvement of Existing Dolphins	Gravity wall type: -4.5m	Unit	18	6	3	
	9.3	Apron Pavement	20m wide, Concrete: 25cm	m2	24400	8000	4	
	9.4	Utilities	Lighting, Water supply	Unit	0			
	9.5	Drainage		Unit	0			
	9.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	Unit	18		2	
10	North Barge Preparation Quays							
	10.1	Dredging and Disposal	600*10	m3	6000	2000	3	
	10.2	Quay	Gravity wall type: -4.5m	m	600	150	4	
	10.3	Apron Pavement	20m wide, Concrete: 25cm	m2	12000	4000	3	
	10.4	Utilities	Lighting, Water supply	m	0			
	10.5	Improvement of Existing Fittings	Fenders and Mooring Fittings	m	0			
	10.6	Improvement of Existing Mole	Grading and Pavement	m2	6000	2000	3	
11	South Barge Stand-by Dolphins							
	11.1	Dredging and Disposal	700*10	m3	7000	2000	3.5	
	11.2	Dolphins	Gravity wall type: -4.5m	Unit	11	3	3.7	
	11.3	Apron Pavement	20m wide, Concrete: 25cm	m2	7000	2000	3.5	
	11.4	Utilities	Lighting, Water supply	Unit	0			
	11.5	Improvement of Existing Fittings	Fenders and Mooring Fittings	Unit	11		2	
12	South Barge Preparation Quays							
	12.1	Dredging and Disposal	500*10	m3	5000	2000	3.5	
	12.2	Quay	Gravity wall type: -4.5m	m	500	150	4.8	
	12.3	Apron Pavement	20m wide, Concrete: 25cm	m2	10000	4000	2.5	
	12.4	Utilities	Lighting, Water supply	m	0			
	12.6	Improvement of Existing Facilities	Fenders/Fittings/ Grading	m	0			



CHAPTER 9 PRELIMINARY COST ESTIMATION

9.1 General Description

9.1.1 Objective of Cost Estimation

This chapter deals with the cost estimation of required facilities for the Short Term Development Plan for 2010, based on the Master Plan of Constantza Port for 2020 provided in the PART II “MASTER PLAN 2020”.

The Short Term Development Plan is principally based on the plan and design described in PART III at Chapters2 and 3, “Short Term Development Plan and Priority Projects”, Chapter 6 “Cargo Handling Equipment” and Chapter 7 “Preliminary Design of Major Port Facilities”.

The primary purposes of the cost estimates are: 1) to specify the financial requirements of each project component in the Short Term Development Plan and Priority Projects, 2) to summarize financial data to verify the necessity of the Short Term Development Plan, and 3) to establish the quantitative bases for both the Economic Analysis and Financial Analysis.

In addition to the cost data that obtained from CPA, reference is made to the cost data for the on-going Container Terminal Project located in the South Port (Existing Pier S2, Phase 1) and also to the other similar projects carried out by the Study Team.

The Study Team has received valuable data, information, advice and criticism (in some cases) from IPTANA which is a leading Romanian port consultant and an associated local consultant for the project.

9.1.2 Scope of Cost Estimation

The required project costs estimated here include the major costs incurred constructing and operating the components based on the Short Term Development Plan issued for the target year 2010. The construction costs (or initial investment cost) will include civil and building works, utilities, cargo handling equipment and facilities necessary for environmental protection.

The major terminals and facilities that have been included in this cost estimation are the following:

Group F “First Priority”
F1) Grain Terminal
F2) Barge Terminal

Group S “Secondary Priority”
S1) Inland Transport Facilities, Gate 5 Access

Group F includes certain project components, which should be urgently implemented as a result of the high traffic demand. However, the works classified in the Group S are also important projects to the Project.

As indicated in the PART II Chapter 3, future cargo traffic demand is estimated for two scheme ş namely Case 1 “High Scenario” and Case 2 “Medium Scenario” . Case 1 was finally selected for the Master Plan study, together with Short Term Development Plan. Thus cost estimation in this chapter is for the facilities required to meet the traffic demand of Case 1 “High Scenario”.

The site selection for the grain terminal was complicated due to the various possibilities in selecting the best location. For this purpose, the Study Team evaluated the technical feasibility among three options. To meet these requirements, the study team prepared three cost alternatives: namely,

Alternative 1: To construct a new terminal at the existing Berth Nos. 31 to 33.
Alternative 2: To construct a new terminal at the existing South Pier S1.
Alternative 3: To construct a new terminal at the new South Pier S3.

Alternative study at Pier S3 was carried out evaluating the Original S3 Layout with 220m slip and the modified S3 Layout with 400m slip. As shown in PART III Chapter 2, the Alternative 3 with a 400m slip layout was finally selected by the Study Team. Thus a detailed cost estimation for only this alternative will be carried.

9.1.3 Costs Criteria

The basic conditions and assumptions applied for the cost estimates are the following:

(a) The cost estimations are based on the market prices prevailing in September 1999, namely the prices in December 2000 obtained by the study team consisting of construction materials, labor rates and construction equipment rates in Constantza and other regions in the country.

It is assumed that price fluctuation is negligible when converted to US dollars and compared between September 1999 and December 2000.

(b) The following average exchange rate is used for this cost estimation:

December 2000: US$ 1.00 = 110 Yen = 26,000 lei

(c) The quantities of works were take-out from the layout drawings and deduced from topographic, soil and other data collected at the present time as shown in PART III Chapters 2 and 7.

(d) Construction methods as shown in Chapter 8 were studied and applied to the cost estimation.

(e) The wage rates and the local material costs are examined on the basis of Romanian labor law and on current market prices.

(f) Physical contingency is assumed to be about 10% of the Civil Construction Works, including building and utilities. However, a 5 % contingency is to be provided for the cargo handling equipment since there is a slight possibility to have to deal with some cost increase because of physical conditions.

In addition, the data and information of the on-going S2 Container Terminal related to present costs, were fully utilized to maintain the compatibility and harmony with other projects.

9.1.4 Subdivision of Foreign Costs and Local Costs

In order to calculate the economic pricing needed for the Economic Analysis, costs are roughly divided into Foreign Cost and Local Cost, based on actually experience in the similar projects. The foreign cost generally includes the following:

(a) Expatriate staff and labor employed directly for the Works;

(b) Social insurance, medical care and other charges related to such expatriate staff and labor, including foreign travel expenses;

(c) Imported materials, both temporary and permanent, including fuel, oil and lubricants required for the Works;

(d) Depreciation and usage of the imported Plant and Contractor’s Equipment, including spare parts, required for the Works;

(e) foreign insurance and freight charges for the imported materials, Plant and Contractor’s Equipment, including spare parts; and

(f) Overhead expenses, fees, profit, and financial charges arising outside of Romania and that are in connection with the Works.

In this estimation, a proportion of each component has also been entered based on the previous experience in similar projects.

9.1.5 Application of Taxes and Duties for the Financial Costs

The following taxes and duties are considered for the financial costs.

(a) Value added tax (VAT) of 19%. For estimating purpose, each component of unit prices is computed on the basis of prices without VAT which will be added later to the Cost. The former will be applied to the economic evaluation and the latter will be used in the financial analysis.

(b) A duty of 20% over CIF cost of imported materials is imposed for permanent works (Ordinance No.673/1991). In the estimate of civil works, 20% of foreign cost is assumed on imported materials. For the estimate of equipment works, 80% of foreign cost is assumed on imported materials.

On the temporary import of construction machinery, customs duty is not imposed.

(c) In order to simplify the cost estimation, profit tax and Construction Authorization fees will not be considered.

9.1.6 Economic Cost and Financial Cost

There are two cost categories: namely, Economic Costs and Financial Costs. The first component consists of the net cost, excluding the non-real cost incurring to the country. For example, the tax portion (such as VAT) is a project expenditure needed for its implementation; however it is not a real cost for the country's economy due to the fact that it brings in some income to the country. The land purchase cost is also excluded from the economic cost.

Financial cost covers all the costs as they trade in the city markets. This includes taxes, duties, land cost and other similar cost.

This chapter deals firstly with the Economic Cost, then Financial Cost will be discussed roughly. More detailed discussion about the Financial Cost will be provided in PART III Chapter 11.

9.1.7 Cost Subdivision by Investors

According to past experience for investment and operation at port terminal development, works are classified by the combination of investors: namely, the public sector (like MOT and CPA) and the private sectors (operators). These two sectors have the main roles in the investment and/or operation.

Table 9.1.1 Two Sectors Participation Alternatives in Investment and Operation

Alternative	Sector	Facility Civil Works	Facility C.H. Equipment	Operation	Remarks
Alt.-1	Public Sector	●	●	●	
	Private Sector				
Alt.-2	Public Sector	●	●		On-going container terminal SII
	Private Sector			○	
Alt.-3	Public Sector	●			Proposed grain terminal SIII
	Private Sector		○	○	
Alt.-4	Public Sector				
	Private Sector	○	○	○	

Notes:
1. Scope of cargo handling equipment contains the related civil works.
2. This subdivision will be affected by the expected financial sources to the project.

According to world port terminal development, Alternatives 2,3,4 are most possible cases. On-going container terminal project is formulated as Alternative 2. Considering the project characteristics, it is recommended to develop the new grain terminal by Alternative 3. Thus the proposed project is divided into public sector investment (Civil works) and private sector investment (Cargo handling equipment including related civil works).

9.2 Cost Classification

The required costs are divided into four (4) categories whose basic characteristics are shown in Table 9.2.1

Table 9.2.1 Basic Characteristics of Cost Categories

Cost Categories	Type			Note and Remarks
	Civil Works	Equipment	Total	
(1) Capital Costs	X	X	X	Investment required before the commencement of operation.
(2) Replacement Costs		X		Replacement of the equipment after its life time
(3) Maintenance Costs	X	X		Maintenance of civil facilities and equipment
(4) Operation Costs			X	Required cost to operate the terminal.

In order to clarify the basic contents, the following subsection outlines an explanation of each cost item. Among these four cost items, capital costs are the most important because they have a decisive influence on project feasibility.

Capital costs generally comprise those for civil works, equipment procurement, engineering services, and administration cost and tax and duties.

9.2.1(A) Capital Costs: Civil Works

(1) Costs Contents

The civil work construction costs comprise Direct Construction Costs, Indirect Construction Costs and the Contractor's Indirect Costs, as shown in Table 9.2.2.

Table 9.2.2 Composition of Construction Costs

Construction costs	- Direct construction costs	- Labor costs - Material Costs - Equipment Costs - Other component of the costs
	- Indirect construction costs	- Temporary facilities - Mobilization costs
	- Contractor's Indirect costs (Overhead)	- Site office expenses - Home office expenses - Profits

(2) Direct Construction Costs

The direct construction costs are estimated on the basis of the unit prices and the lump sum amounts consisting of labor cost, material cost machinery cost and subcontracting costs.

The labor Cost comprises the daily wages and the monthly personnel salaries directly implied in the works. This includes overtime, allowances, social insurance and so on.

The Material Cost comprises purchase prices and inland and/or ocean transportation costs of permanent materials used. Value added taxes and import duties are not included in the material costs at this stage.

The construction machinery cost comprises depreciation, repair, ownership and maintenance costs and also operating costs. Customs duty will not be imposed on temporary imports of machinery (Customs Law No. 626/1997).

(3) Indirect Construction Costs

Indirect Construction Costs comprise:

- Mobilization and demobilization of major construction equipment, plant and personnel
- Contractor’s temporary site facilities
- Engineer’s temporary site office
- Survey and laboratory equipment and operation

Mobilization and demobilization costs comprise costs for the ocean transportation of other construction equipment to be imported, the inland transportation of other major on-land construction equipment locally available and the transport and building of the construction plants.

The indirect construction costs are included in the unit price, except Mobilization/demobilization costs of dredgers.

(4) Contractor’s Indirect Costs

The Contractor’s Indirect Costs consist of site office expenses, and head office expenses and profits.

The site office expenses include the expenses for the contractor’s personnel offices on site, and the camp operation, office expense, labor recruitment and training, communications to and from site, local travel, insurance and bonds, stationery and security costs.

Head office expenses consist of the general administrative expenses, salaries and allowances for the contractor's head office personnel, and welfare expenses, financial cost and taxes etc.

The contractor's indirect costs are also included in the unit price.

9.2.1(B) Capital Costs: Cargo Handling Equipment Procurement

(1) Direct Contents

Equipment procurement costs consist of Direct Construction Costs, Indirect Construction Costs and the Contractor's Indirect Costs, as shown in Table 9.2.2.

(2) Direct Construction Costs

The cargo handling equipment procurement costs consist of the equipment cost and spare part costs as shown in Table 9.2.3. The manufacturer's indirect cost, overhead and profit are all included in the costs. Spare part costs are estimated to be 5% of equipment costs.

(3) Indirect Costs

Both indirect construction costs and contractor's (or manufacture's) indirect costs are incorporated in the unit price.

Table 9.2.3 Composition of Equipment Procurement Costs

Equipment Procurement Costs	- Equipment Costs	- Material and Manufacturing costs - Transportation Costs - Installation Costs - Test and Commissioning - Manufacturer's Indirect Cost, Overhead and Profit
	- Spare Part Costs	- Material and Manufacturing costs - Transportation Costs - Manufacturer's Indirect Cost, Overhead and Profit

9.2.1(C) Capital Costs: Engineering Fee

Engineering fees cover the required consulting costs for the design of facilities including preparation of tender documents and construction supervision costs. Engineering fees are assumed to be 7.5 % of the total capital costs, which consists of the construction and equipment cost.

9.2.1(D) Administration Cost

The administration cost of Implementation Agency **MOT (CPA)** for the project execution is assumed to be **5%** of the local currency portion. And this is actually included in the engineering services.

9.2.2 Replacement Cost for Cargo Handling Equipment

The service life of the equipment is situated between **5** and **30 years**, depending on the type of the equipment, whereas the required replacement costs are estimated. The breakdown is shown in Tables 9.2.4.

Table 9.2.4 Replacement Cost of Equipment: 2 million Ton Grain Terminal

Equipment name	Depreciation Period	Number Purchased	Classification	Procurement Cost (US$1,000)	Notes
1. Unloaders	20	1 lot	B	6,233	2 x 400 ton/hr
2. Receiving Conveyors	15	1 lot	C	4,338	
3. Storage System	15	1 lot	C	7,962	
4. Silos	30	1 lot	A	4,833	100,000 tons
5. Delivery Conveyors	15	1 lot	C	5,399	
6. Loaders	20	1 lot	B	7,040	2 x 800 ton/hr
7. Common System	30	1 lot	A	1,400	
8. Assisting Equipment	5	1 lot	D	260	
9. Miscellaneous Items	20	1 lot	B	350	Auxiliary

Notes 1. See Table 9.4.5 for reviewing more detailed information and equipment specifications.

As shown in the disbursement schedule presented in Section 9.6, these nine equipment items for the grain terminal are regrouped below according to the length of their service life or to their depreciation period.

Class A	(30 Years)	US$ 6.23 million
Class B	(20 Years)	US$ 13.62 million
Class C	(15 Years)	US$ 17.70 million
Class D	(5 Years)	US$ 0.26 million

9.2.3 Maintenance Cost of Terminal and Facility

In order to last long to meet the expected economic benefits, each facility should be have required service check-ups. This effort is needed to minimize the replacement and maintenance costs.

(1) Civil and Building Works

The civil and building works will periodically require maintenance and repair sessions. Based on the Consultant's experiences in other similar projects**,** 0.3% of construction cost is assumed to be necessary in this respect.

(2) Cargo Handling Equipment

The following maintenance rate cost is applied to this cost estimation.

Equipment: 3 % of the capital cost per year

9.2.4 Operation Cost of Terminal

The operation cost of a terminal varies according to the type of terminal and its scale.
For a terminal located along a river, this data would vary more according to the method of utilization.

The operation cost of a grain terminal is however rather flat, since the facilities provided in the terminal are commonly composed of same type of structures to other terminals and only few variations may occur. For a terminal located along a river, this data would also vary more according to the method of utilization.

The operation costs of each terminal generally consist of administration costs and cost incurred from operation staff, fuel and power costs as appropriate for cargo handling operations that are provided by the terminal.

The administration and operation costs for such terminals also covers the personnel salary required for terminal management and the operation organization, and other indirect costs.
The unit operation cost for cargo handling equipment in the Project, includes the required costs of fuel, energy consumption and other miscellaneous materials. The entire operational costs will be multiplied by the projected total throughput.

For these estimations, the following fuel unit prices are referenced:

Fuel (Diesel) : US$ 0.4/litter
Electricity : US$ 0.06 /kWh

Based on the data available from other similar projects in the past, the probable operation costs for each proposed terminal are assumed as follows:

(1) Grain terminal operation cost:

US$ 0.62 / ton

(2) Barge terminal operation cost per cargo weight:

US$ 0.050 / ton	for pusher services.
US$ 0.005 / ton	for barge services.

These assumptions were undertaken by taking into account the following considerations:

For Pusher	
1	Pusher would handle three convoys a day.
2	Operation cost of a pusher is assumed at about US$ 1,000.
3	Cargo carrying by three convoys will be: 3 x 6 x 1,500t = 27,000 tons
4	Thus the cost per ton is about: US$ 1,000 / 27,000 tons = US$ 0.037 / ton say US$ 0.05 / ton
Barge	
1	10% of pusher cost is applied, thus US$ 0.005 / ton

These data are only for reference purpose. More precise operation costs will be provided in Chapter 11, taking the actual operation conditions.

9.3 Capital Cost Estimation Summary

9.3.1 General Description of the Capital Cost Estimation

This section deals with the net capital cost requirements of the proposed projects for the Short Term Development Project. At this stage, only the economic cost, which does not contain tax and duties has been estimated. To convert this to a market price or finance cost, the tax and duties should be added.

To avoid any confusion in regards to the cost requirement and to keep it free from the inflationary impact of the local currency, US$ has been selected as the base currency for cost benchmarks. The US$ is one of the most stable hard currencies and the most convenient and appropriate to facilitate the receipt of external financial loans.

9.3.2 Summary of Capital Costs Required in Short Term Development

The summary of the total capital cost by priority project group calculated for the Short Term Development Project Components is shown in Table 9.3.1.

Table 9.3.1 Total Capital Costs of the Short Term Development Projects

First Priority Projects Group	**US$ 107.7 Million**	**90.1%**
Second Priority Projects Group	**US$ 11.8 Million**	**9.9%**
Total	**US$ 119.5 Million**	**100.0%**

Note: Figures are rounded thus total amount is not always equal to the mathematical total.

According to the summary of capital costs, the total capital costs needed for the Short Term Development Project Components is US$ 119.5 million, of which 90.1% is the First Priority Project cost.

The summary of capital cost for the First Priority Projects is shown in Table 9.3.2.

Table 9.3.2 Total Capital Costs of the First Priority Projects

Grain Terminal	**US$ 81.0 Million**	**75.2%**
Barge Terminal	**US$ 26.7 Million**	**24.8%**
Total	**US$ 107.7 Million**	**100.0%**

As shown above, the required total cost for the First Priority Projects is US$107.7 million consisting of US$81.0 million for constructing the Grain Terminal and US$26.7 million for the Barge Terminal

The first cost item covers the terminal and the facilities which are directly related to future grain cargo demand. However, the facilities categorized by the Barge Terminal classification are those for the required improvement and integration of better and more efficient port operations for river transport.

The summary of capital cost for the Second Priority Projects is shown in Table 9.3.3.

Table 9.3.3 Total Capital Costs of the Second Priority Projects

Inland Transport Facilities	**US$ 11.8Million**	**100.0%**
Total	**US$ 11.8 Million**	**100.0%**

The Second Priority Project Group consist of only one component: namely, Road Improvement for Inland Transport facilities. The total cost of this item is US$11.9 million.

Tables 9.3.4 and 9.3.5 present the capital cost composition in terms of cost item and currency requirement for the local and foreign components.

In Table 9.3.4, the cost components of the First Priority Projects are provided.

Table 9.3.4 Cost Components of the First Priority Projects

1.	**Civil Construction Works**	**US$ 53.9 million**	**50.0%**
2.	**Cargo Handling Equipment**	**US$ 38.9 million**	**36.1%**
3.	**Physical Contingency**	**US$ 7.3 million**	**6.8%**
4.	**Engineering Services**	**US$ 7.5 million**	**7.0%**
	Total	**US$ 107.7 million**	**100.0%**
1.	**Local Currency Component**	**US$ 46.2 million**	**42.9%**
2.	**Foreign Currency Component**	**US$ 61.5 million**	**57.1%**
	Total	**US$ 107.7 million**	**100.0%**

Note. Figures are rounded thus total amount is not always equal to the mathematical total.

As seen in the above table, the Civil Works are 50.0% and the Cargo Handling Equipment on the other hand requires some 36.1% of the investment. The total share of the physical contingency and the required costs for the engineering services isUS$14.8 million, or 13.8%.

The ratio of the local currency requirement is about 42.9%, indicating high use of foreign currency because of the high investment in foreign cargo handling equipment.

Table 9.3.5 presents the cost components of the Second Priority Projects.

Table 9.3.5 Cost Components of the Second Priority Projects

1.	Civil Construction Works	US$ 10.0 million	84.7
2.	Cargo Handling Equipment	US$ 0.0 million	0.0%
3.	Physical Contingency	US$ 1.0 million	8.5%
4.	Engineering Services	US$ 0.8 million	6.8%
	Total	US$ 11.8 million	100.0%
1.	Local Currency Component	US$ 5.1 million	43.2%
2.	Foreign Currency Component	US$ 6.7 million	56.8%
	Total	US$ 11.8 million	100.0%

Note. Figure is rounded thus total amount is not always equal to the mathematical total.

In the above table for the Second Priority Projects, the Civil Works are about 84.7% and no Cargo Handling Equipment is required. The total share of the physical contingency and the required cost of the engineering services are US$1.8 million, or 15.3%.

The foreign currency ratio requirement is 56.8%, attributed to the high ratio of bridge construction work components part of which may be implemented by foreign contractors.

9.4 Detailed Capital Cost Estimation

9.4.1 Summary

This section deals with the detailed capital cost estimation of the selected project components in four terminals and one supporting access road program.

The main purpose of the cost estimation is to provide important information to evaluate each project component contained in the Short Term Development Plan. As indicated in the title of the report, the final target of this study is preparation of recommendations for the top priority projects after the feasibility study.

Cost components were classified by various items indicated in Section 9.2. However, this detailed cost estimation covers only the capital costs.

Costs interrelate with the feasibility study in two areas: namely, the financial analysis and economic evaluation. The former covers the actual cash flow in project implementation and terminal operation in terms of revenue and expenditure. On the other hand, the latter covers the meaning and justification to use national resources for project components. Only justified components are candidates for implementation.

In order to simplify the estimation, economic cost is calculated first and then converted into the financial cost by adding the transfer cost items including tax and duties.

Financial cost items are provided in PART III Chapter 11. Discussion on this aspect is outlined in Section 9.6.

9.4.2 Data in the Tables

In order to define the Project Capital Cost required to implement the proposed Short Term Development Plan, the cost estimation is broken down and summarized.

There are nine tables namely;

a) Table 9.4.1 Summary of Capital Cost (1) - Group F: First Priority Projects - (for Economic Analysis)
b) Table 9.4.2 Summary of Capital Cost (2) - Group S: Secondary Priority Projects -
c) Table 9.4.3 Summary of Capital Cost (3) - Short Term Projects: Group F and S -
d) Table 9.4.4 Breakdown of Construction Cost (Grain Terminal: 2006/2007)
e) Table 9.4.5 Breakdown of Equipment Procurement Cost (Grain Terminal, Between 2006 and 2007）
f) Table 9.4.6 Breakdown of Construction Cost (Barge Terminal: 2006/2007)

g) Table 9.4.7 Breakdown of Construction Cost
(Inland Transport Facilities: Between 2006 and 2007)

The first three tables summarize cost data in terms of capital costs. Among these costs, the First Priority Projects, namely the ones for the **Grain Terminal and for the Barge Terminal** are included in the feasibility study.

These two important terminals will be implemented during 2006 and 2007 and will be ready for operation by the beginning of Year 2008. Section 9.6 presents the expenditure schedule for each terminal. More information are given in PART III Chapter 8, that is: ‘Construction Program and Project Implementation‘.

The following three tables (Tables 9.4.4 up to 6) show the contents of the capital costs that are investigated for **two First Priority Projects,** namely for the **Grain Terminal and Barge Terminal**. Table 9.4.5 indicates all the cargo handling equipment that is to be purchased for starting operation of Grain Terminal by the year 2008 with a two million tons capacity.

It is expected that no heavy investment will be done for cargo handling equipment as required for the Barge Terminal. It is however assumed that any smaller investment will be procured and placed at site by the operators assigned and appointed by specific concession contracts signed with CPA (MOT).

The last table covers the capital costs of the Inland Transport Facilities. Theses facilities as indicated in the Master Plan, PART II Chapter 6 covers a wide port area and various scope of works however the Inland Transport Facilities at this stage focuses only on the Gate 5 Access Improvement. It is an urgent requirement to modify the existing layout to achieve smooth traffic circulation.

Table 9.4.1 Summary of Capital Cost (1) - Group F: First Priority Projects - (for Economic Analysis),

Description of work	Grain Terminal (2004 - 2007), Alternative: S3			Barge Terminal (2004 - 2007)			Total Capital Costs (2004 - 2007), Group F: First Priority Projects		
	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)
1. Civil Construction	20,619	10,744	31,363	14,804	7,747	22,551	35,423	18,491	53,914
2. Cargo Handling Equipment	3,826	35,120	38,947	0	0	0	3,826	35,120	38,947
Subtotal (1 - 2)	24,445	45,865	70,310	14,804	7,747	22,551	39,249	53,611	92,861
3. Physical Contingency (10% / 5%)	2,253	2,830	5,084	1,480	775	2,255	3,734	3,605	7,339
Subtotal (1 - 3)	26,698	48,695	75,393	16,285	8,521	24,806	42,983	57,216	100,200
4. Engineering Services (7.5%)	2,002	3,652	5,655	1,221	639	1,860	3,224	4,291	7,515
Grand Total (1 -5)	**28,701**	**52,347**	**81,048**	**17,506**	**9,160**	**26,667**	**46,207**	**61,508**	**107,715**

Notes: 1. Physical contengency: Civil construction in 10%, Equipment in 5%

Table 9.4.2 Summary of Capital Cost (2) - Group S: Secondary Priority Projects -

Description of work	Inland Transport Facilities (2004 - 2007)			Total Capital Costs (2004 - 2007), Group S: Secondary Priority Projects		
	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)
1. Civil Construction	4,349	5,651	10,000	4,349	5,651	10,000
2. Cargo Handling Equipment	0	0	0	0	0	0
Subtotal (1 - 2)	4,349	5,651	10,000	4,349	5,651	10,000
3. Physical Contingency (10% / 5%)	435	565	1,000	435	565	1,000
Subtotal (1 - 3)	4,784	6,216	11,000	4,784	6,216	11,000
4. Engineering Services (7.5%)	359	466	825	359	466	825
Grand Total (1 -5)	**5,143**	**6,682**	**11,825**	**5,143**	**6,682**	**11,825**

Notes: 1. Physical contengency: Civil construction in 10%, Equipment in 5%

Table 9.4.3 Summary of Capital Cost (3) - Short Term Projects: Group F and S-

Description of work	Total Capital Costs (2004 - 2007), Group F: First Priority Projects			Total Capital Costs (2004 - 2007), Group S: Secondary Priority Projects			Total Capital Costs (2004 - 2007), Short Term Projects: Group F and Group S:		
	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)
1. Civil Construction	35,423	18,491	53,914	4,349	5,651	10,000	39,772	24,142	63,914
2. Cargo Handling Equipment	3,826	35,120	38,947	0	0	0	3,826	35,120	38,947
Subtotal (1 - 2)	39,249	53,611	92,861	4,349	5,651	10,000	43,599	59,262	102,861
3. Physical Contingency (10% / 5%)	3,734	3,605	7,339	435	565	1,000	4,169	4,170	8,339
Subtotal (1 - 3)	42,983	57,216	100,200	4,784	6,216	11,000	47,767	63,432	111,200
4. Engineering Services (7.5%)	3,224	4,291	7,515	359	466	825	3,583	4,757	8,340
Grand Total (1 -5)	46,207	61,508	107,715	5,143	6,682	11,825	51,350	68,190	119,540

Notes: 1. Physical contengency: Civil construction in 10%, Equipment in 5%

Table 9.4.4 Breakdown of Construction Cost (Grain Terminal: 2006/2007)

Unitn in US$

No	Works		Specifications	Unit	Quantity	Unit Price					Total Amount			Notes
						L.C		F.C		Total	L.C.	F.C.	Total	
						US$	%	US$	%	US$	US$	US$	US$	
1	Mobilization and Demobilization			LS	1	250000	25	750000	75	1,000,000	250,000	750,000	1000000	**Dredg
2	Temporary Works			LS	1	28000	80	7000	20	35,000	28,000	7,000	35000	**
3	Site Preparation													
	3.1	Demolishing and Removal	Obstacles	LS	1	0		0			0	0	0	
	3.2	Removal and Reuse	North Grion. 7 caissons	unit	7	148000	80	37000	20	185,000	1,036,000	259,000	1295000	ChpIII8
	3.3	Removal and Reuse	South Grion. 4 caissons	unit	4	148000	80	37000	20	185,000	592,000	148,000	740000	ChpIII8
		Subtotal									1628000	407000	2035000	**
4	Dredging and Reclamation													
	4.1	Borrowing and Reclamation	Borrowing from the canal bank	m3										
	1)	Mid-Pier . 875m*40m*19m		m3	332500	1.95	65	1.05	35	3	648,375	349,125	997500	ChpIII8
	2)	New Seawall. 675m*50m*19m		m3	320625	1.3	65	0.7	35	2	416,813	224,438	641250	ChpIII8
	3)	Terminal Site 1. 190m*325m*19m		m3	1173250	1.3	65	0.7	35	2	1,525,225	821,275	2346500	ChpIII8
	4)	Terminal Site 2. 675m*190m*0.5*19n	25%	m3	304594	1.3	65	0.7	35	2	395,972	213,216	609188	ChpIII8
		Subtotal			2130969						2986384	1608053	4594438	**
	4.2	Dredging and Reclamation		m3	0	2.5	50	2.5	50	5	0	0	0	**
5	Soil Improvement													
	5.1	Replacement of Soft Layers		m3	0	3	30	7	70	10	0	0	0	
	5.2	Preloading and Consolidation	2130969 x 5% = 106500m3	m3	106548	3	30	7	70	10	319,645	745,839	1065484	
		Subtotal									319645	745839	1065484	**
6	Main Quaywall													
	6.1	New Caisson	18 Caissons - 6 Caissons	unit	12	360750	65	194250	35	555000	4,329,000	2,331,000	6660000	
	6.2	Recycling Caissons	6 Caissons	unit	6	0	80	0	20	0	0	0	0	
	6.3	Caisson Foundation by Rocks	20m*3m*540m	m3	32400	9	60	6	40	15	291,600	194,400	486000	
	6.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*540m	m3	179550	4.8	60	3.2	40	8	861,840	574,560	1436400	
	6.5	Concrete capping and apron	16m	m2	8800	73.5	70	31.5	30	105	646,800	277,200	924000	
	6.6	Asphalt Pavement	9m	m2	4950	35	70	15	30	50	173,250	74,250	247500	
	6.7	Railways	3 Tracks for 300m	m	900	350	70	150	30	500	315,000	135,000	450000	
	6.8	Fittings	Fender and Moorings	m	550	300	30	700	70	1000	165,000	385,000	550000	
	6.9	Utilities		m	550	350	70	150	30	500	192,500	82,500	275000	
		Subtotal									6974990	4053910	11028900	**
7	Supplemental Quaywall													
	7.1	New Caisson	5 Caissons - 5 Caissons	unit	0	360750	65	194250	35	555000	0	0	0	
	7.2	Recycling Caissons	5 Caissons	unit	5	0	80	0	20	0	0	0	0	
	7.3	Caisson Rock Foundation	20m*3m*200m	m3	12000	9	60	6	40	15	108,000	72,000	180000	
	7.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*200m	m3	66500	4.8	60	3.2	40	8	319,200	212,800	532000	
	7.5	Concrete capping and apron	16m	m2	3200	73.5	70	31.5	30	105	235,200	100,800	336000	
	7.6	Asphalt Pavement	9m	m2	1800	35	70	15	30	50	63,000	27,000	90000	
	7.7	Railways		m	0	350	70	150	30	500	0	0	0	
	7.8	Fittings	Fender and Moorings	m	170	120	30	280	70	400	20,400	47,600	68000	
	7.9	Utilities		m	170	210	70	90	30	300	35,700	15,300	51000	
		Subtotal									781500	475500	1257000	**
8	West Seawall													
	8.1	Improvement of Existing Seawall	325m	m	325	400	80	100	20	500	130,000	32,500	162500	
	8.2	New Seawall	675m	m	675	3200	80	800	20	4000	2,160,000	540,000	2700000	
		Subtotal									2290000	572500	2862500	**
9	Railway located on-land													
	9.1	Center Tracks	3 Tracks for 300m	m	900	350	70	150	30	500	315,000	135,000	450000	
	9.2	Sidings	4 Tracks for 325m	m	1300	350	70	150	30	500	455,000	195,000	650000	
	9.3	Connection to outside	Single track for 675m	m	675	455	70	195	30	650	307,125	131,625	438750	
		Subtotal									1077125	461625	1538750	**
10	Terminal Site													
	10.1	Grading	325m*195m	m2	63375	2.4	80	0.6	20	3	152,100	38,025	190125	
	10.2	Pavement in Asphalt	20%	m2	12555	45.5	70	19.5	30	65	571,253	244,823	816075	
	10.3	Gravel Pavement	80%	m2	50220	12	80	3	20	15	602,640	150,660	753300	
	10.4	Silo, Superstructure : Steel made	See equipment cost			0		0			0	0		
	10.5	Silo, Concrete pile foundation	40cm*35m, 100000*1.1*0.5/10(	ea.	550	700	70	300	30	1000	385,000	165,000	550000	
	10.6	Supporting Steel Frames	300m2 * 0.15t/m2	ea.	20	31500	70	13500	30	45000	630,000	270,000	900000	
	10.7	Machinery Tower, Steel F. Structure	50m * 15m * 6Str.	m2	4500	140	70	60	30	200	630,000	270,000	900000	
	10.8	Substructure of Receiving/ L. Station	3*27m*3.5m	m2	284	175	70	75	30	250	49,613	21,263	70875	
	10.9	Terminal Office(Control/ Laboratory)	200m2 * 4	m2	800	350	70	150	30	500	280,000	120,000	400000	
	10.10	Maintenance shop	200m2	m2	200	350	70	150	30	500	70,000	30,000	100000	
	10.11	Substructure of Weigh-bridge	See equipment cost	m2	300	175	70	75	30	250	52,500	22,500	75000	
	10.12	Substructure of Clearing Equipment		m2	20	175	70	75	30	250	3,500	1,500	5000	
	10.13	Transformer Station House		m2	200	350	70	150	30	500	70,000	30,000	100000	
	10.14	Transformer		LS	1	175000	70	75000	30	250000	175,000	75,000	250000	
	10.15	Emargency Generator		ea.	1	175000	70	75000	30	250000	175,000	75,000	250000	
	10.16	Lighting		unit	1	84000	70	36000	30	120000	84,000	36,000	120000	
	10.17	Utilities		unit	1	140000	70	60000	30	200000	140,000	60,000	200000	
		Subtotal									4070605	1609770	5680375	**
11	Fence and Gates													
	11.1	Security Fence	Height in 2.1m steel	m	1370	120	80	30	20	150	164,400	41,100	205500	
	11.2	Gates		unit	2	24000	80	6000	20	30,000	48,000	12,000	60000	
											212400	53100	265500	**
		Tatal									**20618650**	**10744297**	**31362947**	
		share									65.7%	34.3%	100%	
	Total of Net Civil Work Cost		Items, 1 to 8								15258520	8619802	23878322	
											63.9%	36.1%	100%	
	Total of Equipment Related Cost		Items, 9, 10 and 11								5360130	2124495	7484625	
											71.6%	28.4%	100%	

Notes 1. L.C: Local Components , F,C : Foreign Components

2. Refer to Part III Chapter 8 for the construction method of reuse of existing caisson and derdging cost.

3 Total of Net Civil Work Cost will be invested by Public Sector.

4 Total of Equipment Related Cost will be invested by Private Sector.

Table 9.4.4L220 BREAKDOWN OF CONSTRUCTION COST
(Grain Terminal: 2006/2007)

Unitn in US$

No	Works		Specifications	Unit	Quantity	Unit Price					Total Amount			Notes
						L.C		F.C		Total	L.C.	F.C.	Total	
						US$	%	US$	%	US$	US$	US$	US$	
1	Mobilization and Demobilization			LS	1	250000	25	750000	75	1,000,000	250,000	750,000	1000000	**Dredg
2	Temporary Works			LS	1	28000	80	7000	20	35,000	28,000	7,000	35000	**
3	Site Preparation													
	3.1	Demolishing and Removal	Obstacles	LS	1	0		0			0	0	0	
	3.2	Removal and Reuse		unit	0	148000	80	37000	20	185,000	0	0	0	
	3.3	Removal and Reuse		unit	0	148000	80	37000	20	185,000	0	0	0	
		Subtotal									0	0	0	**
4	Dredging and Reclamation													
	4.1	Borrowing and Reclamation	Borrowing from the canal banks	m3										
	1)	Mid-Pier . 825m*40m*19m		m3	313500	1.95	65	1.05	35	3	611,325	329,175	940500	ChpIII8
	2)	New Seawall. 250m*50m*19m		m3	118750	1.3	65	0.7	35	2	154,375	83,125	237500	ChpIII8
	3)	Terminal Site 1. 190m*325m*19m		m3	1E+06	1.3	65	0.7	35	2	1,525,225	821,275	2346500	ChpIII8
	4)	Terminal Site 2. 170m*400m*19m	25%	m3	387600	1.3	65	0.7	35	2	503,880	271,320	775200	ChpIII8
	5)	Terminal Site 2. 200m*150m*19m	25%	m3	142500	1.3	65	0.7	35	2	185,250	99,750	285000	ChpIII8
		Subtotal			2E+06						2980055	1604645	4584700	**
	4.2	Dredging and Reclamation		m3	0	2.5	50	2.5	50	5	0	0	0	**
5	Soil Improvement													
	5.1	Replacement of Soft Layers		m3	0	3	30	7	70	10	0	0	0	
	5.2	Preloading and Consolidation	2135600 x 5% = 106780m3	m3	106780	3	30	7	70	10	320,340	747,460	1067800	
		Subtotal									320340	747460	1067800	**
6	Main Quaywall													
	6.1	New Caisson (500-120)/37=10.3	10 Caissons	unit	10	360750	65	194250	35	555000	3,607,500	1,942,500	5550000	
	6.2	Recycling Caissons	6 Caissons	unit	0	0	80	0	20	0	0	0	0	
	6.3	Caisson Foundation by Rocks	20m*3m*400m	m3	24000	9	60	6	40	15	216,000	144,000	360000	
	6.4	Selected Backfill, gravel	(8*19m and 19*19m*0.5)*400m	m3	133000	4.8	60	3.2	40	8	638,400	425,600	1064000	
	6.5	Concrete capping and apron	16m	m2	8000	73.5	70	31.5	30	105	588,000	252,000	840000	
	6.6	Asphalt Pavement	9m	m2	4500	35	70	15	30	50	157,500	67,500	225000	
	6.7	Railways	3 Tracks for 300m	m	900	350	70	150	30	500	315,000	135,000	450000	
	6.8	Fittings	Fender and Moorings	m	550	300	30	700	70	1000	165,000	385,000	550000	
	6.9	Utilities		m	550	350	70	150	30	500	192,500	82,500	275000	
	7.0	Mooring Dolphin		ls	1	325000	65	175000	35	500000	325,000	175,000	500000	
		Subtotal									6,204,900	3,609,100	9814000	**
7	North Head Quaywall													
	7.1	New Caisson		unit	0	360750	65	194250	35	555000	0	0	0	
	7.2	Recycling Caissons		unit	0	0	80	0	20	0	0	0	0	
	7.3	Caisson Rock Foundation		m3	0	9	60	6	40	15	0	0	0	
	7.4	Selected Backfill, gravel	19x19mx0.5x200m	m3	36100	4.8	60	3.2	40	8	173,280	115,520	288800	
	7.5	Concrete capping and apron	240mx16m	m2	3840	73.5	70	31.5	30	105	282,240	120,960	403200	
	7.6	Asphalt Pavement		m2	0	35	70	15	30	50	0	0	0	
	7.7	Railways		m	0	350	70	150	30	500	0	0	0	
	7.8	Fittings		m	0	120	30	280	70	400	0	0	0	
	7.9	Utilities		m	0	210	70	90	30	300	0	0	0	
		Subtotal									455520	236480	692000	**
8	West Seawall													
	8.1	Improvement of Existing Seawall	325m	m	325	400	80	100	20	500	130,000	32,500	162500	
	8.2	New Seawall		m	150	3200	80	800	20	4000	480,000	120,000	600000	
		Subtotal									610000	152500	762500	**
9	Railway located on-land													
	9.1	Center Tracks	3 Tracks for 300m	m	900	350	70	150	30	500	315,000	135,000	450000	
	9.2	Sidings	4 Tracks for 325m	m	1300	350	70	150	30	500	455,000	195,000	650000	
	9.3	Connection to outside	Single track for 675m	m	675	455	70	195	30	650	307,125	131,625	438750	
		Subtotal									1077125	461625	1538750	**
10	Terminal Site													
	10.1	Grading	325m*195m	m2	63375	2.4	80	0.6	20	3	152,100	38,025	190125	
	10.2	Pavement in Asphalt	20%	m2	12555	45.5	70	19.5	30	65	571,253	244,823	816075	
	10.3	Gravel Pavement	80%	m2	50220	12	80	3	20	15	602,640	150,660	753300	
	10.4	Silo, Superstructure : Steel made	See equipment cost			0		0			0	0		
	10.5	Silo, Concrete pile foundation	40cm*35m, 100000*1.1*0.5/100	ea.	550	700	70	300	30	1000	385,000	165,000	550000	
	10.6	Supporting Steel Frames	300m2 * 0.15t/m2	ea.	20	31500	70	13500	30	45000	630,000	270,000	900000	
	10.7	Machinery Tower, Steel F. Structure	50m * 15m * 6Str.	m2	4500	140	70	60	30	200	630,000	270,000	900000	
	10.8	Substructure of Receiving/ L. Station	3*27m*3.5m	m2	284	175	70	75	30	250	49,613	21,263	70875	
	10.9	Terminal Office(Control/ Laboratory)	200m2 * 4	m2	800	350	70	150	30	500	280,000	120,000	400000	
	10.10	Maintenance shop	200m2	m2	200	350	70	150	30	500	70,000	30,000	100000	
	10.1	Substructure of Weigh-bridge	See equipment cost	m2	300	175	70	75	30	250	52,500	22,500	75000	
	10.12	Substructure of Clearing Equipment		m2	20	175	70	75	30	250	3,500	1,500	5000	
	10.1	Transformer Station House		m2	200	350	70	150	30	500	70,000	30,000	100000	
	10.14	Transformer		LS	1	175000	70	75000	30	250000	175,000	75,000	250000	
	10.2	Emargency Generator		ea.	1	175000	70	75000	30	250000	175,000	75,000	250000	
	10.16	Lighting		unit	1	84000	70	36000	30	120000	84,000	36,000	120000	
	10.2	Utilities		unit	1	140000	70	60000	30	200000	140,000	60,000	200000	
		Subtotal									4070605	1609770	5680375	**
11	Fence and Gates													
	11.1	Security Fence	Height in 2.1m steel	m	1370	120	80	30	20	150	164,400	41,100	205500	
	11.2	Gates		unit	2	24000	80	6000	20	30,000	48,000	12,000	60000	
											212400	53100	265500	**
											16208945	9231680	25440625	
											63.7%	36.3%	100%	

Notes 1. L.C: Local Components , F,C : Foreign Components

2. Refer to Part III Chapter 8 for the construction method of reuse of existing caisson and derdging cost.

Table 9.4.5 BREAKDOWN OF EQUIPMENT PROCUREMENT COST:
- (Grain Terminal, Between 2006 and 2007 ）

X1,000US$

System		Equipment		Outline Specifications	Number	Unit	Foreign Components		Local Components		Total
							Unit Cost	Total Cost	Unit Cost	Total Cost	
1	Unloading / Receiving System	1	Barge/Vessel Unloader (For vessels up to 55,000 DWT)	Pneumatic type, with metal detector/ magnet separator 400 t/h capacity (2 x 200 t/h nozzles), with 10 t winch at boom top	2	units	2,400.0	4,800.0	240.0	480.0	5,280.0
		2	Railway Wagon Receiving System (Length x Breadth = 27.0 x 3.5 m)	400 t/h capacity with chain conveyors 1 line x 30m with metal detector/ iron separator	2	units	340.0	680.0	36.0	72.0	752.0
		3	Road Truck Receiving System (Length x Breadth = 18.0 x 3.0 m)	200 t/h capacity with chain conveyors x 70m with metal detector/ iron separator	1	units	180.0	180.0	21.0	21.0	201.0
			Sub-Total					5,660.0		573.0	6,233.0
2	Receiving Conveyor Line System	1	Conveyor System From Barge/Vessel Unloaders to the Grain Storage System	Chain conveyors, 1 line x (250m+25m+135m+125m) 800 t/h	560	m	3.0	1,680.0	0.3	168.0	1,848.0
				Bucket elevator 800 t/h	1	units	150.0	150.0	15.0	15.0	165.0
				Screening Device 800t/h	1	units	650.0	650.0	90.0	90.0	740.0
		2	Conveyor System From Railway Wagon Receiving System to Grain Storage System	Chain conveyors, 1 line x (35m+15m) 800 t/h	50	m	3.0	150.0	0.3	15.0	165.0
				Bucket elevator 800 t/h	1	units	150.0	150.0	15.0	15.0	165.0
				Screening Device 800t/h	1	units	650.0	650.0	90.0	90.0	740.0
		3	Conveyor System From Road Truck Receiving System to Grain Storage System	Chain conveyors, 1 line x (25m+70m) 200 t/h	95	m	1.5	142.5	0.2	19.0	161.5
				Bucket elevator 200 t/h	1	units	75.0	75.0	7.5	7.5	82.5
				Screening Device 200t/h	1	units	240.0	240.0	30.0	30.0	270.0
			Sub-Total					3,887.5		449.5	4,337.0
3	Grain Storage System	1	Bucket Elevators	800 t/h, chain bucket	6	units	150.0	900.0	15.0	90.0	990.0
				200 t/h, chain bucket	2	units	75.0	150.0	7.5	15.0	165.0
		2	Distributing Conveyors over Silos	800 t/h, chain conveyor, 6 line x 90m	540	m	3.0	1,620.0	0.3	162.0	1,782.0
				800 t/h, chain conveyor, 2 line x 45m	90	m	3.0	270.0	0.3	27.0	297.0
		3	Retrieving Conveyors under Silos	800 t/h, chain conveyor, 6 line x 90m	540	m	3.0	1,620.0	0.3	162.0	1,782.0
				800 t/h, chain conveyor, 2 line x 45m	90	m	3.0	270.0	0.3	27.0	297.0
		4	Weighing System	Bulk weighers/electronical, 800 t/h	4	units	30.0	120.0	3.0	12.0	132.0
				Bulk weighers/electronical, 200 t/h	2	units	15.0	30.0	1.5	3.0	33.0
		5	Fumigation System	Spraying of insecticide liquid and/or tablets for grains 800 t/h	1	units	100.0	100.0	10.0	10.0	110.0
		6	Drying System	Tower dryer, 100 t/h for reducing 5% of moisture	1	units	480.0	480.0	50.0	50.0	530.0
				200 t/h, bucket elevator	1	units	75.0	75.0	7.5	7.5	82.5
				100 t/h, bucket elevator	2	units	60.0	120.0	6.0	12.0	132.0
				100 t/h, conveyor, 1 line x 70m	70	m	1.0	70.0	0.2	14.0	84.0
		7	Sampling System	Automatic rotary cross cut type samplers (800 t/h)	3	units	360.0	1,080.0	50.0	150.0	1,230.0
				Core type truck probe (200 t/h)	1	units	30.0	30.0	5.0	5.0	35.0
		8	Dust Collecting System	Dust emission prevention	1	units	150.0	150.0	20.0	20.0	170.0
		9	Explosion Preventing System	Dust suppression	1	units	50.0	50.0	5.0	5.0	55.0
		10	Temperature Sensing System	Sensing temperature of grains in silos	1	units	50.0	50.0	5.0	5.0	55.0
			Sub-Total					7,185.0		776.5	7,961.5
4	Silos	1	Main Silos	Steel silo bins (excl. concrete cone bottom), 5,000 t capacity Diameter = 18.3 m; total height = 36.0 m	20	units	200.0	4,000.0	30.0	600.0	4,600.0
		2	Buffer Silos	Steel silo bins (cone bottom), 500 t capacity each Diameter = 9.00 m; total height = 16 m	3	units	70.0	210.0	7.5	22.5	232.5
			Sub-Total					4,210.0		622.5	4,832.5
5	Delivery Conveyor Line System	1	Conveyor System From Silo System to Ship Loader	Chain conveyors, 2 lines x (110m+45m+30m+550m) 800 t/h	1,470	m	3.0	4,410.0	0.3	441.0	4,851.0
				Bucket elevator 800 t/h	2	units	150.0	300.0	15.0	30.0	330.0
		2	Conveyor System From Silo System to Wagon Loading Chute	Chain conveyors, 1 line x 30m 200 t/h	30	m	1.5	45.0	0.2	6.0	51.0
				Bucket elevator 200 t/h	1	units	75.0	75.0	7.5	7.5	82.5
		3	Conveyor System From Silo System to Truck Loading Chute	Chain conveyors, 1 line x 15m 100 t/h	15	m	1.0	15.0	0.2	3.0	18.0
				Bucket elevator 100 t/h	1	units	60.0	60.0	6.0	6.0	66.0
			Sub-Total					4,905.0		493.5	5,398.5
6	Loading / Delivery System	1	Ship Loader	Bucket elevator, with swing type dustless telescopic chute 800 t/h, vessels up to 65,000 DWT	2	units	3,000.0	6,000.0	270.0	540.0	6,540.0
		2	Railway Wagon Loading System	Dustless telescopic chute, 200 t/h capacity	2	units	180.0	360.0	20.0	40.0	400.0
		3	Road Truck Loading System	Dustless telescopic chute, 100 t/h capacity	1	units	90.0	90.0	10.0	10.0	100.0
			Sub-Total					6,450.0		590.0	7,040.0
7	Common System	1	Truck Scale System	Weigh bridge, electronic, 100 t	2	units	130.0	260.0	15.0	30.0	290.0
		1	Control System	Equipment/system control, automatic/sequencial operation Inventory management	1	units	750.0	750.0	80.0	80.0	830.0
		2	Communication System	Internal communication system External communication system	1	units	100.0	100.0	10.0	10.0	110.0
		3	Fire Fighting System	Hydrants	1	units	150.0	150.0	20.0	20.0	170.0
			Sub-Total					1,260.0		140.0	1,400.0
8	Assisting Equipment	1	Front bucket wheel loader	"Bobcat" For barge/vessel hold bottom cleaning	3	units	60.0	180.0	5.0	15.0	195.0
		2	Forklift	5 t lifting capacity For maintenance work, etc., general use	1	units	60.0	60.0	5.0	5.0	65.0
			Sub-Total					240.0		20.0	260.0
9	Others	1	Auxiliary Equipment	-	1	units	300.0	300.0	50.0	50.0	350.0
10	Total	-	-	-	-	-	-	34,097.5	-	3,715.0	37,812.5
11	Spare Parts	1	Spare Parts, etc.	3%	1	units	-	1,022.9	-	111.5	1,134.4
12	Grand Total	-	-	-	-	-	-	35,120.4	-	3,826.5	38,946.9

Table 9.4.6 BREAKDOWN OF CONSTRUCTION COST
(Barge Terminal: 2006/2007)

Unit in US$

No.	Works		Specifications	Unit	Quantity	Unit Price					Total Amount			Notes
						L.C		F.C		Total	L.C.	F.C.	Total	
						US$	%	US$	%	US$	US$	US$	US$	
1	Mobilization and Demobilization			LS	1	250000	25	750000	75	1000000	250000	750000	1000000	**
2	Temporary Works			LS	1	400000	80	100000	20	500000	400000	100000	500000	**
3	Site Preparation													
	3.1	Demolishing and Removal	Sunk vessels	LS	1	250000	50	250000	50	500000	250000	250000	500000	
	3.2	Removal and Reuse		LS	0	0	80	0	20	0	0	0	0	
		Subtotal									250000	250000	500000	**
4	Dredging and Reclamation													
	4.1	Borrowing and Reclamation	Borrowing from the canal banks	m3	0	1.95	65	1.08	36	3	0	0	0	
	4.2	Dredging and Reclamation		m3	0	1.95	65	1.08	36	3	0	0	0	
		Subtotal									0	0	0	**
5	Soil Improvement													
	5.1	Replacement of Soft Layers		m3	0	3	30	7	70	10	0	0	0	
	5.2	Preloading and Consolidation		m3	0	3	30	7	70	10	0	0	0	
		Subtotal									0	0	0	**
6	Supplemental Tugboat Basin													
	6.1	Dredging and Disposal	150*300*2m	m3	90000	3.25	65	1.75	35	5	292500	157500	450000	
	6.2	Quaywall	Gravity wall type: -4.5m	m	450	2600	65	1400	35	4000	1170000	630000	1800000	
	6.3	Apron Pavement	20m wide, Concrete: 25cm	m2	9000	52.5	70	22.5	30	75	472500	202500	675000	
	6.4	Utilities	Lighting, Water supply	m	450	280	70	120	30	400	126000	54000	180000	
	6.5	Drainage	Storm water	m	450	140	70	60	30	200	63000	27000	90000	
	6.6	Fittings	Fenders and Mooring Fittings	m	450	210	70	90	30	300	94500	40500	135000	
	6.7	Others		m	450	140	70	60	30	200	63000	27000	90000	
		Subtotal									2281500	1138500	3420000	**
7	West Barge Operation Main Quay													
	7.1	Dredging and Disposal	700*10	m3	7000	3.25	65	1.75	35	5	22750	12250	35000	
	7.2	Quaywall	Gravity wall type: -4.5m	m	700	2600	65	1400	35	4000	1820000	980000	2800000	
	7.3	Apron Pavement	20m wide, Concrete: 25cm	m2	14000	52.5	70	22.5	30	75	735000	315000	1050000	
	7.4	Utilities	Lighting, Water supply	m	700	280	70	120	30	400	196000	84000	280000	
	7.5	Drainage		m	700	140	70	60	30	200	98000	42000	140000	
	7.6	Fittings	Fenders and Mooring Fittings	m	700	210	70	90	30	300	147000	63000	210000	
	7.7	Others		m	700	140	70	60	30	200	98000	42000	140000	
		Subtotal									3116750	1538250	4655000	**
8	Improvement of West Access Road													
	8.1	Pavement, Overlay	Asphalt, 3,000m*12m	m2	36000	14	70	6	30	20	504000	216000	720000	
	8.2	Lighting		m	3000	52.5	70	22.5	30	75	157500	67500	225000	
		Subtotal									661500	283500	945000	**
9	North Barge Stand-by Dolphins													
	9.1	Dredging and Disposal	1020*10	m3	10200	3.25	65	1.75	35	5	33150	17850	51000	
	9.2	Improvement of Existing Dolphins	Gravity wall type: -4.5m	Unit	18	700	70	300	30	1000	12600	5400	18000	
	9.3	Apron Pavement	20m wide, Concrete: 25cm	m2	24400	52.5	70	22.5	30	75	1281000	549000	1830000	
	9.4	Utilities	Lighting, Water supply	Unit	0	2800	70	1200	30	4000	0	0	0	
	9.5	Drainage		Unit	0	1400	70	600	30	2000	0	0	0	
	9.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	Unit	18	1400	70	600	30	2000	25200	10800	36000	
	9.7	Others		Unit	18	1400	70	600	30	2000	25200	10800	36000	
		Subtotal									1377150	593850	1971000	**
10	North Barge Preparation Quays													
	10.1	Dredging and Disposal	600*10	m3	6000	3.25	65	1.75	35	5	19500	10500	30000	
	10.2	Quay	Gravity wall type: -4.5m	m	600	2600	65	1400	35	4000	1560000	840000	2400000	
	10.3	Apron Pavement	20m wide, Concrete: 25cm	m2	12000	52.5	70	22.5	30	75	630000	270000	900000	
	10.4	Utilities	Lighting, Water supply	m	0	280	70	120	30	400	0	0	0	
	10.5	Drainage		m	0	140	70	60	30	200	0	0	0	
	10.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	m	0	210	70	90	30	300	0	0	0	
	10.7	Improvement of Existing Mole	Grading and Pavement	m2	6000	140	70	60	30	200	840000	360000	1200000	
	10.8	Others		m	600	140	70	60	30	200	84000	36000	120000	
		Subtotal									3133500	1516500	4650000	**
11	South Barge Stand-by Dolphins													
	11.1	Dredging and Disposal	700*10	m3	7000	3.25	65	1.75	35	5	22750	12250	35000	
	11.2	Dolphins	Gravity wall type: -4.5m	Unit	11	700	70	300	30	1000	7700	3300	11000	
	11.3	Apron Pavement	20m wide, Concrete: 25cm	m2	7000	52.5	70	22.5	30	75	367500	157500	525000	
	11.4	Utilities	Lighting, Water supply	Unit	0	2800	70	1200	30	4000	0	0	0	
	11.5	Drainage		Unit	0	1400	70	600	30	2000	0	0	0	
	11.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	Unit	11	1400	70	600	30	2000	15400	6600	22000	
	11.7	Others		Unit	11	1400	70	600	30	2000	15400	6600	22000	
		Subtotal									428750	186250	615000	**
12	South Barge Preparation Quays													
	12.1	Dredging and Disposal	500*10	m3	5000	3.25	65	1.75	35	5	16250	8750	25000	
	12.2	Quay	Gravity wall type: -4.5m	m	500	2600	65	1400	35	4000	1300000	700000	2000000	
	12.3	Apron Pavement	20m wide, Concrete: 25cm	m2	10000	52.5	70	22.5	30	75	525000	225000	750000	
	12.4	Utilities	Lighting, Water supply	m	0	280	70	120	30	400	0	0	0	
	12.5	Drainage		m	0	140	70	60	30	200	0	0	0	
	12.6	Improvement of Existing Fittings	Fenders and Mooring Fittings	m	0	210	70	90	30	300	0	0	0	
	12.7	Improvement of Existing Mole	Grading and Pavement	m2	7000	140	70	60	30	200	980000	420000	1400000	
	12.7	Others		m	600	140	70	60	30	200	84000	36000	120000	
		Subtotal									2905250	1389750	4295000	**
											14804400	7746600	22551000	
											65.6%	34.4%	100%	

Notes 1. L.C: Local Components, F.C: Foreign Components

Table 9.4.7 BREAKDOWN OF CONSTRUCTION COST

(Inland T. Facilities, Gate 5 Access; Between 2006 and 2007)

Description of work	Quantity	Unit	Unit Price					Total Amount		
			Local Component		Foreign Component		Total	Local Compo.	Foreign Compo.	Total
			(USD)	%	(USD)	%	(USD)	(1,000 USD)	(1,000 USD)	(1,000 USD)
1. INDIRECT CONSTRUCTION										
1.1. Mobilization, Temporary Facilities, etc.	5	%						**250**	**225**	**475**
2. CIVIL WORK										
2.1. Gate Platform , L=220m										
(1) Connection zone (10m wide x 110m)	1,100	m	520	40	780	60	1,300.0	572	858	**1,430**
(2)Gate Area Zone, (20m wide x 100m)	2,000	m	520	40	780	60	1,300.0	1,040	1,560	**2,600**
(3) Gate House	150	m2	400	80	100	20	500.0	60	15	**75**
(4) Gate	1	ls	12,000	80	3,000	20	15,000.0	12	3	**15**
(5) Fence , (2.1m steel)	210	m	120	80	30	20	150.0	25	6	**32**
(6) Utility	1	ls	80,000	80	20,000	20	100,000.0	80	20	**100**
Subtotal								1,789	2,462	**4,252**
2.2. Fly-over Bridges, L=330m										
(1) Bridge Section a), (45mx10mxH20m)	45	m	8,000	40	12,000	60	20,000	360	540	**900**
(2) Bridge Section b), (2x30mx10mxH17m)	60	m	6,800	40	10,200	60	17,000	408	612	**1,020**
(3) Bridge Section c), (60mx10mxH13m)	60	m	7,280	40	10,920	60	18,200	437	655	**1,092**
(4) Bridge Section d), (45mx10mxH12m)	45	m	4,800	40	7,200	60	12,000	216	324	**540**
(5) Bridge Section e), (4x30mx10mxH10m)	120	m	4,000	40	6,000	60	10,000	480	720	**1,200**
(6) Utility: Lighting	1	ls	40,000	80	10,000	20	50,000	40	10	**50**
Subtotal								**1,941**	**2,861**	**4,802**
2.3 Landing Zone to Port Area, L= 50m										
(1) Earth Mound (15m wide x 4mH)	50	m	960	80	240	20	1,200	48	12	**60**
(2) Asphalt Pavement (12m wide x 50m)	50	m	80	80	20	20	100	4	1	**5**
(3) Utility: Lighting	1	ls	16,000	80	4,000	20	20,000	16	4	**20**
Subtotal								**68**	**17**	**85**
2.4 Supplemental Works										
(1) Slope Protection (150m x 80m x 3mH)	150	m	1,920	80	480	20	2,400	288	72	**360**
(2) Others	1	ls	13,250	50	13,250	50	26,500	13	13	**27**
Subtotal								**301**	**85**	**387**
Total for Civil Works								**4,349**	**5,651**	**10,000**

9.5 Financial Cost for the Feasibility Study

9.5.1 Conversion of the Net Economic Cost to Financial Cost

As described in sub-section 9.4.1, there are two cost categories: namely, the Economic Cost and the Financial Cost. The former, discussed in the previous sections of this chapter, is the net cost excluding the non-real cost incurring to the country.

For example, the tax amount, such as VAT, is expenditure needed for project implementation; however, it is not a real cost for the country's economy because it brings in some income. The land purchase cost is also excluded from the economic cost.

Thus the financial cost covers all the costs which trade in the city markets. This includes tax, duties, land cost and other similar costs. An outline estimation of the financial cost is carried out in the following sections.

Financial Cost will be also discussed in detail in PART III Chapter 11.

9.5.2 Conversion Method

As discussed in subsection 9.1.5, tax and duty application is studied separately from the estimation of economic capital costs. In order to convert the economic costs to financial, the following conversion criteria has been set up::

(a) The 19% Value Added -Tax (VAT) is included to the financial costs.

(b) The 20% CIF duty for imported materials needed for the permanent works (Government Order No. 673/1991) is included. In regarding to the civil works, 20% of the estimated foreign cost is assumed to be for imported materials. When it comes to the estimating the equipment works, it is assumed that 80% of the estimated foreign costs will constitute imported materials.

(c) When dealing with temporary import of construction machinery, no custom duty is imposed.

In order to summarize this aspect of cost estimation, a simplified conversion system was separately introduced to the Civil Works and Cargo Handling Equipment.

Table 9.5.1 indicates the method of conversion from Economic Costs into Financial Costs

Table 9.5.1 Conversion from the Economic Costs to Financial Costs

Item	**Civil Works**		**Cargo Handling Equipment**	
1. Economic Costs	**L: Local**	**F: Foreign**	**L: Local**	**F: Foreign**
2. Duty	0	0.2*0.2=0.04	0	0.8*0.2=0.16
3. After Duty	L	1.04F	L	1.16F
(1+2)				
4. VAT	0.19L	0.19*1.04F=0.1976F	0.19L	0.19*1.16F=0.2204F
5. After VAT	**1.19L**	1.2376F	**1.19L**	1.3804F
(3+4)		**1.24F**		**1.38F**

Table 9.5.2 Summary of Capital Cost - Group F: First Priority Projects - (for Financial Analysis),

Description of work	Grain Terminal (2004 - 2007), Alternative: S3			Barge Terminal (2004 - 2007)			Total Capital Costs (2004 - 2007), Group F: First Priority Projects		
	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)
1. Civil Construction	15,259	8,620	23,878	14,804	7,747	22,551	30,063	16,366	46,429
1.1 Duty	0	345	345	0	310	310	0	655	655
1.2 VAT	2,899	1,703	4,602	2,813	1,531	4,344	5,712	3,234	8,946
Sub-total	18,158	10,668	28,826	17,617	9,587	27,204	35,775	20,255	56,030
2. Cargo Handling Equipment	40,481	5,951	46,432	0	0	0	40,481	5,951	46,432
2.1 Duty	0	952	952	0	0	0	0	952	952
2.2 VAT	7,691	1,312	9,003	0	0	0	7,691	1,312	9,003
Sub-total	48,172	8,215	56,387	0	0	0	48,172	8,215	56,387
Subtotal (1 - 2)	66,329	18,883	85,212	17,617	9,587	27,204	83,947	28,470	112,416
3. Physical Contingency (10% / 5%)	4,224	1,478	5,702	1,762	959	2,720	5,986	2,436	8,422
Subtotal (1 - 3)	70,554	20,360	90,914	19,379	10,546	29,925	89,933	30,906	120,839
4. Engineering Services (7.5%)	5,292	1,527	6,819	1,453	791	2,244	6,745	2,318	9,063
Grand Total (1 -5)	**75,845**	**21,887**	**97,732**	**20,832**	**11,337**	**32,169**	**96,678**	**33,224**	**129,902**

Notes 1. Physical contingency: Civil construction in 10%, Equipment in 5%,
2. Refer to more details in chapter 11.
3. Cost is rearranged to meet the Investment Pattern, see table blow.

Arrangement of the Estimated Cost to meet the Investment Pattern : Grain Terminal

Description of work	Basic Estimation			Investment Pattern			Cost Rearrengement		
	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)	Public Investment	Public & Private	Private Investment	Local Cost (1000 USD)	Foreign Cost (1000 USD)	Total (1000 USD)
1. Civil Construction							**Infrastructure Cost by Public Investment**		
1) Net Civil Works	15,259	8,620	23,878	$			15,259	8,620	23,878
2) Equipment Related Civil Works	5,360	2,124	7,485			$	0	0	0
3) Equipment	0	0	0			$	0	0	0
Sub-total	**20,619**	**10,744**	**31,363**				**15,259**	**8,620**	**23,878**
2. Cargo Handling Equipment							**Superstructure Cost by Privarte Investment**		
1) Net Civil Works	0	0	0	$			0	0	-
2) Equipment Related Civil Works	0	0	0			$	5,360	2,124	7,485
3) Equipment	35,120	3,826	38,947			$	35,120	3,826	38,947
Sub-total	**35,120**	**3,826**	**38,947**				**40,481**	**5,951**	**46,432**
Total	**55,739**	**14,571**	**70,310**				**55,739**	**14,571**	**70,310**

Note 1. See Table 9.4.4 for subdivision of Civil Construction Cost.
2 Infrastructure will be inveated by Public Sector.
3 Superstructure will be invested by Privarte Sector.

9.6 Disbursement Schedule

9.6.1 General Description

It is assumed that all the required investments are carried out properly according to the rearranged schedule, not too early and not too late. Thus the basic schedule is based on the implementation plan proposed in PART III Chapter 8.

This section deals with the Expenditure Plan in view of the economic aspect related to traffic demand and the implementation schedule. The data presented are directly interrelated with the economic analysis discussed in Chapter 10 “Economic Analysis“.

9.6.2 Disbursement Schedule in Economic Terms

As a summary of the above discussions, a disbursement schedule for a 30 year period, that is for two feasibility study items namely, **the Grain Terminal and Barge Terminal**, is presented in Tables 9.6.1 and 9.6.2. These tables contain only economic costs. In order to stay within the financial costs terms, so-called transfer items should be added, such as tax and duties, to the economic costs.

The dispersement schedule was prepared taking into account implementation of the project schedule in the following years:

(1) *Financial Arrangement* 2002/2003
(2) Detailed design in 2004
(3) International tender and contract in 2005
(4) Civil work construction and Cargo Handling Equipment procurement will be implemented in 2006/2007.
(5) Starting operation in the beginning, or at least the middle, of 2008

The most important date among these is the time imposed for the ***Financial Arrangement***.

The tables include the following cost items:

(1) Capital Costs
(2) Maintenance Costs
(3) Cargo Handling Equipment Replacement Costs
(4) Operation Costs (Preliminary)

The item that generates the largest impact in terms of project economy among the four, is ***Capital Costs*** due to its scale and earlier expenditure when compared to the others. This most-governing item covers the cost components of civil construction works, procurement of cargo handling equipment, possible costs of physical contingency and engineering services.

For loan financing, the Capital Costs are the items to be discussed between the Bank and the Borrowers. The operation costs are heavily related to the operation management system and either the public sector or private operator. A rough operation cost estimation was accordingly carried out for reference.

Refer to PART III Chapter 5 for more information on operation and privatization.

9.6.3 Tentative Disbursement Schedule in Financial Terms

The tentative Disbursement Schedule in Financial Terms was prepared taking into account the transfer cost items: namely, taxes, duties and others of similar nature.

As a summary of the above discussions, the financial disbursement schedule for a 30 year period of the two feasibility study items is presented in Tables 9.6.3and 9.6.4.

Note: Financial study should be incorporated with the investment entity. It is assumed that barge terminal will be invested by one entity, public sector. However, grain terminal will be invested by two sectors, namely, public sector and private sector. It is reported that financial analysis will be carried out separately with sector. In this respect, please refer to Chapter 11 for more details.

Table 9.6.1 Disbursement Schedule for Grain Terminal: Economic Cost: First Priority Project in Short Term Development

Unit in Million US$

Traffic Demand Forecast		**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Net and middle Volume	1000t	1,913	2,080	2,261	2,458	2,672	2,905	3,158	3,433	3,732	4,057	4,410	4,602	4,802	5,012	5,230	5,458	5,648	5,844	6,048	6,259	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477
Rate of New Capacity to Total Capacity: 2.0/(3.7+2.0)=0.351		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351
Throughput of New Terminal	1000t	0	0	0	0	0	0	0	0	1,310	1,424	1,548	1,615	1,686	1,759	1,836	1,916	1,982	2,051	2,123	2,197	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273

Capital Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (50%,50%)	mil US$							15.7	15.7																									
Equipment (50%,50%)	mil US$							19.5	19.5																									
Physical Contingency (50%,50%)	mil US$							2.54	2.54																									
Engineering Fee (50%,25%,25%)	mil US$					2.83		1.41	1.41																									
Total	mil US$				-	2.83		39.11	39.11			-					-	-	-	0	0	0	0	0	0	0	0	0	0	0				0
Maintenance Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (0.3%)	mil US$								0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.1035
Equipment (3.0%)	mil US$								1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.2268
Total	mil US$				-	-	-	-	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.3303
Replacement Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Equipment																																		
A. 30 year Life, US$6.23million	mil US$																																	6.23
B. 20 year Life, US$13.62million	mil US$																												13.62					
C. 15 year Life, US$17.70million	mil US$																							17.70										
D. 5 year Life, US$0.26million	mil US$													0.26					0.26					0.26					0.26					0.26
Total	mil US$													0.26					0.26					17.96					13.88					6.49
Operation Cost																																		
Operation, US$ 0.62/ Ton	mil US$				0.00	0.00	0.00	0.00	0.00	0.81	0.88	0.96	1.00	1.05	1.09	1.14	1.19	1.23	1.27	1.32	1.36	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Total	mil US$				0.00	0.00	0.00	0.00	0.00	0.81	0.88	0.96	1.00	1.05	1.09	1.14	1.19	1.23	1.27	1.32	1.36	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Total Costs		-	-	-	-	**2.83**	-	**39.11**	**40.44**	**2.14**	**2.21**	**2.29**	**2.33**	**2.64**	**2.42**	**2.47**	**2.52**	**2.56**	**2.86**	**2.65**	**2.69**	**2.74**	**2.74**	**20.70**	**2.74**	**2.74**	**2.74**	**2.74**	**16.62**	**2.74**	**2.74**	**2.74**	**2.74**	**9.23**

Notes
1 Refer to Table 9.4.1 for the detail of capital costs.
2 Annual maintenance cost ratio is 0.3% of the initial costs of civil works and 3% of the Cargo Handling Equipment costs.
3 Refer to Table 9.2.4 for the replacement cost of cargo handling equipment.
4 Operation cost is tentastive, refer to Sub-Section 9.2.4.
5 Allocated traffic to the project is estimated tentatively.
It is assumed that actual grain traffic will be divided by new grain terminal and the existing grain terniminals including capacity which may be increased in very near future. Rate of this distribution may be based on share in the terminal capacity.

Share= 2.0/ (3.7 + 2.0) = 0.351

Where:

Annual capacity of new grain terminal:	2.0 million tons
Annual capacity of existing grain terminal including planned capacity to be installed very near future(0.7million tons):	3.0 + 0.7 = 3.7 million tons

Table 9.6.2 Disbursement Schedule for Barge Terminal: Economic Cost : First Priority Project in Short Term Development

Unit in Million US$

Traffic by Modal Split	unit	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Cargo to be carried by Barges	1000t	10,914.5	11,419.3	11,947.4	12,499.9	13,078.0	13,682.8	14,315.6	14,977.6	15,670.3	16,394.9	17,153.2	17,451.4	17,754.9	18,063.7	18,377.8	18,697.4	19,022.5	19,353.3	19,689.9	20,032.3	20,380.7	20,735.1	21,095.7	21,462.5	21,835.8	22,215.5	22,601.8	22,994.9	23,394.7	23,801.6	24,215.5	24,636.6	25,065.0
Rate of Additional Capacity by Project to Total Capacity: 10mil.ton / (10mil.ton + 10mil.ton) = 0.5		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Throughput handled by New Terminal Facilites		0	0	0	0	0	0	0	0	7,835	8,197	8,577	8,726	8,877	9,032	9,189	9,349	9,511	9,677	9,845	10,016	10,190	10,368	10,548	10,731	10,918	11,108	11,301	11,497	11,697	11,901	12,108	12,318	12,533

Capital Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (50%, 50%)	milUS$							11.28	11.28																									
Equipment (50%, 50%)	milUS$							-	-																									
Physical Contingency(50%, 50%)	milUS$							1.13	1.13																									
Engineering Fee (50%, 25%,25%)	milUS$					0.93		0.47	0.47																									
Total	milUS$				-	0.93	-	12.87	12.87			-					-	-	-	0	0	0	0	0	0	0	0	0	0	0				0
Maintenance Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (0.3%)	milUS$								0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07442
Equipment (3.0%)	milUS$								-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total	milUS$				-	-	-	-	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07442
Replacement Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Equipment	milUS$																							-										
Total	milUS$																							-										
Operation Cost																																		
Pusher Operation $ 0.05 / ton	milUS$				0.00	0.00	0.00	0.00	0.00	0.39	0.41	0.43	0.44	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.57	0.58	0.60	0.61	0.62	0.63
Barge Operation $ 0.005 / ton	milUS$				0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Total	milUS$				0.00	0.00	0.00	0.00	0.00	0.39	0.41	0.43	0.44	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.57	0.58	0.60	0.61	0.62	0.63
(Refer to notes)																																		
Total Costs	milUS$	-	-	-	-	**0.93**	-	**12.87**	**12.94**	**0.47**	**0.48**	**0.50**	**0.51**	**0.52**	**0.53**	**0.53**	**0.54**	**0.55**	**0.56**	**0.57**	**0.58**	**0.58**	**0.59**	**0.60**	**0.61**	**0.62**	**0.63**	**0.64**	**0.65**	**0.66**	**0.67**	**0.68**	**0.69**	**0.70**

Notes

(1) Pusher operation
1 Pusher handles three convoys a day.
2 Operation cost of a pusher is assumed of US$ 1,000.
3 Cargo carriyng by three convoys will be: 3 x 6 x 1,500t = 27,000 tons
4 thus cost per ton is : US$ 1,000 / 27,000 tons = US$ 0.037 / ton say US$ 0.05 / ton

(2) Barge operation
1 There are many variation in type of barge, size/dimension, age and remaining life.
2 As the niture of barge, it has no engine thus no fuel requiremant. Also no crew and capatin.
3 As an average unit rate of a barge, 10% of unit cost per a pusher is tentively applied, thus US$ 0.005 / ton

(3) Impact of New Investment
1 One of reasons of barge terminal improvemenrt is to increase the existing barge terminal capacity to mitagate the present congesion in water basin and quay.
2 The existing capacity of barge handling is assumed of about 10 million tons of cargo per year.
3 The inclemental capacity of barge handling by new investment is also assumed of about 10 million tons of cargo per year.
4 Thus the ratio of additonal capacity by the project to the total capacity will be about 0.5.

Table 9.6.3 Disbursement Schedule for Grain Terminal: Financial Cost: First Priority Project in Short Term Development

Unit in Million US$

Traffic Demand Forecast		**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Net and middle Volume	1000t	1,913	2,080	2,261	2,458	2,672	2,905	3,158	3,433	3,732	4,057	4,410	4,602	4,802	5,012	5,230	5,458	5,648	5,844	6,048	6,259	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477	6,477
Rate of New Capacity to Total Capacity: 2.0/(3.7+2.0)=0.351		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351	0.351
Throughput of New Terminal	1000t	0	0	0	0	0	0	0	0	1,310	1,424	1,548	1,615	1,686	1,759	1,836	1,916	1,982	2,051	2,123	2,197	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273	2,273

Capital Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (50%,50%)	mil US$							14.4	14.4																									
Equipment (50%,50%)	mil US$							28.2	28.2																									
Physical Contingency (50%,50%)	mil US$							2.85	2.85																									
Engineering Fee (50%,25%,25%)	mil US$					3.41		1.70	1.70																									
Total	mil US$				-	3.41		47.16	47.16			-					-	-	-	0	0	0	0	0	0	0	0	0	0	0				0
Maintenance Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (0.3%)	mil US$								0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.0951
Equipment (3.0%)	mil US$								1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.7762
Total	mil US$				-	-	-	-	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.8713
Replacement Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Equipment																																		
A. 30 year Life, US$8.60million	mil US$																																	8.6
B. 20 year Life, US$18.80million	mil US$																												18.8					
C. 15 year Life, US$24.43million	mil US$																							24.43										
D. 5 year Life, US$0.36million	mil US$													0.36					0.36					0.36					0.36					0.36
Total	mil US$													0.36					0.36					24.79					19.16					8.96
Operation Cost																																		
Operation, US$ 0.74/ Ton	mil US$				0.00	0.00	0.00	0.00	0.00	0.97	1.05	1.15	1.20	1.25	1.30	1.36	1.42	1.47	1.52	1.57	1.63	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Total	mil US$				0.00	0.00	0.00	0.00	0.00	0.97	1.05	1.15	1.20	1.25	1.30	1.36	1.42	1.47	1.52	1.57	1.63	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
Total Costs		**-**	**-**	**-**	**-**	**3.41**	**-**	**47.16**	**49.03**	**2.84**	**2.92**	**3.02**	**3.07**	**3.48**	**3.17**	**3.23**	**3.29**	**3.34**	**3.75**	**3.44**	**3.50**	**3.55**	**3.55**	**28.34**	**3.55**	**3.55**	**3.55**	**3.55**	**22.71**	**3.55**	**3.55**	**3.55**	**3.55**	**12.51**

Notes 1 Estimation of cost after tax and duty for Equipment Replacement Cost:
(1+0.19) Economis Cost x (1+0.8x0.2) = ECx1.19x1.18 = 1.38EC

A. 30 year Life, 1.38 x US$6.23million = 8.60
B. 20 year Life, 1.38 x US$13.62million = 18.80
C. 15 year Life, 1.38 x US$17.70million = 24.43
D. 5 year Life, 1.38 x US$ 0.26million = 0.36

2 Financial Operation Cost, EC= Economic Cost

EC x (1 + 0.19) = 1.19xEC = 1.19 X 0.62 = US$ 0.74 / Ton

Table 9.6.4 Disbursement Schedule for Barge Terminal: Financial Cost : First Priority Project in Short Term Development

Unit in Million US$

Traffic by Modal Split	unit	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Cargo to be carried by Barges	1000t	10,914.5	11,419.3	11,947.4	12,499.9	13,078.0	13,682.8	14,315.6	14,977.6	15,670.3	16,394.9	17,153.2	17,451.4	17,754.9	18,063.7	18,377.8	18,697.4	19,022.5	19,353.3	19,689.9	20,032.3	20,380.7	20,735.1	21,095.7	21,462.5	21,835.8	22,215.5	22,601.8	22,994.9	23,394.7	23,801.6	24,215.5	24,636.6	25,065.0
Rate of Additional Capacity by Project to Total Capacity: 10mil.ton / (10mil.ton + 10mil.ton) = 0.5		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Throughput handled by New Terminal Facilites		0	0	0	0	0	0	0	0	7,835	8,197	8,577	8,726	8,877	9,032	9,189	9,349	9,511	9,677	9,845	10,016	10,190	10,368	10,548	10,731	10,918	11,108	11,301	11,497	11,697	11,901	12,108	12,318	12,533

Capital Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (50%, 50%)	milUS$							13.60	13.60																									
Equipment (50%, 50%)	milUS$							-	-																									
Physical Contingency(50%, 50%)	milUS$							1.36	1.36																									
Engineering Fee (50%, 25%,25%)	milUS$					1.12		0.56	0.56																									
Total	milUS$				-	1.12	-	15.52	15.52			-					-	-	-	0	0	0	0	0	0	0	0	0	0	0				0
Maintenance Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Civil Works (0.3%)	milUS$								0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.0898
Equipment (3.0%)	milUS$								-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Total	milUS$				-	-	-	-	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.0898
Replacement Cost																																		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Equipment	milUS$																							-										
Total	milUS$																							-										
Operation Cost																																		
Barge Operation $ 0.06 / ton	milUS$				0.00	0.00	0.00	0.00	0.00	0.39	0.41	0.43	0.44	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.57	0.58	0.60	0.61	0.62	0.63
Pusher Operation $ 0.006 / ton	milUS$				0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Total	milUS$				0.00	0.00	0.00	0.00	0.00	0.39	0.41	0.43	0.44	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.57	0.58	0.60	0.61	0.62	0.63
Total Costs	milUS$	**-**	**-**	**-**	**-**	**1.12**	**-**	**15.52**	**15.61**	**0.48**	**0.50**	**0.52**	**0.53**	**0.53**	**0.54**	**0.55**	**0.56**	**0.57**	**0.57**	**0.58**	**0.59**	**0.60**	**0.61**	**0.62**	**0.63**	**0.64**	**0.65**	**0.65**	**0.66**	**0.67**	**0.68**	**0.70**	**0.71**	**0.72**

Notes

(1) Pusher operation
1 Pusher handles three convoys a day.
2 Operation cost of a pusher is assumed of US$ 1,000.
3 Cargo carriyng by three convoys will be: 3 x 6 x 1,500t = 27,000 tons
4 thus cost per ton is : US$ 1,000 / 27,000 tons = US$ 0.037 / ton say US$ 0.05 / ton
5 Pusher operation cost after tax and duty: US$ 0.05 / ton X 1.19 = US$ 0.06 / ton

(2) Barge operation
1 There are many variation in type of barge, size/dimension, age and remaining life.
2 As the niture of barge, it has no engine thus no fuel requiremant. Also no crew and capatin.
3 As an average unit rate of a barge, 10% of unit cost per a pusher is tentively applied, thus US$ 0.005 / ton
4 Barge operation cost after tax and duty: US$ 0.005 / ton X 1.19 = US$ 0.006 / ton

(3) Impact of New Investment
1 One of reasons of barge terminal improvemenrt is to increase the existing barge terminal capacity to mitagate the present congesion in water basin and quay.
2 The existing capacity of barge handling is assumed of about 10 million tons of cargo per year.
3 The inclemental capacity of barge handling by new investment is also assumed of about 10 million tons of cargo per year.
4 Thus the ratio of additonal capacity by the project to the total capacity will be about 0.5.