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22 June 1981

USSR Report

TRANSPORTATION

(FOUO 5/81)

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OCEAN AND RIVER

ORGANIZING THE SEAPORT PROCESSING OF RO-RO AND OTHER VESSELS

Moscow GRUZOVYYE RABOTY V MORSKIKH PORTAKH in Russian 1979 (signed to press 13 Dec 79) pp 98-110, 125-126, 130

[Sections 30-32 and figures 12-14 from book "Cargo Handling Operations at Seaports", by Nikolay Fedorovich Lazarev, Izdatel'stvo "Transport", 2,000 copies, 224 pages]

[Text] Section 30. Specific Features of Organizing the Processing of Ro-Ro Vessels

Ro-Ro vessels are now being processed on a regular basis in Riga, Leningrad and other seaports in the country. Vessels of this type are used to carry trucks and automobiles, other wheeled and crawler equipment, cargo on trailers, semitrailers and heavy-load trailers, in containers and on flats, close-packed piece cargo, as well as certain timber and lumber and lengthy cargo. A number of vessels are capable of carrying refrigerated containers and liquid cargo in tanks.

Motor vehicles and other wheeled equipment and crawler machines can be driven on and off a Ro-Ro vessel under their own power or towed by port tractors. The tractors may be used to tow trailers and semitrailers loaded with containers and other cargo on and off the vessel. Cargo can also be vertically loaded and unloaded and stacked by cranes.

The Ro-Ro vessel has the necessary equipment for rolling the cargo on and off. Every vessel is equipped with a ramp that can be raised and lowered; when it is lowered to the dock, a passage is formed for wheeled and other machines to the main deck.

The ramps are usually located in the stern of the vessel. Ramps are set up for the machines to pass to the upper deck and into the hold, and in certain cases the hold and main deck are connected by elevators.

The spaces of the vessel and the upper deck are furnished with devices for fastening the cargo. Their regular equipment includes securing gear and made-up stays of various types, purposes, lengths and strengths. The containers and flat pallets are secured to the deck with hitches, and stays are used to secure the loads on pallets of the second and subsequent tiers.

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Most Ro-Ro vessels have two decks, their draft does not exceed 6 meters, and the engineroom is located in the stern. The holds and tweendecks are between 2.2 and 5.7 meters high, the stern door is between 3 and 6.1 meters high and between 3 and 6 meters wide.

Large-tonnage vessels of the Ro-Ro type, with a draft exceeding 6 meters, are built as a rule with the engineroom located amidships; they have several decks (from two to six), intermediate decks--for automobiles and palletized cargo.

Soviet seaports are visited by ships like the "Borodin" (a French vessel), "Inzhener Sukhorukov," "Inzhener Machul'skiy," "Inzhener Bashkirov," "Mekhanik Konovalov," "Skul'ptor Konenkov," "Magnitogorsk," etc. Data on certain types of vessels are given in Table 6.

Table 6

Name of Prototype Vessel of Series	Length, m	Beam, m	Draft, m	Deadweight Tonnage, t	Displacement, m^3	Speed, knots
"Inzhener Machul'skiy"	124.0	19.2	7.02	3,860 6,249	16,000	17.04
"Skul'ptor Konenkov"	181.0	28.2	9.64	11,400 17,500	33,150	20.50
"Kapitan Smirnov"	226.0	30.0	9.87	18,000	55,000	20.80
"Magnitogorsk"	205.8	31.0	9.70	22,690	15,709	22.00

Special cargo-handling complexes are set up to process Ro-Ro vessels. These complexes consist of the following: the dockside cargo-handling area; open areas for parking wheeled equipment, containers, flat pallets and other consolidated loads of cargo; the rear cargo-handling area with open and covered storage areas for the consolidated loads of cargo; buildings housing offices and workrooms and other facilities. The standard layout of the cargo-handling complex for processing container carriers and Ro-Ro vessels is shown in Figure 6.

The dockside cargo-handling area is for receiving, unloading and loading wheeled and other equipment, consolidated loads of cargo, and also cargo that will be stowed during shipment in tight stacks. It is here that the entire processing of the ship is done.

The dockside cargo-handling area includes berths with all equipment and machinery and other hydraulic engineering structures. To accommodate the ship's ramp the berth must have a fixed ramp that is inclined or can be raised and lowered, and bumpers. Use of both types of equipment helps to reduce the time required for mooring operations.

There should be no sharp turns in the road leading to the berth. If turns are inevitable, they must not hinder the movement of long trailers.

The equipment of the dockside area set aside for horizontal and vertical loading is unified and can be used together or separately depending on the specific conditions for performing cargo-handling operations.

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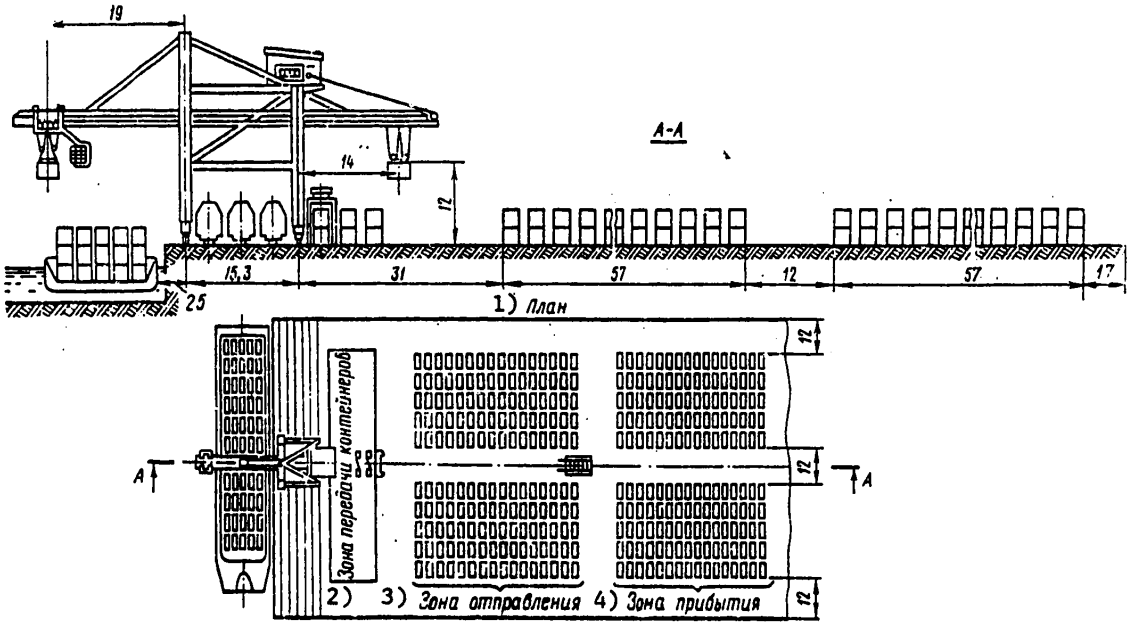

Figure 6. Layout of the container area for incoming and outgoing large-capacity containers.

Key: 1. Plan
2. Zone for deposit and pickup of containers
3. Outgoing container zone
4. Incoming container zone

In open areas for wheeled equipment and consolidated cargo units the cargo is assembled and prepared for loading on maritime vessels, cargo is received from vessels and prepared for loading in freight cars and trucks; and equipment for consolidating cargo units is located in these areas.

The rear cargo-handling area is used for loading and unloading railroad cars and trucks, for consolidating cargo units after unloading from land transportation (so that the cargo can be loaded more quickly and easily in the ports), and for breaking down cargo units unloaded from maritime vessels. It includes the operational area and the makeup storage area.

Switching and loading and unloading railroad tracks and roads are laid in the operations area; it has loading platforms for receiving long-distance highway trucks, buffer areas (where the cargo units are consolidated and passed on to the open areas for wheeled equipment), and also the machinery for performing cargo-handling operations.

The makeup storage area consists of two storage areas: a covered shed with a loading platform, railroad tracks and roads, and an open storage area. In the makeup storage area light and small pieces of cargo reaching the port by rail and truck

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are assembled and consolidated, consolidated cargo units arriving on vessels are broken down and loaded onto land transportation. Piece cargo that is stowed in tight stacks when carried by rail and on maritime vessels goes through the makeup storage area; it is consolidated in this area before loading on the vessel and also on board the vessel when it is being unloaded. It is broken down on the vessel when it is stowed in stacks in the holds and tweendecks, and it is also broken down as it is loaded into railroad cars and trucks.

Office and workroom facilities include workshops, a washing station, a filling station, and so on. Seaports are also being furnished specialized trailers, tractors, lift trucks and similar machines to process Ro-Ro vessels.

Fuller use of the capacity of Ro-Ro vessels and stepping up the pace of cargo-handling operations are achieved by using low-bed port semitrailers. They are low and have a simple construction. Special stubby tractors, which are highly maneuverable, are used in the loading and unloading of Ro-Ro trailers and in work with low-bed semitrailers.

Semitrailer lift trucks consisting of a semitrailer equipped with a container grab and a tractor which tows the semitrailer and operates the grab, are intended for the transport and stacking of containers and flat pallets. Straddle, front-loading and side-loading lift trucks are used in processing Ro-Ro vessels. They are distinguished by their low height and high maneuverability. For example, the Finnish lift trucks manufactured by the Valmet firm have a carrying capacity of 20 tons, a length of 5,420 mm, a width of 3,800 mm, and a height of 2,840 mm.

In the port of Riga 260 running meters of berths have been designated for processing Ro-Ro vessels. Sokol portal cranes with a capacity of 30 tons are lined up along the dock. The storage areas are located at a considerable distance from the docks. Cargo is made up in the storage area and is transported to the berth on trailers by Si-Su and Terberg tractors.

The ship is loaded through the stern ramp on 20-foot and 40-foot trailers. The front-loading LMV lift truck, which has a capacity of 25 tons and good maneuverability characteristics, is used to stack the containers and flat pallets.

In order to improve use of vessel-carrying capacity, they are in part loaded with separate pieces of cargo: packages, bales, and so on. These are delivered to the holds where they are stacked with front-loading lift trucks with a capacity of 1.5-12 tons. This detracts from the pace of cargo-handling operations.

A comparison of worker output when various methods are used to load the same cargo shows the high efficiency of horizontal cargohandling (on trailers with tractors). The output of workers under the different conditions is given in Table 7.

In the port of Leningrad the container terminal and specialized berths are equipped with Kone container carriers (PKP), portal cranes (PK), trestle container conveyors (KKP). Piper, Hermes and Midas internal-combustion container lift trucks, Terberg and Si-Su tractors (TCCh), and internal-combustion and electric lift trucks.

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Table 7

Conditions of Cargo-Handling Operations	Worker Output in Cargo-Handling, tons/man-shift				
	Cotton in Bales	Equipment in Boxes or Crates	Bag Cargo on Pallets	Cargo in Drums	Nonferrous Metals on Pallets
Loading and unloading of separate pieces of cargo by cranes into general-purpose vessels	16	23	13	13.7	18
Loading and unloading of separate pieces of cargo by general-purpose lift trucks into Ro-Ro vessels	40	34	18	--	38
Loading and unloading of containers and flat pallets into Ro-Ro vessels with specialized loading conveyors and cranes	68	--	50	79.0	--
Loading and unloading with specialized tractors and trailers into Ro-Ro vessels	89	96	64	97.0	96

There are various procedures for loading and unloading Ro-Ro vessels.

Equipping terminals and specialized berths makes it possible to do without portal cranes; loading and unloadingwith cranes considerably reduces the berthing time of ships and makes it possible to increase sharply the labor productivity of longshoremen. When Ro-Ro vessels are being processed, for example, wind and precipitation do not affect the pace of cargo-handling operations, which makes it possible to keep strictly to their operating schedule.

Wheeled equipment is being successfully loaded on and off Ro-Ro vessels in ports under its own power. Procedures have been worked out for loading and unloading operations, there are different ways of loading motor vehicles, and procedures have been developed for securing them on shipboard [19] [Bibliography not included in this translation.]

Figure 7 shows the scheme for loading ZIL-130, ZIL-157K and ASRM-157K trucks on the Ro-Ro vessel "Akademik Millionshchikov." Computations and experimental shipments show that the optimum loading is 145 trucks. The spaces between the trucks is 150-200 mm on the side and 400-600 mm front and back. Additional work was done on the vessel to ensure reliability in securing the trucks.

The trucks are loaded on the motor vessel through the stern ramp onto the main and lower decks simultaneously. The trucks are parked to cover the entire area except the small stern portion and the inside ramp. Then the inside ramp is set up, and loading on the upper deck begins. To speed up loading operations on the upper deck,

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trucks are driven, and dockside cranes operate at the same time. Once the upper deck has been loaded, trucks are loaded in the stern portion of the main deck and on the ramp.

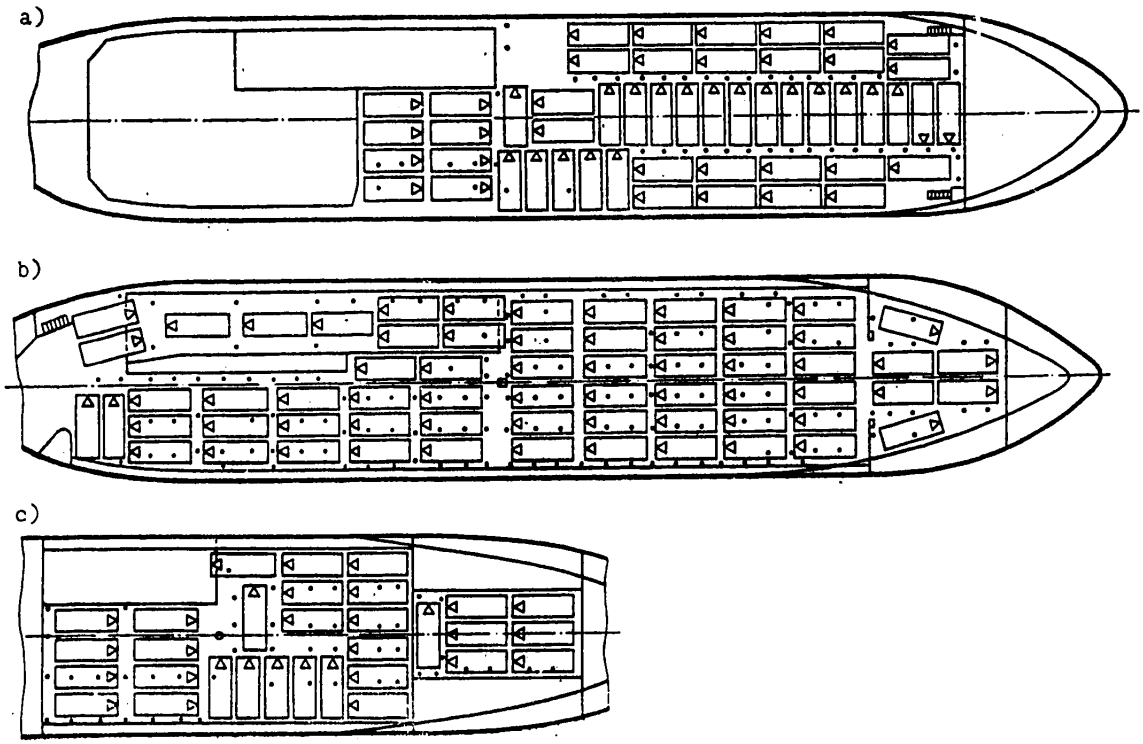

Figure 7. Scheme for loading ZIL-130, ZIL-157K, ASRM-157K trucks on the Ro-Ro vessel "Akademik Millionshchikov": a--upper deck; b--main deck; c--lower deck.

The trucks are loaded on a motor vessel like the "Akademik Millionshchikov" by 19 drivers (6 are loading the trucks on the ship, 13 are driving the trucks to the ship from the storage area) and 21 longshoremen (16 are securing the trucks, while 5 are making tallies and fixing seals on the trucks).

The sequence of operations in loading the vessel, their duration and the assignment of the workers are shown in Figure 8. Chains are installed on the decks when the ship is being prepared for loading operations, so that time for loading and securing the trucks (including the meal break) is approximately 10 hours.

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	(1) Технологические процессы	(2) Чистое время выполнения операции, ч												
		1	2	3	4	5	6	7	8	9	10	11	12	13
(4)	Установка цепей на верхней палубе		4											
(5)	То же, на главной палубе	(3)	чел. 4											
(6)	То же, на нижней палубе		чел. 4											
(7)	Погрузка автомобилей на нижнюю палубу		чел.			3								
(8)	Крепление автомобилей на нижней палубе					чел. 8								
(9)	Погрузка автомобилей на главную палубу					чел. 3							6	
(10)	Крепление автомобилей на главной палубе					чел. 8							чел.	8
(11)	Установка аппарели для въезда на верхнюю палубу					чел.								чел.
(12)	Погрузка автомобилей на верхнюю палубу									6				
(13)	Крепление автомобилей на верхней палубе									чел. 16				
(14)	Установка аппарели для въезда на кардек									чел.				
(15)	Погрузка автомобилей на кардек											6		
(16)	Крепление автомобилей на кардеке											чел. 16 чел.		

Figure 8. Sequence of operations, their duration and the assignment of personnel in loading the Ro-Ro vessel "Akademik Millionshchikov."

Key:
1. Operations
2. Net operation performance time, hrs
3. ... men
4. Installing chains on the upper deck
5. Same as above on the main deck
6. Same as above on the lower deck
7. Loading trucks on the lower deck
8. Securing trucks on the lower deck
9. Loading trucks on the main deck
10. Securing trucks on the main deck
11. Installing ramp to reach the upper deck
12. Loading trucks on the upper deck
13. Securing trucks on the upper deck
14. Installing ramp to reach the car deck
15. Loading trucks on the car deck
16. Securing trucks on the car deck

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Section 31. Specific Aspects of Organizing the Processing of Line, Passenger, and Combination (Cargo-Passenger) Vessels

Line shipping is organized as a rule to carry passengers and small-lot cargo on maritime vessels. It is characterized by scheduled movement of the fleet, stable flows of passengers and cargo, and the permanent assignment of vessels to the routes.

The port accepts all merchant vessels for processing on a first-come, first-served basis, regardless of their flag. But an exception is made for certain vessels, line vessels included. Line vessels, which operate according to a fixed schedule, are received for processing out of turn and are included in the quota of the NPGRP [continuous schedule-plan of port operation] on a priority basis.

The assignment of vessels to routes and the scheduled operation of the fleet make it possible for ports to make better preparations for processing the vessels, and a reduction of berthing time is consequently achieved.

The point of departure in planning the processing of a line vessel is that all the operations involved in its full servicing, cargo-handling operations above all, must be performed within the berthing time set aside for the ship; auxiliary operations must be performed within the time required for performance of cargo-handling operations. When the continuous schedule-plan of port operations is introduced, plans for processing line vessels, i.e., vessels whose laydays are fixed before the vessel processing plan has been drafted, are also compiled so as to take into account the processing of each vessel within the period fixed in advance.

A peculiarity in the processing of passenger vessels is that operations involved in servicing them have priority for the port. It is usually assumed that if a vessel is mainly intended for carrying passengers, and if it carries freight only to obtain additional income, then it is a passenger vessel. If the carrying of passengers is not its principal purpose, then the vessel is called a combination vessel. But this is an arbitrary division, since any vessel which has accommodations for more than 12 passengers is classified as a passenger vessel in accordance with the International Convention for Safety of Life at Sea and the Rules of the USSR Ship Register.

Present-day passenger and combination vessels have cargo holds of considerable size intended for carrying cargo and mail, and automobiles are customarily carried on the deck. For example, the combination vessel "Admiral Nakhimov" can take more than 1,300 tons of cargo, the "Gruziya" about 1,400 tons, the "Ivan Franko" between 1,500 and 1,800 tons, and the "Pobeda" 2,120 tons.

Movement of the passenger fleet is organized strictly according to the schedule. The berthing time of the vessels in port is clearly stated; during that time the operations of boarding and disembarkation of passengers must be performed, spaces have to be prepared for new passengers (changing linen, cleaning), fuel and food stocks have to be replenished, the vessel must be supplied with everything it needs, and cargo-handling operations also have to be performed. Cargo is loaded and unloaded in many cases on docks that do not have dockside cranes, i.e., with the ship's cargo-handling equipment.

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Passenger cruises have now become quite common. The Soviet passenger fleet has superb vessels like the "Azerbaijan," "Belorussiya," "Kareliya," and so on, which are used for cruises. On these vessels maximum comfort has been provided for the passengers, including tourists traveling with their automobiles. Several hundred automobiles can be accommodated on each vessel. The ships have the necessary equipment for this purpose: side loading ports and ramps making it possible to load and unload the vehicles without hoisting. The vessels ordinarily spend a lengthy time in ports, and the owners of the cars are able to drive them ashore and drive them back on board before the ship sails.

Cargo is also loaded and unloaded without hoisting in transport not involving transshipment. Rail ferries are an example of such transport; they have rails on their decks, trimming capability and other equipment which makes it possible to carry railroad cars loaded and empty. A locomotive loads the cars onto the decks and moves them onto the dock. Ferries are often used for combined cargo and passenger service.

For example, ferries like the "Sovetskiy Azerbaijan" have been operating effectively on the Baku--Krasnovodsk route in the Caspian Sea. This vessel has railroad tracks (two on each side) on its upper deck. There are devices for securing them. It takes less than 30 minutes to load the cars on the ferry and to unload them from the ferry. The ferry's operation has been highly efficient in economic terms: carrying one railroad car brings in income of 154 rubles. Theoretically it is also possible to carry motor vehicles on this ferry, since there is room enough, but ventilation has not been provided for, nor are there devices for securing the motor vehicles.

The ferry is also equipped to carry passengers, it has passenger cabins and saloons, and it can take more than 200 passengers. Considerably more time is required for the boarding and disembarkation of passengers, to prepare spaces to receive new passengers, to supply the vessel and to perform other operations related to serving the passengers than to roll the freight cars on and off.

Using the ferries to carry passengers has made it possible to eliminate passenger vessels from the routes the ferries serve.

Processing certain other types of vessels also has specific features. Often, for example, dry cargo is carried in tankers. In such cases the cargo is loaded and unloaded through the narrow manholes of the tanks, which impedes cargo-handling operations. Sometimes bag cargo is carried in tankers, whale meal for example. Then one or two bags are unloaded at a time from the tank, and the pace of the operation drops off. The bags pulled out of the tanks are stacked on the deck, where they are made up into pallets, which are then moved to the dock by cranes.

More often cargo is carried in the bulk (loose) in tankers. Experience has been gained in carrying raw sugar in bulk from Cuban ports to Soviet ports. These shipments make it possible to load up the tankers on the return trip and to reduce ballast runs. But the berthing time of ships for unloading is greatly increased. The raw sugar is unloaded with pneumatic cargo-handling machinery. It is efficient enough, but the consumption of electric power is quite considerable, and in addition the raw sugar chokes up the cargo-handling equipment, which has to be cleaned

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out periodically, and this detracts from the pace of operations. A large economic benefit is achieved when grain is carried in tankers.

In a number of cases oil, wine and similar cargo not unloaded at petroleum docks is carried in tankers. Cargo of this kind is unloaded in dry-cargo berths by ship pumps; transshipment operations are organized exclusively on a direct basis. Coordinated efforts of the port and the railroad have paramount importance in improving the rate of transshipment in cases like this.

Section 32. Measures To Speed Up the Processing of Vessels and Their Effectiveness

Faster processing of vessels makes it possible to reduce the berthing time of vessels, to increase their carrying capacity and the traffic capacity of ports, and to obtain a substantial benefit from the standpoint of the national economy. That is why the processing of vessels by faster methods has now become widespread in USSR ports.

In order to ensure faster processing the vessel's cargo plan is drafted to take into account the shortest times for loading (unloading) the vessel. For each vessel a program of organizational and technological measures is outlined to make it possible to step up the pace of cargo-handling operations.

The most important measures that provide for faster processing of vessels are the following:

i. concentration of cargo-handling equipment at the vessel being processed (without effect on the indicators of the port's operation as a whole). When a vessel is being processed by the faster methods, an effort is made to organize a large number of mechanized lines, using the ship's cargo-handling equipment and crawler cranes;

ii. extension of the length of the loading and unloading operation, including organizing cargo-handling operations on the water side using towed harbor vessels (lighters, barges and scows);

iii. increasing the productivity of cargo-handling operations on each mechanized line, which is achieved through full mechanization of the transshipment process, by introducing advanced technology for loading (unloading) cargo, through better organization of work, and through full utilization of work time;

iv. maximum concurrence of the operations of processing the vessel.

In a number of cases the system of remuneration by the job is used.

The measures which have been outlined are explained to the operative, agreements are reached with all the staff services of the port and with other organizations participating in processing the vessels or supporting those operations (with the railroad station, with storage facilities, the harbor fleet, etc.). The close interrelationship of all the entities in the port is reflected in contracts concluded between the port and the vessel, between the port and the railroad station.

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In accordance with the measures outlined a thorough preparation is made for their performance: cargo-handling equipment, cargo-lifting appliances, tackle and gear are assembled and prepared on the dock, cargo is marked off and sorted by size and weight and assembled in advance on docks, in lighters, in railroad cars; vessel crews prepare the ship's cargo-handling equipment and equipment for lighting work areas on the vessel, and they get the holds ready.

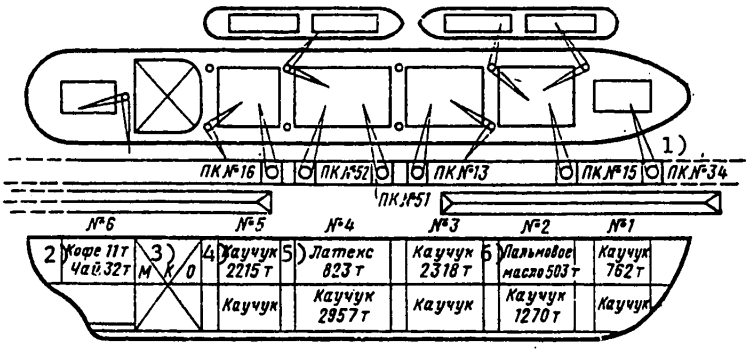

Figure 9. Diagram showing pattern of operation in processing of vessel.

Key:
1. Portal crane ...
2. Coffee 11 t, tea 32 t
3. Engineering space
4. Rubber ...
5. Latex 823 t
6. Palm oil 503 t

In organizing faster unloading of a vessel it is very important that information be up-to-date and complete concerning the vessel's arrival time in the port and the amount and location of the cargo on the vessel.

We will illustrate certain measures to speed up processing of vessels and their effectiveness with the example of faster processing of a tweendeck six-hatch vessel with a carrying capacity of 12,840 tons.

The principal cargo to be unloaded was rubber. The vessel's stowage plan is shown in Figure 9.

In order to speed up performance of cargo-handling and auxiliary operations the plan for processing the vessel drafted by the port envisaged the following:

1) concentration of cargo-handling equipment. Six portal cranes were assigned to processing the vessel in the first and subsequent shifts. Moreover, use of the ship's cranes was planned;

2) optimum placement of the cranes, which made it possible to operate several pieces of cargo-handling equipment through a single hatch without detracting from the productivity of cargo-handling operations. A computation was made for the placement of the cranes along the line of operation in processing the vessel, and their operating procedure was defined. Taking a vessel 155.73 meters long, the

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average length of the line of operations in cargo-handling is 120 meters, the minimum distance between cranes was 20-25 meters, which proved to be adequate for the normal operation of cargo-handling machines.

The ship's cranes were used mainly at the same time with the portal cranes at those hatches which would determine the length of the operation. The plan called for Hold No 6 to be emptied entirely by the ship's crane. The placement of the cargo-handling machines is shown in Figure 9;

3) extending the length of cargo-handling operations, which was the purpose of planning unloading of cargo on the water side with the ship's cranes and the barges of the harbor fleet. The stationing of the barges alongside the vessel is shown in Figure 9;

4) use of more than one cargo-handling machine in working one hold and ensuring a fast pace of unloading of the holds that determine the time of the entire operation. The length of each hatch on the vessel made it possible to use more than one cargo-handling machine at the same time. The decisive hold was No 4, and it was therefore emptied simultaneously by two cranes from the outset and to the end of the vessel's processing, and the operation of three lines including the ship's crane was planned on a three-shift basis. The decisions made to operate two or more flows at a single hatch (even in the dark) were specifically stipulated in the resolution of the dispatcher's conference and approved by the harbormaster. In all there were 8-10 cargo-handling lines processing the vessel. The operating schedule of the cranes is shown in Figure 10;

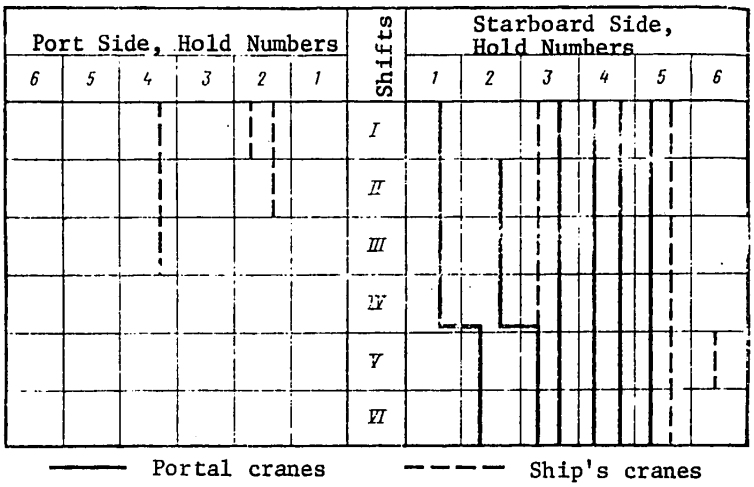

Figure 10. Shift schedule for operation of cranes.

5) increasing productivity on each mechanized line in the following ways:

a. using special grabs for rubber (designed in the port of Il'ichevsk), which make it possible to move 24 bales of rubber at the same time and to increase the weight of the hoist to 2.7 tons;

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b. use of 5-ton and 10-ton internal-combustion lift trucks equipped with self-dumping buckets to move the rubber within the port;

c. a high level of organization of work and better use of work time.

Experience in the transshipment of rubber in the port of Il'ichevsk was taken into account in working out this pattern of operations;

6) measures to guarantee work safety. Provision was made for the cargo-handling machines simultaneously used in emptying the same hold to operate in turn. A senior longshoreman was designated in each group of dockworkers working in the hold; an expanded team was created; and additional lighting was provided when it was dark.

The preparatory work that had been done, the progressive procedure for unloading rubber, concentration of the cargo-handling equipment and extension of the line of operations in cargohandling, responsive operational supervision of the cargo-handling process, and the enthusiasm of the longshoremen have made it possible for the work force of the port to achieve good results.

Average output per mechanized line and also labor productivity per worker have increased 1.5-fold, 96 vessel-hours of berth time have been saved, a saving that amounts to 53 percent of the time set aside, and the port received a dispatch bonus of 4,334 rubles.

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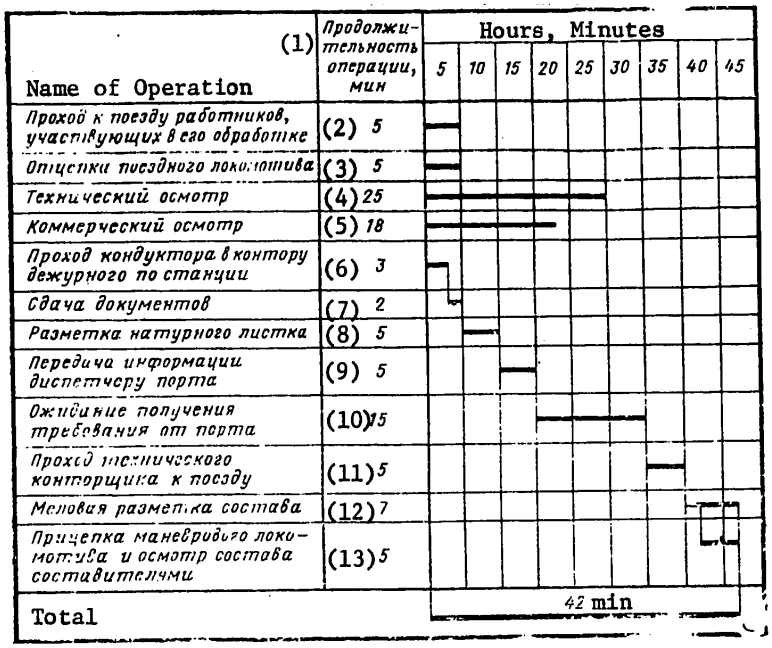

Name of Operation (1)	Продолжительность операции, мин	Hours, Minutes 5	10	15	20	25	30	35	40	45
Проход к поезду работников, участвующих в его обработке	(2) 5									
Отцепки поездного локомотива	(3) 5									
Технический осмотр	(4) 25									
Коммерческий осмотр	(5) 18									
Проход кондуктора в контору дежурного по станции	(6) 3									
Сдача документов	(7) 2									
Разметка натурного листка	(8) 5									
Передача информации диспетчеру порта	(9) 5									
Ожидание получения требования от порта	(10) 15									
Проход технического конторщика к поезду	(11) 5									
Меловая разметка состава	(12) 7									
Прицепка маневрового локомотива и осмотр состава составителями	(13) 5									
Total		42 min								

Figure 12. Schedule for processing freight cars on arrival at the port station.

Key:
1. Length of operation, min
2. Movement to the train of the workers participating in its processing
3. Uncoupling of the train's locomotive
4. Technical inspection
5. Commercial inspection
6. Movement of the conductor to the office of the person in charge of the station
7. Submittal of documents
8. Marking the waybill (natur listok)
9. Conveying information to the port dispatcher
10. Waiting to receive the order from the port
11. Movement of the technical official to the train
12. Marking the train with chalk
13. Coupling the switching locomotive and examination of the train by makeup men

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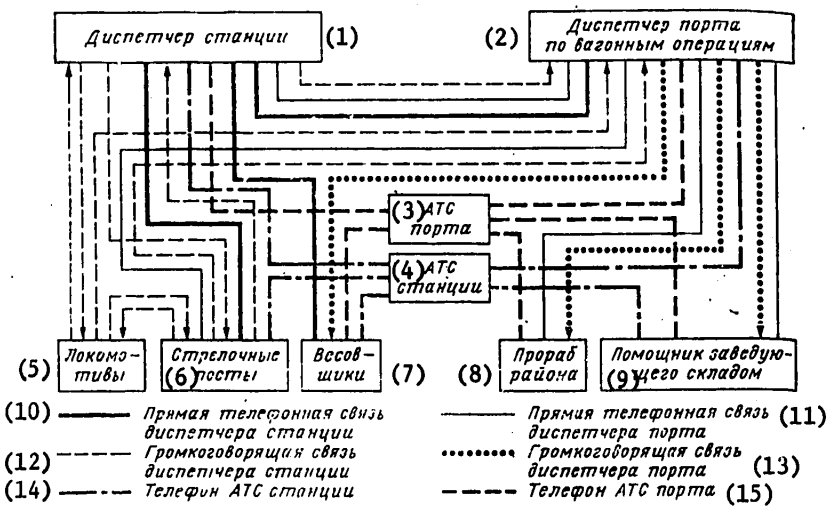

Figure 13. Scheme for operational communication between the port dispatcher and the rail station dispatcher.

Key:
1. Rail station dispatcher
2. Port dispatcher for railroad car operations
3. Port automatic telephone switchboard
4. Rail station automatic telephone switchboard
5. Locomotives
6. Switchman locations
7. Weighmasters
8. Section work foreman
9. Assistant head of the storage depot
10. Direct telephone communication of the rail station dispatcher
11. Direct telephone communication of the port dispatcher
12. Loudspeaker communication of the rail station dispatcher
13. Loudspeaker communication of the port dispatcher
14. Telephone of the rail station's automatic switchboard
15. Telephone of the port's automatic switchboard

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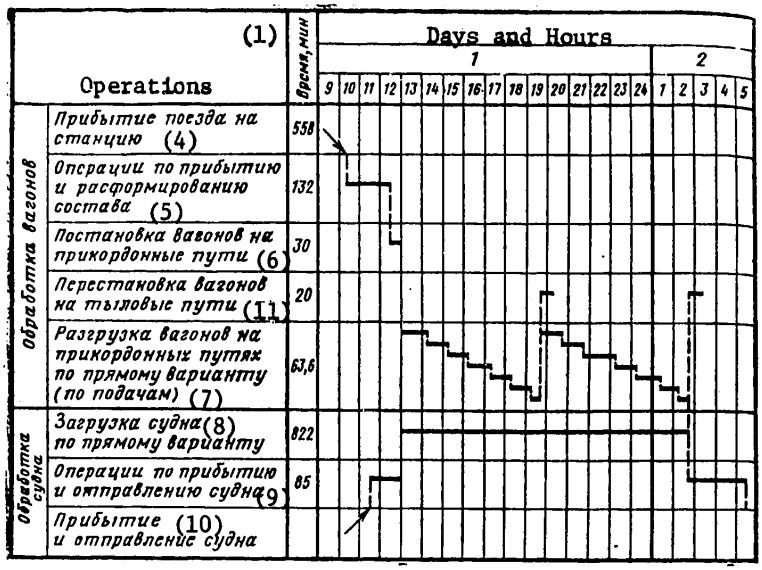

Figure 14. Schedule for processing a vessel and railroad cars in direct transshipment of freight.

Key:
1. Time, min
2. Processing the vessel
3. Processing the railroad cars
4. Arrival of the train at the station
5. Operations upon arrival and to break down the freight train
6. Placement of cars on dockside tracks
7. Direct unloading of the cars on the dockside tracks (as they arrive)
8. Direct unloading of the vessel
9. Operations related to the arrival and sailing of the vessel
10. Vessel's arrival and departure
11. Rearrangement of cars on rear tracks

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OCEAN AND RIVER

NEW BOOK DISCUSSES ECONOMICS OF FUEL, ENERGY TRANSPORTATION

Moscow EKONOMIKA TRANSPORTA TOPLIVA I ENERGII in Russian 1980 pp 190-191, 162-166

[Table of contents and subchapter of book "The Economics of Fuel and Energy Transportation" by S. S. Ushakov and T. M. Borisenko, edited by Professor Ye. O. Shteyngauz, doctor of economic sciences, Izdatel'stvo "Energiya", number of copies and pages not given]

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8.2. Sea Transportation

Sea transportation of petroleum, petroleum products, and coal played a secondary role in the country's fuel-energy complex. It carried on relatively modest export shipment of petroleum and petroleum products and coastwise shipping between individual ports, chiefly in the Black Sea and Far Eastern basin. As a result there was relatively modest development of the tanker fleet in terms of both total tonnage and the cargo capacity of individual ships. The discovery of petroleum in the Central Ob' region and the great increase in petroleum prices on the world market created the prerequisites for the USSR to enter the world petroleum market. The role of the country's tanker fleet grew.

On 1 July 1977 the gross tonnage of the USSR maritime fleet reached 26.2 million register tons according to the USSR Maritime Register. This included 40.07 million tons of petroleum-carrying ships [30, 52, 104].

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In addition to tankers, dry-cargo ships were used to carry fuel. Among them were a significant number of so-called bulker-tankers, which were adapted for carrying liquid and bulk cargoes. In addition there were dry-cargo ships built specially to carry coal and ore.

The location of the principal petroleum extraction regions in Western Siberia and along the Volga foreordains the creation and further development of petroleum seaports on the Black and Baltic seas with petroleum delivered to them by a system of large pipelines that at the same time supply petroleum for export by water and to the socialist countries and petroleum refineries located in the western regions of the European part of the country. The maximum cargo capacity of the tankers of our fleet is also predetermined by the geographic factor. Tankers with deadweights of about 150,000 tons and tankers of 170,000-180,000 tons that are specially built to pass through narrow, winding straits can sail through the Dardanelles and Bosphorus from the Black Sea and the Kiel straits from the Baltic without restriction.

The principal industrially developed countries of Western Europe consume chiefly imported petroleum. Japan meets its energy needs almost entirely through imported petroleum, and roughly 50 percent of the petroleum consumed in the United States is imported. All of these countries receive imported petroleum by sea transportation. This is what gives sea transportation of petroleum its exceptional role and draws attention to its development.

Shipment of liquid cargoes by sea transportation rose from 225 million tons in 1950 to 1.37 billion tons in 1970, while shipping of dry cargo rose 300 million to 1.08 million tons in the same years. In just the decade from 1964 to 1974, preceding the crisis in world shipping, the volume of shipment of petroleum and petroleum products tripled from 480 million tons to 1.46 billion tons, which was 44-46 percent of the total volume of world shipping.

The transportation distance from the Persian Gulf region to Japan is about 12,000 kilometers, while to the main ports of the European countries it is 10,000-12,000 kilometers through the Suez Canal and about 20,000 kilometers around the Cape of Good Hope.

The enormous amount of petroleum being shipped and the great distance of the shipments led to a search for ways to reduce transportation costs and a desire to streamline petroleum shipping. The most expedient thing to do was to increase the cargo capacity of tankers. The maximum deadweight for Japanese tankers was 28,400 tons in the early 1950's, and 107,000 tons in the early 1960's. In 1966 the world's first supertanker with a deadweight of 209,000 tons was launched, and in 1968 supertankers of 276,000 and 312,000 tons were built.

During the years preceding the world energy crisis tankers with cargo capacities up to 500,000 tons were built and even larger ones were planned.

During the "oil boom" specialists in the capitalist countries predicted a rapid growth in shipping and the future need for tonnage. This led to large-scale

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orders for ships, mainly large tankers. As a result, by 1975 about 100 million tons of the 287 million tons of deadweight for liquid-cargo ships with deadweights of 10,000 tons and more proved "superfluous"; this was some 35 percent of the total deadweight of tankers. The "very large" tankers with deadweights of 175,000-300,000 tons were in the worst situation. There are slightly more than 600 such ships in the world, but by total deadweight they are more than 150 million tons. A large number of such ships were under construction when the drop in shipping occurred. All these factors led to a number of new phenomena in the development of the tanker fleet and petroleum shipping.

First of all, many orders for tankers were cancelled. Tanker orders in 1975 declined from 205 million tons to 149 million tons, and by the end of the first quarter of 1975 orders for ships with a total cargo capacity of 54 million tons had been cancelled while a significant number of orders were switched to other ships, chiefly bulker-tankers. At the same time the shipbuilding capacities of almost all the capitalist countries are underloaded and the prices for ships are dropping sharply.

In the second place, obsolete ships are being scrapped at an accelerated pace. In 1975 a monthly average of 700,000-800,000 tons of deadweight was turned in for scrap metal, 3-4 times the figure of preceding years.

In the third place, the sailing speeds of ships have been cut sharply to save fuel, whose price has gone up several times. In many cases tankers are chartered at such low rates that they do not cover expenses at normal sailing speeds. The fuel economy achieved by reducing speed makes it possible to lower operating costs so that operating the ships is more profitable than laying them up. Speeds are reduced 30 percent, and in some cases up to 50 percent.

Nonetheless, all this does not permit full use of the existing tanker fleet, and part of the fleet has been laid up. At the beginning of the second quarter of 1976, counting the liquid-cargo tonnage of bulker-tankers, more than 550 vessels, mainly large tankers, with a total deadweight of 54.5 million tons were laid up.

The opening of the Suez Canal also reduces slightly the demand for the tanker fleet. The use of the Suez Canal for supertankers to return in ballast leads to a rise in their productivity and, of course, also tends to increase the number of tankers laid up.

The decision of the international consulting commission on maritime navigation to ban the dumping of ballast and flushing waters on the high seas, which was made to control petroleum pollution of the water, caused some change in the indicators of use of the tanker fleet. This decision required that part of the tanks on each ship be used for ballast and flushing waters and led to a slight decrease in the usable cargo capacity of the ships. However, these losses in productivity were relatively small and did not have a significant impact on the loading of the fleet.

By mid-1978 342 tankers with a deadweight of 37.3 million tons had been laid up. But at the same time the total deadweight of the tanker fleet in the last three years increased to 318.5 million tons.

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It should be noted that the conditions for use of small and medium-capacity tankers, which constitute the bulk of the USSR tanker fleet and are designated chiefly for carrying petroleum products, are much better than for large tankers. All existing tankers of these classes have been operated and chartered on a satisfactory level.

The domestic sea-going fleet engaged in shipping petroleum, petroleum products, and coal has hardly felt the impact of the crisis, which can be seen from the report data shown in Table 8-3 below.

Table 8-3

Indicators	1970	1973	1975	1977
All Sea Transportation				
Cargo Turnover, billions of ton-miles	354.3	405.4	397.5	417.2
Average Distance of Shipment, miles	2,188	2,171	1,988	1,894
Fuel Cargoes				
Cargo Flow of Petroleum and Petroleum Products, millions of tons	75.1	84.2	91.4	100.8
Cargo Flow of Hard Coal, millions of tons	9.3	8.6	9.2	10.2

Thus, shipping by the domestic fleet as a whole has risen steadily in recent years. The average distance of shipments has decreased somewhat, chiefly because of the market conditions of foreign trade and in part owing to opening of the Suez Canal.

Table 8-4 below gives a description of the ships of the domestic fleet that are used to carry fuel (petroleum, petroleum products, and coal).

The approximate costs of shipping fuel by sea transportation can be defined as the sum of expenditures (operating and capital investment) in four categories: [48, 59, 60]:

1. Sailing operations, that is, expenditures related to ship travel under load and in ballast (see Table 8-5 below);

2. Initial and final operations and expenditures related to ship downtime for loading operations and cargo handling (see Table 8-6 below);

3. Expenditures for construction and operation of port structures in a proportionate amount per ton of cargo handled (see Table 8-7 below);

4. For maintenance of the transportation fleet, which can be taken as equal to 6-7 rubles of operating expenditures per 10 tons of coal (capital investment of 37 rubles for the

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Table 8-4

Грузоподъемность, тыс. т (1)	Дедвейт, тыс. т (2)	Вместимость грузовых помещений, тыс. м³ (3)	Мощность главных двигателей, тыс. л. с. (4)	Длина корпуса, м (5)	Осадка с грузом, м (6)	Скорость с грузом, узлов (7)	Эксплуатационные расходы, руб/судо-сут (8) на ходу (9)	при погрузке и выгрузке судовыми средствами (10)	при погрузке и выгрузке без судовых средств (11)
				Tankers					
145,0	150,0	183,0	30,0	277,1	17,0	17,0	15 840	15 080	12 790
44,7	49,4	57,0	19,0	230,0	11,6	17,0	4655	3222	2908
31,4	34,6	47,0	18,0	207,0	10,6	17,9	3802	2955	2554
14,0	15,0	21,0	6,2	150,0	8,5	15,0	2020	1790	1555
11,4	12,0	16,0	5,0	147,0	8,0	13,0	1865	1610	1320
5,4	6,0	8,0	3,2	117	6,5	14,0	1250	1210	1005
				Ships for Bulk Cargo					
67,0	70,0	91,0	18,7	252,6	12,6	16,5	3980	2720	2705
42,0	45,0	58,0	15,5	222,0	11,0	16,0	3225	2160	2145
21,0	23,0	31,2	10,4	180,0	9,8	16,0	2360	1675	1635
14,0	15,0	21,0	6,5	157,0	8,2	15,0	1810	1350	1315

Key:
(1) Cargo Capacity, thousands of tons;
(2) Deadweight, thousands of tons;
(3) Capacity of Cargo Areas, thousands of cubic meters;
(4) Power of Main Engines, thousands of horsepower;
(5) Hull Length, meters;
(6) Draft under Load, meters;
(7) Speed under Load, knots;
(8) Operating Costs, rubles per ship-day;
(9) Traveling;
(10) During Loading and Unloading by Ship Equipment;
(11) During Loading and Unloading Without Ship Equipment.

Northern basin, 25 rubles for the Baltic and Black Sea basins, and 15-18 rubles for the Far Eastern and Caspian basins) and operating expenditures of 0.8-0.9 rubles in capital investment of 6-7 rubles per 10 tons of liquid cargo.

All the specific indicators for traveling and initial-final operations given in Tables 8-5 and 8-6 were calculated for the conditions of the Azov-Black Sea basin. The indicators for the Baltic and Caspian seas are similar (a factor of 1.03-1.05). Expenditures in other basins, especially when sailing under Arctic conditions, are much higher. They are 17-28 percent higher for the Far Eastern basin and 26-28 percent higher for the Northern basin.

Expenditures for loading-unloading work are given for large well-mechanized ports. Expenditures for loading-unloading work in ports with lower cargo turnover and, especially those located in unfavorable climatic conditions are significantly higher than the figures given in Table 8-7.

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Table 8-5

Грузоподъемность, тыс. т (1)	Эксплуатационные расходы судна, коп/(10 т·миль) (2)		Капиталовложения в судно, коп/(10 т·миль) (3)		Грузоподъемность, тыс. т (1)	Эксплуатационные расходы судна, коп/10 т·миль) (2)		Капиталовложения в судно, коп/(10 т·миль) (3)	
	с грузом (4)	в балласте (5)	с грузом (4)	в балласте (5)		с грузом (4)	в балласте (5)	с грузом (4)	в балласте (5)
Tankers					Ships for Bulk Cargo				
44,7	0,26	0,25	1,68	1,59	67,0	0,16	0,15	1,33	1,26
31,4	0,29	0,28	2,15	2,04	42,0	0,20	0,19	1,64	1,56
14,0	0,41	0,39	3,16	3,00	21,0	0,30	0,29	2,39	2,27
11,4	0,50	0,48	3,33	3,16	14,0	0,37	0,35	2,98	2,87
5,4	0,78	0,70	5,17	4,91					

Key: (1) Cargo Capacity, thousands of tons;
(2) Ship Operating Expenditures, kopecks per 10 ton-miles;
(3) Capital Investment in the Ship, kopecks per 10 ton-miles;
(4) Under Load;
(5) In Ballast.

Table 8-6

(1) Грузоподъемность, тыс. т	Эксплуатационные расходы, руб/(10 т·миль) (2)		Капиталовложения, руб/(10 т·миль) (3)		(1) Грузоподъемность, тыс. т	Эксплуатационные расходы, руб/(10 т·миль) (2)		Капиталовложения, руб/(10 т·миль) (3)	
	(4) Наливные грузы					(5) Насыпные грузы			
	Налив (6)	Слив (7)	Налив (6)	Слив (7)		Крановая схема (8)	Спецустановка (9)	Крановая схема (8)	Спецустановка (9)
Tankers					Ships for Bulk Cargo				
44,7	0,51	0,60	5,66	5,90	67,0	2,02	0,64	25,50	4,90
31,4	0,54	0,60	5,95	6,30	42,0	1,82	0,53	21,55	5,92
14,0	0,60	0,64	6,00	6,10	21,0	1,44	0,51	17,13	6,50
11,4	0,62	0,68	5,75	5,90	14,0	1,60	0,43	18,30	8,12
5,4	1,00	1,02	8,80	8,45					

Key: (1) Cargo Capacity, thousands of tons;
(2) Operating Expenditures, rubles per 10 ton-miles;
(3) Capital Investment, rubles per 10 ton-miles;
(4) Liquid Cargoes;
(5) Bulk Cargoes;
(6) Pouring;
(7) Discharging;
(8) Crane System;
(9) Special Installation.

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Table 8-7

Длина причала, м / Глубина у кордона, м (1)	Вариант погрузочно-разгрузочных работ (2)	Пропускная способность причала, тыс. т/год (3)	(4) Расходная ставка, руб/10т	
			Эксплуатационные расходы (5)	Капиталовложения (6)
		Light Petroleum Products		
145 / 8,25	Налив (7)	1050	2,34	8,15
	(8) Слив	1100	2,27	7,95
180 / 9,75	Налив (7)	2000	2,20	8,70
	(8) Слив	2100	2,10	8,50
215 / 11,5	Налив (7)	3100	2,18	8,70
	(8) Слив	3300	2,06	8,40
		Petroleum and Dark Petroleum Products		
180 / 9,75	Налив (7)	2500	1,86	7,85
	(8) Слив	2500	1,84	7,70
215 / 11,5	Налив (7)	3900	1,82	7,80
	(8) Слив	3900	1,82	7,80
500 / 13,5	Налив (7)	12 500	1,99	8,55
	(8) Слив	13 500	1,87	8,20
		Coal		
165 / 8,25	Складской (9)	1405	5,40	29,30
	(10) Прямой	1340	4,20	26,60
190 / 9,75	Складской (9)	1540	5,70	34,30
	(10) Прямой	1400	4,50	31,90
235 / 11,5	Складской (9)	2290	5,20	33,30
	(10) Прямой	2090	4,10	31,00
265 / 13,0	Складской (9)	3120	4,80	37,70
	(10) Прямой	2750	4,00	36,80

Key: (1) Length of Dock, meters / Depth at Cordon, meters;
(2) Variation of Loading-Unloading Work;
(3) Traffic Capacity of Dock, thousands of tons per year;
(4) Expenditure Rate, rubles per 10 tons;
(5) Operating Expenditures;
(6) Capital Investment;
(7) Pouring;
(8) Discharge;
(9) Storage;
(10) Direct.

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The indicators given in the tables may be used for preliminary estimates of the shipping of fuel by sea transportation when comparing alternatives for fuel transportation with other forms of transportation. When determining actual expenditures during the calculation of the prime cost of the output of enterprises that receive fuel by sea transportation it is simpler to use existing shipping rates, bearing in mind that other expenditure subheadings will also be adopted based on current prices and rates.

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