(k) Forklift

Small-sized forklifts are allocated for machinery and equipment for warehouses. Since palletization is not planned for the regional warehouse level, the small-sized forklift is not designed for palletization. It is aimed at the receiving, moving and temporary stacking of materials.

The planned size of the forklift is as follows:

Loading capacity:	3.0 tons (for 25 bags of 100 kg rice and wooden pallet)
Power type:	Gasoline or diesel engine
Wheels:	Air tire, large, 4 (2 wheels driven)
Fork height:	Maximum 3.0 m
Rider seated type	

8-3 Machinery and Equipment at Shipping Facilities

8-3-1 Approach to the Plan

The shipping facilities must be designed to efficiently facilitate the export of Thai-produced rice. It must also achieve not only the high evaluation of quality exported Thai-rice, but also permit the performance of efficient shipping works.

In addition, the facilities should permit the maintenance of current overseas markets and the promotion of new markets. Planning must also reflect the private sector as a pilot plan. In order to satisfy the above purposes, the following guidelines have been established:

1. The facilities permit the improved quality of export rice.

2. The facilities permit the shipping load for export rice as compared with the conventional method.

3. The facilities are composed of a series of cleaning rice processing including receiving, temporary storing, cleaning, re-polishing, mixing and packing, and machinery and equipment for shipping.

4. Each facility is to be planned by corresponding to the conditions of each location, including facility maintenance for the existing PWO warehouses near the Bangkok port. These PWO warehouses are to function as part of the shipping facilities.

5. The facility size planning at each site is to be established on the basis of the handling volume planning for rice.

6. The facilities must afford economical facilities under the current grain distribution system.

8-3-2 Planning for Machinery and Equipment

The shipping facilities handles both the domestic consumption of rice and rice export. The facilities are composed of storage, rice processing, and shipping. If PWO has already prepared the storage facilities, only the rice processing and shipping facilities are to be prepared.

(a) Planning Machinery and Equipment Preparation for Existing PWO Warehouses

Central shipping facilities planned in this project consist of storage rice processing and shipping as mentioned before. The facilities handle the domestic consumption of rice in the Bangkok Metropolitan area and the export of rice. The plan indicates that existing PWO's warehouse shipping functions are to be improved and operate functionally and economically as part of the central shipping facilities.

PWO has three warehouses under the control of the Central Warehouse Department for rice storage warehouses; Rajburana (58,400 tons), Bukkalo (51,000 tons), and Bangkasor (21,600 tons). These are merely warehouse spaces.

Outlines of these are listed in Table 8-3.

Cleaning rice processing equipment and shipping facilities are not currently provided as machine equipment so that these facilities are to be prepared in this plan. In addition, the prompt loading and unloading of large amounts of cleaning rice are required at the central shipping complex. The palletization system is to be introduced for rationalization of this loading and unloading. In order to satisfy this goal, the necessary machinery and tools have been prepared.

Table 8-3 Outline of Existing PWO Warehouses

Item \ Place	Bangkasor, Nonthaburi	Bukkalo, Tonburi	Rajburana, Tonburi
Distance form estuary	the left bank, about 70 km.	the right bank, 14.3 km	the right bank, 38.5 km.
Acreage of the site	72,408 m^2	31,168 m^2	33,716 m^2
Existing storing capacity (construction year)	2,000 ton x 2 W/H 2,940 ton x 6 W/H 21,600 ton	26,000 ton x 1 W/H (1,977) 8,400 ton x 3 W/H (1,969, 1972, 1975) 51,000ton	25,200 ton x 15,700 ton x 1 W/H 58,400 ton 17,500 ton x 1 W/H (1,983)
Warehouse structure			
roof	slate	slate	slate
beam	steel frame truss	steel frame truss	steel frame truss
pillar	reinforced concrete,no stud	reinforced concrete,stud	reinforced concerte, stud
wall	block or brick	block	block
floor	concrete	concrete	concrete
skylight	yes	yes	yes
high level window	yes	yes	yes
door	shutter	shutter	slide
Wharf for shipping	nil	2 (for barge),length 15.5x12 m 20x9.5 m depth of water 18 ft	Wharf No27A, length 142 m (for vessel),LOA 370 ft, LLW 24 ft, interval between vessels > 30 ft
Machinery & Equipment			
truck scale	nil	30 M/T x 1	30 M/T x 2
platform scale	yes	yes	yes
top-pan scale	yes	yes	yes
high-sieve	yes	yes	yes
sealing machine	yes	yes	yes
pallet (1x1x0.11 m)	7,000	9,000	10,000
Fire protection	Extinguisher	fire engine extinguisher	fireplug
Emergency light	nil	nil	yes

(b) Machine Installation Plan for Laem Chabang Seaport Warehouse

According to the operating plan in this project, a part of export rice is to be shipped from sea ports. In order to achieve this purpose, a wharf warehouse (capacity of 70,000 tons) is planned for construction, and exporting rice adjusting facilities are scheduled to be adjoined to the warehouse. The warehouse and machine and equipment facilities building must be located as close to the wharf as possible to reduce the delivery distance. Fig. 8-7 indicates the layout plan for the warehouse and machine building.

The new machine building is planned as a 2-stair building from the standpoint of the multiple use of the limited port site. (Fig. 8-8)

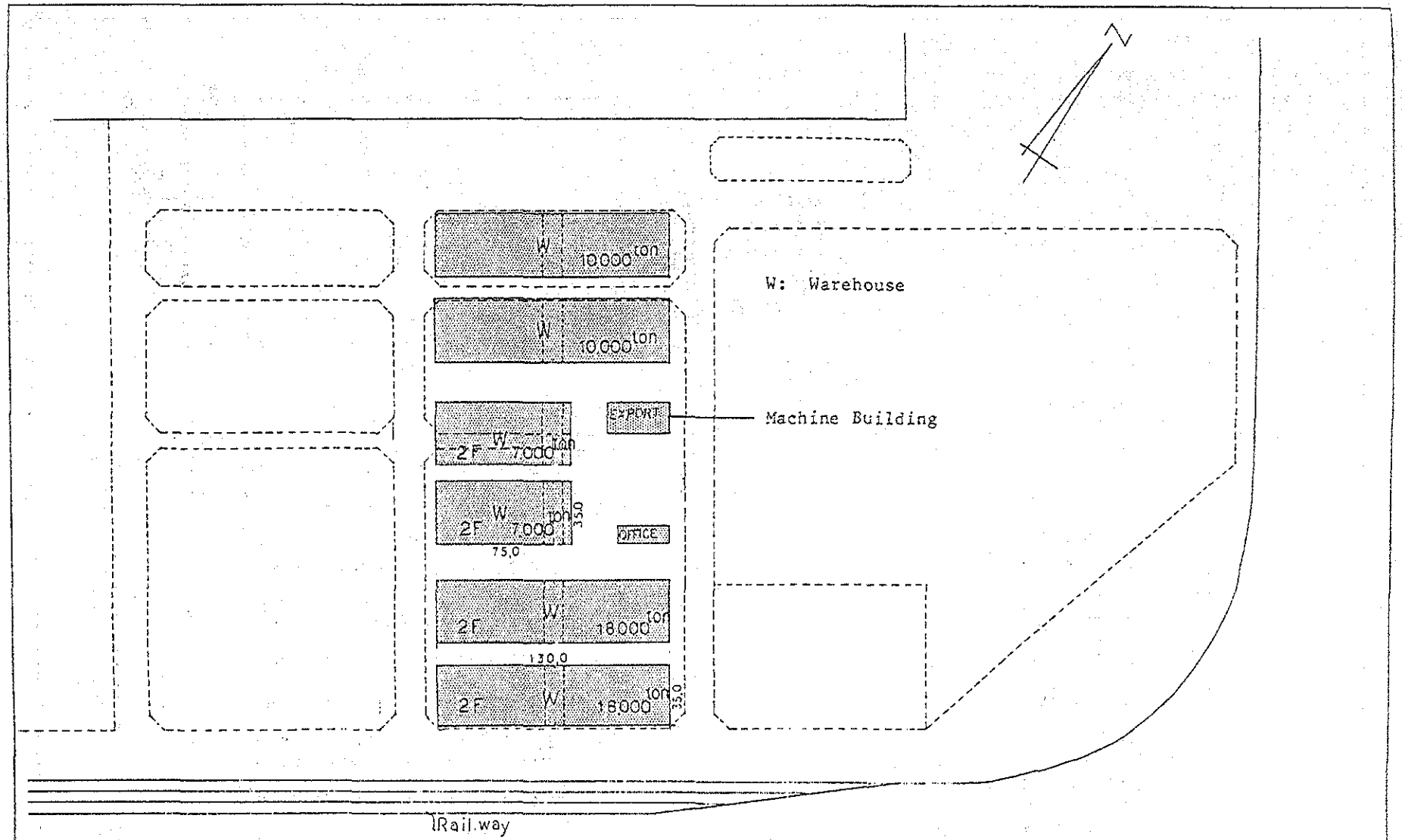


Fig. 8-7 Layout Plan for the Warehouse and Machine Building, Laem Chabang

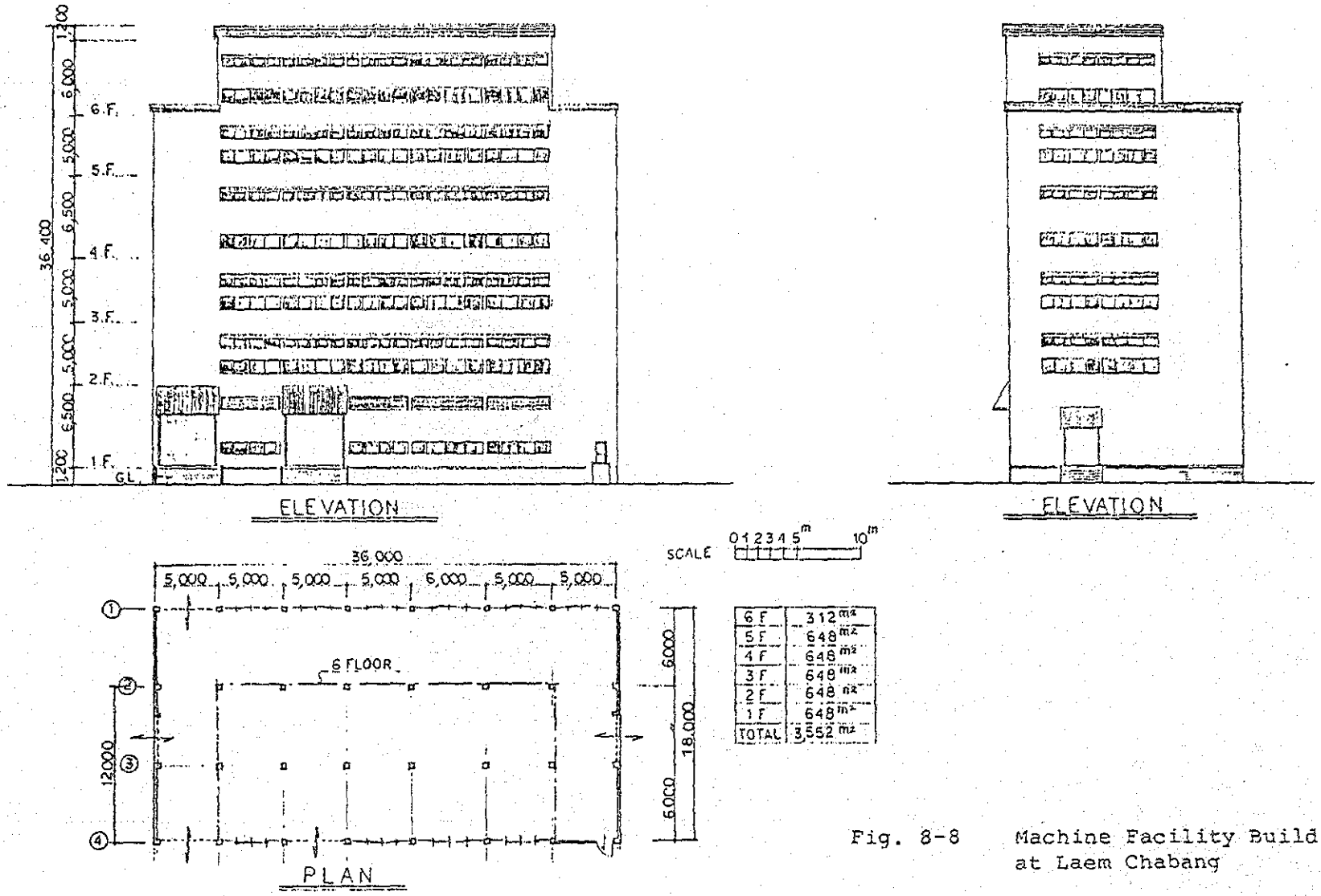


Fig. 8-8 Machine Facility Building at Laem Chabang

8-3-3 Planning for the Shipping Facilities at Existing Warehouse

The following are the facilities preparation planned for each existing warehouse.

Nonthaburi

Since the existing warehouses have been rebuilt from warehouses of old jute plants, they are not suitable for the extended storage of rice. Thus existing buildings are to be removed in this project. The regional warehouse (20,000 tons), Storage Technology Improvement and Training Center, and a wharf are to be built for barges to ship export rice and supply consumption rice to the northern region of the Bangkok Metropolitan area. To achieve this, processing facilities for exporting rice, shipping machine and equipment facilities are to be planned and packing facilities for domestic consumption of rice.

Because appropriate buildings for installation of the machinery and equipment are not present in Nonthaburi, the machine installation building is to be built. Though no other restriction is present in making the machine layout, all relationships between these locations must be considered carefully.

PWO has attempted to move its headquarters to the site but a concrete plan has not been established. Layout plan for each facility is shown in Fig. 8-9.

Bukkalo

According to the operating plan in this project, the Bukkalo warehouse handles domestic consumption of rice in the Bangkok Metropolitan area, so that domestic consumption of rice of processing facilities is scheduled for planning.

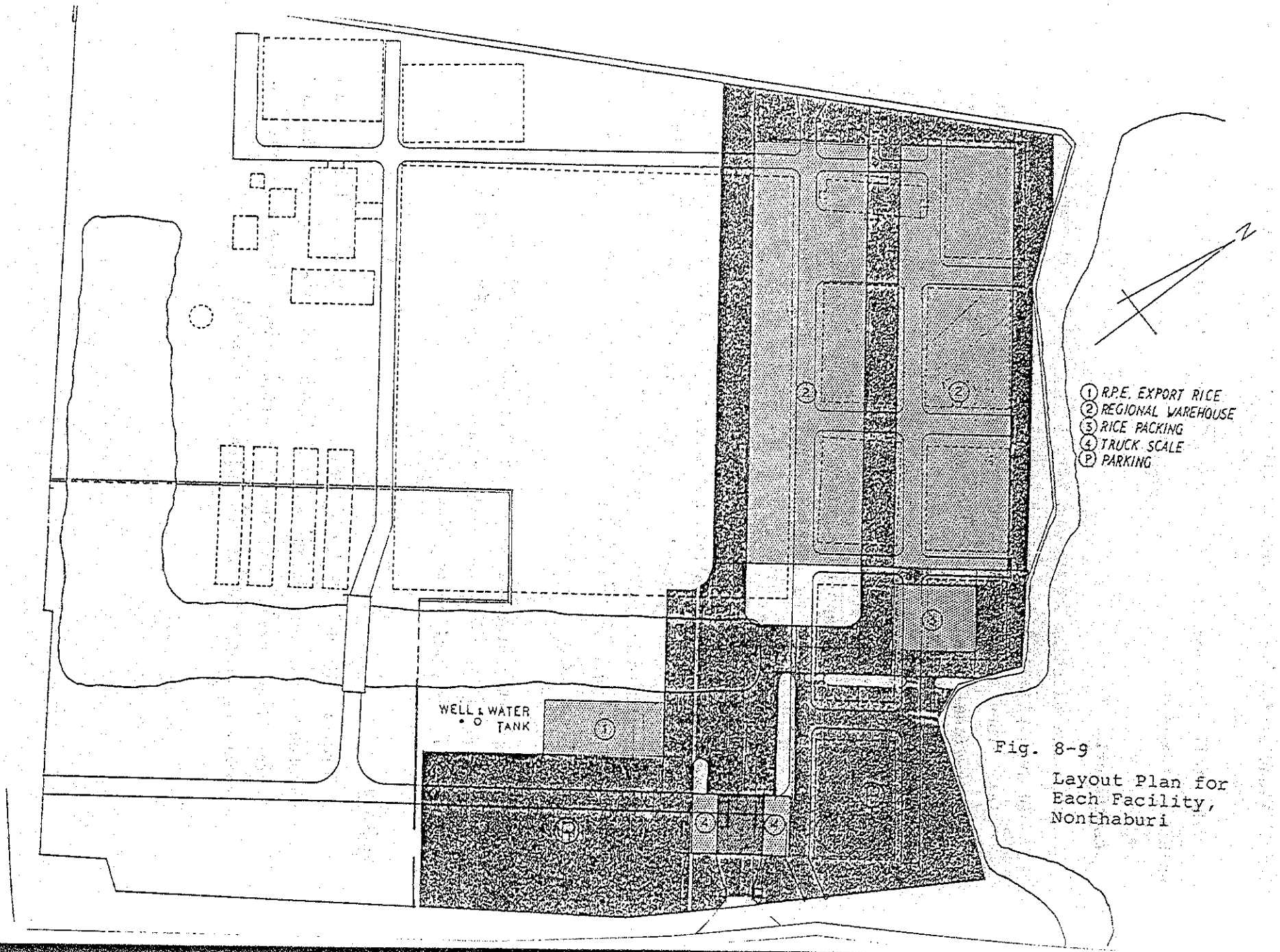


Fig. 8-9
Layout Plan for Each Facility, Nonthaburi

The same type of facilities as those being planned in Nonthaburi are to cover only a part of the northern region of the Metropolitan area, so that the facilities in Bukkalo will complete this purpose.

It has been clarified after studying the basic floor structure of the existing warehouse that it is unsuitable for the facilities installation. Pit works seem to be difficult. The dedicated building must therefore be built.

Since PWO has about 5,000 square meters of vacant land in front of the warehouse, a part of the land is scheduled to be planned as a substitute. New Material rice receiving works and bagged rice storage facilities are planned to be located near the existing warehouse for convenience. The location of the new machine building is shown in Fig. 8-10. The new machine building is far from the existing wharf, but no other inconvenience exists because all domestic consumption of rice is delivered by truck.

Rajburana

According to the operating plan in this project, the Rajburana warehouse handles only exporting rice. Thus export rice processing facilities are planned for construction. A mother ship can approach the wharf (Wharf No. 27A) of this warehouse without the presence of bridges in the lower reaches of the river. Exporting rice can thus be shipped directly from the wharf. The Rajburana warehouse takes advantage of an exporting rice site as compared with other sites. Export rice processing facilities and high efficient shipping facilities are to be planned.

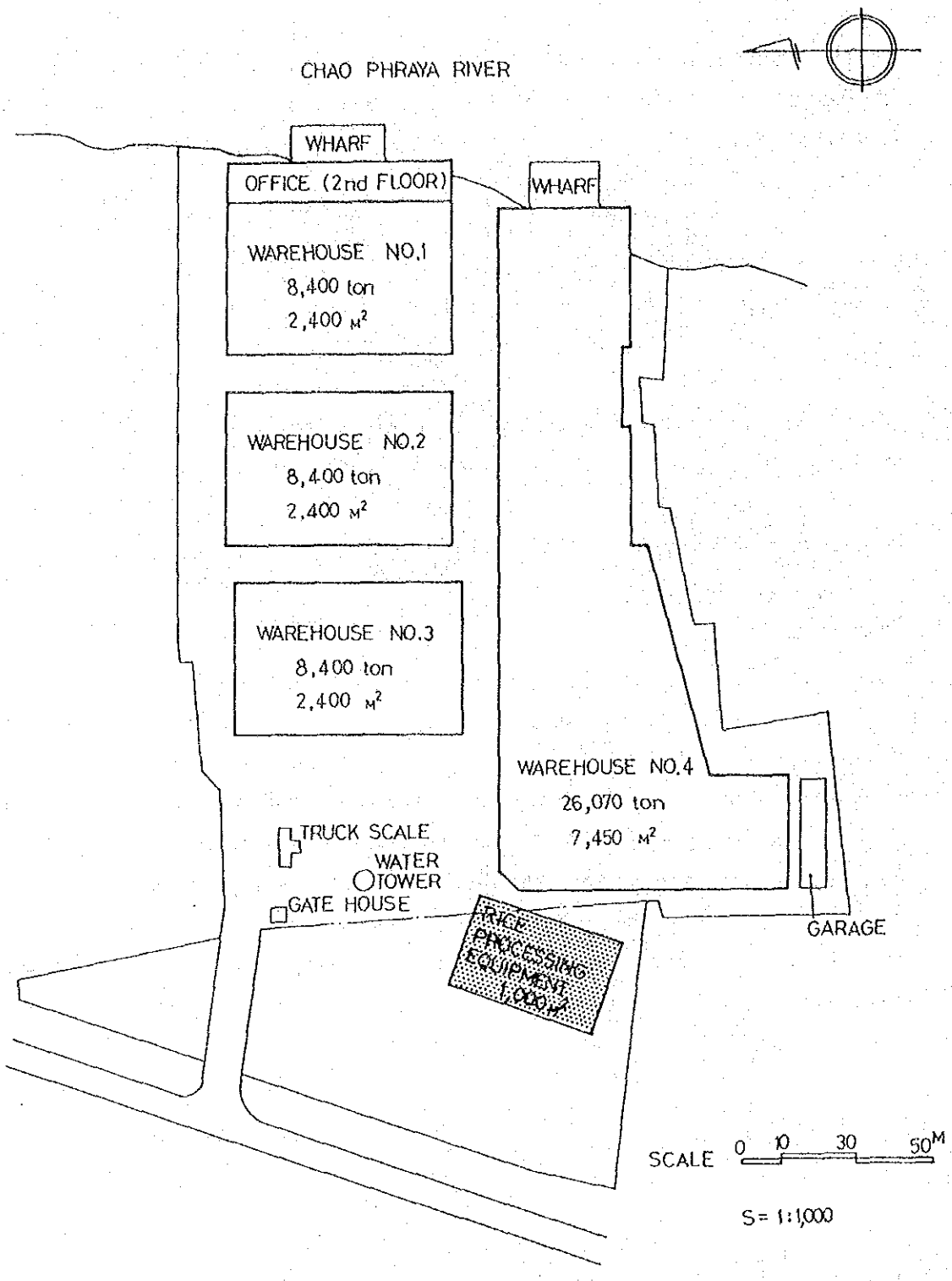


Fig.8-10 LOCATION OF RICE PROCESSING EQUIPMENT FOR DOMESTIC RICE, BUKKALO

When shipping the products to a mother ship, the derrick of the ship is used for conventional work but a truck crane is usually employed when shipping to a barge for offshore shipping.

The existing warehouse was built in 1982, and can be converted to a machine building. The south side of the fifth warehouse is the most appropriate site, as Fig. 8-11 indicates from the following facts or conditions for the export rice processing facilities.

- o The site is to be located at an almost equal distance from each warehouse and deliver.

- o The site is to be located a short delivery distance from temporary storage after adjusting rice, because the wharf is close.

- o The office must be close to the site of the facilities from the standpoint of management, but the office is also required to prevent noise and dust.

From the above facts, a fifth warehouse has been selected. Since the facilities are installed in the existing flat warehouse, the layout is to be the flat type because of height restrictions.

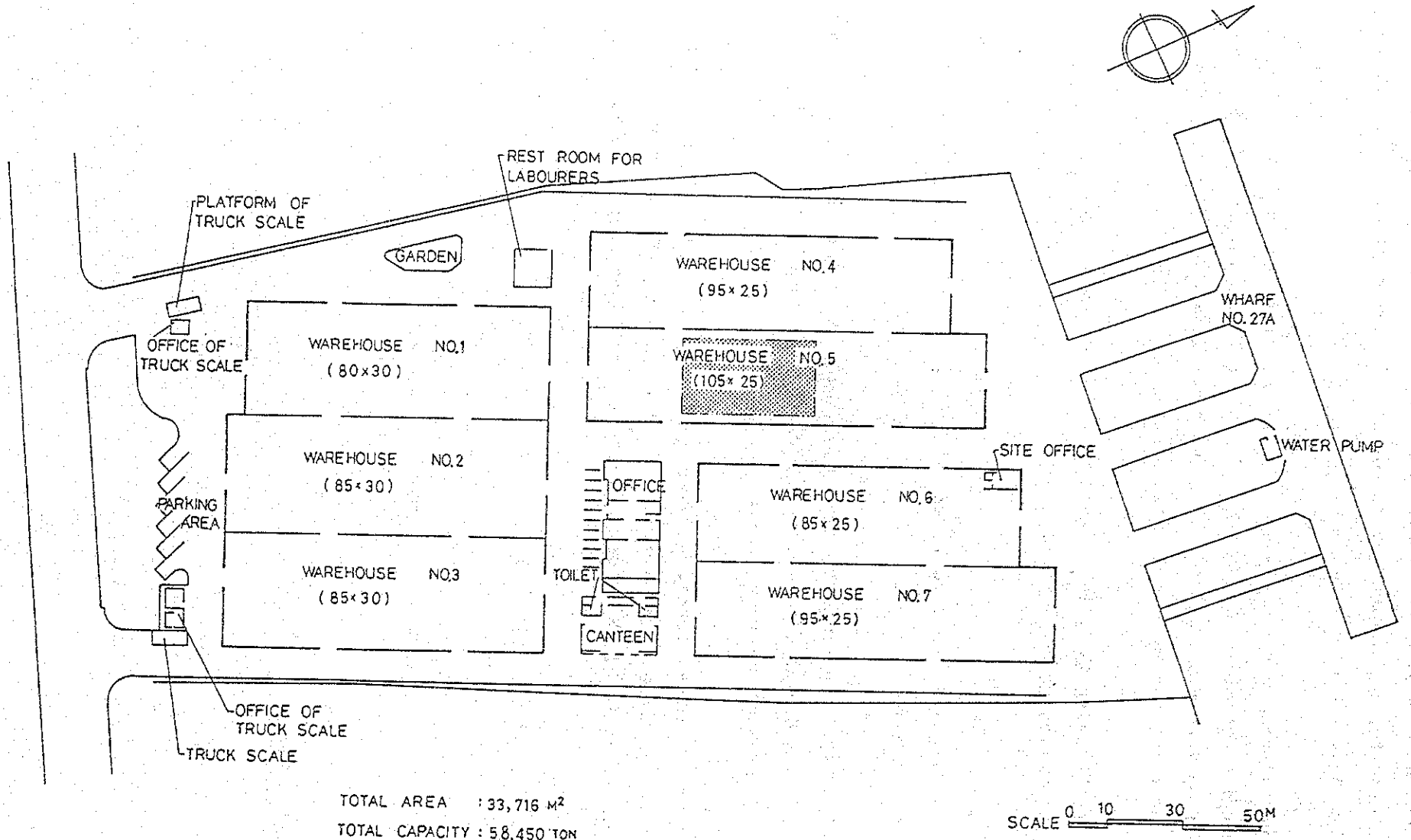


Fig. 8-11 Most Appropriate Site of Rice Processing Facilities in Rajburana Warehouse

8-3-4 Planning for Common Apparatuses or Tools

As mentioned, the shipping facilities covers three sites of warehouses under the control of PWO and a seaport site being planned by the Industrial Estate Authority of Thailand. Common materials and tools applied to these sites include: truck scale for weight checking, inspection instruments, forklift and pallet for palletization, platform scale, bag shipping. Table 8-4 indicates apparatuses or tools to be allocated for each site:

Table 8-4 Number of Apparatuses or Tools to be Allocated for Port Warehouses

Location / Name of Apparatuses or Tools	River Port			Seaport	Total
	Rajburana	Bukkalo	Nonthaburi	Laem Chabang	
Truck scale	(Existing)	(Existing)	(Including regional warehouse planning)	2	2
Inspection tools	1	1	1	1	4
Forklift	6	5	2	10	23
Pallet	17,000	15,000	7,000	23,000	62,000
Platform scale	(Existing)	(Existing)	(Including regional warehouse planning)	10	10
Bag sewing machine	2	2	(Same as above)	2	6
Cleaning tool	1	1	(Same as above)	1	3
Truck crane	2	-	1	-	3

The following is a brief description of plans for each apparatus or tool.

(a) Truck Scale

In Thailand, the 10-wheel truck (weighing capacity of 10 ton) is the most widely used truck for cargo transportation, but a problem has recently arisen. This large truck has damaged roads, so the governmental authority has attempted to convert the large truck into a trailer truck. Under these conditions, the truck scale is designed so that it will be applicable for the trailer truck as well as the large truck. The weighing system by road cell type does not require a pit at the installation, so that locations where draining is difficult are not a problem. In addition, this system has the advantage that a digital display is indicated. However, for accuracy, a dependable power supply is required.

The following mechanical type of truck scale is planned for seaport warehouses:

Weighing system	Mechanical lever
Display system	Dial or slide
Printing system	Engraving
Weighing capacity	50 tons
Platform	3 x 10 ∿ 15m
	(Steel plate for trailer truck)
Drainage	Drain ditch

(b) Inspection Instruments

Inspection instruments are also prepared for each warehouse, as they are for each provincial warehouse. For provincial warehouses, testing tools for paddy are required, but they are not necessary here. However, multi-purpose nature testing is required to fit milled rice quality to the export standard. In order to satisfy the purpose, the following instruments are prepared:

Test rice grader
Micrometer
Table balance
Karton (seed sample pan)
Chemical reagent
Dockage tester or sieve set
Grain identification board
Test rice husker
Test milling machine.

The inspection room is prepared as an annex room to the control room.

(c) Pallets for Palletization

In Thailand, rice packing is still carried out manually. Other agricultural products such as cassava products, corn or milo are handled by a mechanical system. This indicates that the rice packing mechanization is difficult from technical and economical viewpoints. However, the export volume of rice has been increasing rapidly. As a result, load rationalization is becoming indispensable.

Under these conditions, the "Integrated Palletization System" is planned in this project for the shipping facilities. This system is designed to make efficient load works by using the facilities of existing warehouses as a practical improvement.

When considering pallet storage, a series of works, are repeated so that the basic piling type, pallet specification and number of layers must be studied so that each stage of work is carried out smoothly. In Thailand, there are two types of rice packing forms employed for milled rice distribution; 100 kg and 50 kg jute or chemical fiber bags excepting prepacking bags in the retail stage. Our planning is restricted to these two types, and multiple pallets are not necessary.

The study team tried to make a preliminary test to plan pallet specifications and unit dimensions in planning to introduce the palletization system.

Details of the preliminary test are described in the Appendix H-1. According to the results of the preliminary test, the 100 kg bag "Tsugaru-5" 6 bag layers and 50 kg bag "Goro-8B" 6 bag layers make an approximate value for plane size/unit weight, so that these ideal pallets are interchangeable.

A number of pallets is ideal for enhancing efficient warehouse use, but three pallets are the most appropriate number. If the number is increased, bags are likely to fall down.

In order to implement the palletization, actual experimentation is required. When employing the palletization, safety and efficient storage must be considered. In Thailand, the 100 kg bag - 27 layers, is usually employed but for palletization, the number of layers becomes less than 27 for safety reasons. This is a necessary item in designing a new warehouse. The following table is a summary of the implementation plan for palletization:

Table 8-5 Specifications of the Palletization Plan

Item	100 kg bag	50 kg bag
Bag specifications		
Dimensions (cm)	109 x 74	87 x 57, 88 x 55
Weight (kg)	1.1	0.55, 0.58
Material	Jute	Chemical fiber
Layer		
Form of bag arrangement	"Tsugaru-5"	"Goro-8B"
Bag layers on pallet	6	6
No. of pallets in each pile	3	3
Total bag layers	18 = 6 x 3	18 = 6 x 3
Height of pile (m)	(1.3 + 0.15) x 3 = 4.35	(1.13 + 0.15) x 3 = 3.84
Weight of one unit (kg)	3,100 ≒ (5 x 100 x 6) + 80	2,500 ≒ (8 x 50 x 6) + 80
Pallet		
Dimensions (estimated) (cm)	200W x 160 L x 15H	200W x 160L x 15H
Weight (estimated) (kg)	80	80
Material	Termite-proof	Termite-proof
Required No. of pallets	Warehouse capacity (t) / 3t	Warehouse capacity (t) / 3t

Existing pallets (100 W x 100 L x 11 H (cm), 24 kg) for the PWO warehouses are not required when palletization is implemented. They may be transferred to new provincial warehouses where no palletization is planned.

(d) Forklift

Transport machines are required for palletization. The forklift or ceiling crane can be used for loading works in a warehouse, but the forklift must be employed in this project because the continued inside and outside works of a warehouse are necessary conditions.

These works include the following:

° Piling work to place products at a given location in the warehouse after unloading from a truck

- Removal from a pile and movement to a feeding hopper of adjusting facilities
- Storing products in temporary storage after adjustment
- Loading products into a truck for shipment or transferring them to the wharf

One forklift unit is allocated per 20,000 tons of yearly handled rice. Forklift specifications are determined on the following basis of the palletization plan stated above:

Loading capacity	4.0 - 4.5 tons
Power type	Gasoline or diesel engine
Wheels	Air tire, large, 4 (2-wheel driven)
Maximum fork height	3.5 m (3.05 m)
Control type	Rider seated

(e) Platform Scale

Each warehouse is allocated one set of medium-sized platform scales, the same as for provincial warehouses. This platform scale is used for weight inspection at the time of arrival, or daily repacking works at the warehouse.

Principal specifications are:

Weighing capacity	10 - 500 kg
Platform size	Approx. 500 - 700 mm

(f) Small Bag Sewing Machine

Each warehouse is allocated one set of the small sized bag sewing machines, the same as for regional warehouses. However, two sets of the machines are prepared for port warehouses, because these warehouses are composed of many buildings.

(g) Cleaning Tools

In addition to various tools prepared for regional and provincial warehouses, a vacuum cleaner, which is already used at modernized

rice mills is prepared for cleaning in the warehouse. This vacuum cleaner is a strong tool for gathering scattered rice or dust on the floor.

(h) Truck Crane

Loading works into a barge has been conventionally carried out completely manually with a worker's efficiency assumed to be 30 tons per hour for each barge. But man-power loading is reaching its limit. On the other hand, the load working of the truck crane has employed a general working method for heavy products like the steel roll. This proposal recommends that units (100 kg x 30 bags, 50 kg x 48 bags) be lifted to the wharf by forklift, and in the palletization system to be loaded to the barge by truck crane. As an actual example, Mah Boonkrong Rice Mill Co. Ltd., a modernized rice mill company located in the riverside of Chao Phraya, utilizes a truck crane to load rice into a barge. Its efficiency seems to be 500 tons per day.

The following items are to be considered for shipping work by truck crane:

° Type of sling for rice bags present

° In order to enhance efficiency, the bag and the pallet can be shipped together. However, there may be some inconvenience because of the small storage space in the ship.

The following are temporary specifications of the truck crane:

Efficiency (day)	500 tons/base
Objected barge	Maximum 200 tons (32.2 L x 8.4 B x 3.7 D (m))
Max. lifting capacity	20 - 25 tons
Max. boom length	20 - 25 m
Max. working radius	To be capable of turning above the wharf
Outriggers	Hydraulically operated, simultaneously or independently

8-3-5 Planning Rice Processing Equipment for Export Rice

As indicated in Table 8-6, the rice processing equipment for export rice is to be planned for Nonthaburi (150 tons/day), Rajburana (350 tons/day) and the Laem Chabang (700 tons/day) based on the annual processing volume at each site. The basic function is the same respectively, but according to given conditions, scale, site, whether a warehouse is present or not, and the layout and machine configuration are to be different.

Table 8-6 Plan for Rice Processing Equipment Scale for Shipping Facilities

(ton)

Site / Item	Bangkok River Port			Seaport
	Rajburana	Bukkalo	Nonthaburi	Laem Chabang
Processing volume (daily)				
Export rice	350	-	150	700
Domestic consumption rice	-	100	-	-
Section in plant (Processing capacity for each process (hourly))				
Receiving section	50	15	25	110
Processing section	20	8	10	50
Repolishing section	5	2	2.5	12

(1) Export Rice Processing Equipment at Nonthaburi

Design Specifications

1. 40,000 tons of rice are planned for handling annually at the Nonthaburi warehouse. A part of the products are supplied to the Bangkok Metropolitan area but most of the handling volume is loaded onto a barge and exported.

2. Assumptions are as follows:
   Annual operation days are to be determined at 250 days, then layout and equipment are established. Regarding the processing volume, daily changes and seasonal changes are not considered.

   Annual processing volume (40,000 tons)/Operation days (250 days)
   = Daily production 160 tons

3. Working hour system is determined as one day-time shift for the receiving process and two day/night-time shifts for machine operation and packing processes.

4. Hourly processing capability for each process section in the plant

   Receiving section
   150 tons (day)/8 hours/0.8 (operation efficiency)
   = 25 tons

   Processing (grading, mixing, packing) section
   150 tons (day)/16 hours/0.9 (operation efficiency)
   = 10 tons

5. Processing capability of polishing and repolishing (for inferior rice) for high quality rice processing is assumed to be 25 percent of the whole processing capability.

   10 tons (hour) x 0.25 = 2.5 tons (hour)

6. Machine facility building is built. The machine layout is arranged with the solid type to reduce the occurrence of broken rice caused by bucket elevator during processing.

7. The flowchart is shown in Fig. 8-12, and Fig. 8-13 indicates the machine facility building.

8. The receiving bin (tank) is capable of offering a distribution processing capability (permitting feed products in the day-time and the performance of day and night works) as plant. To be planned as an indoor type of steel product.

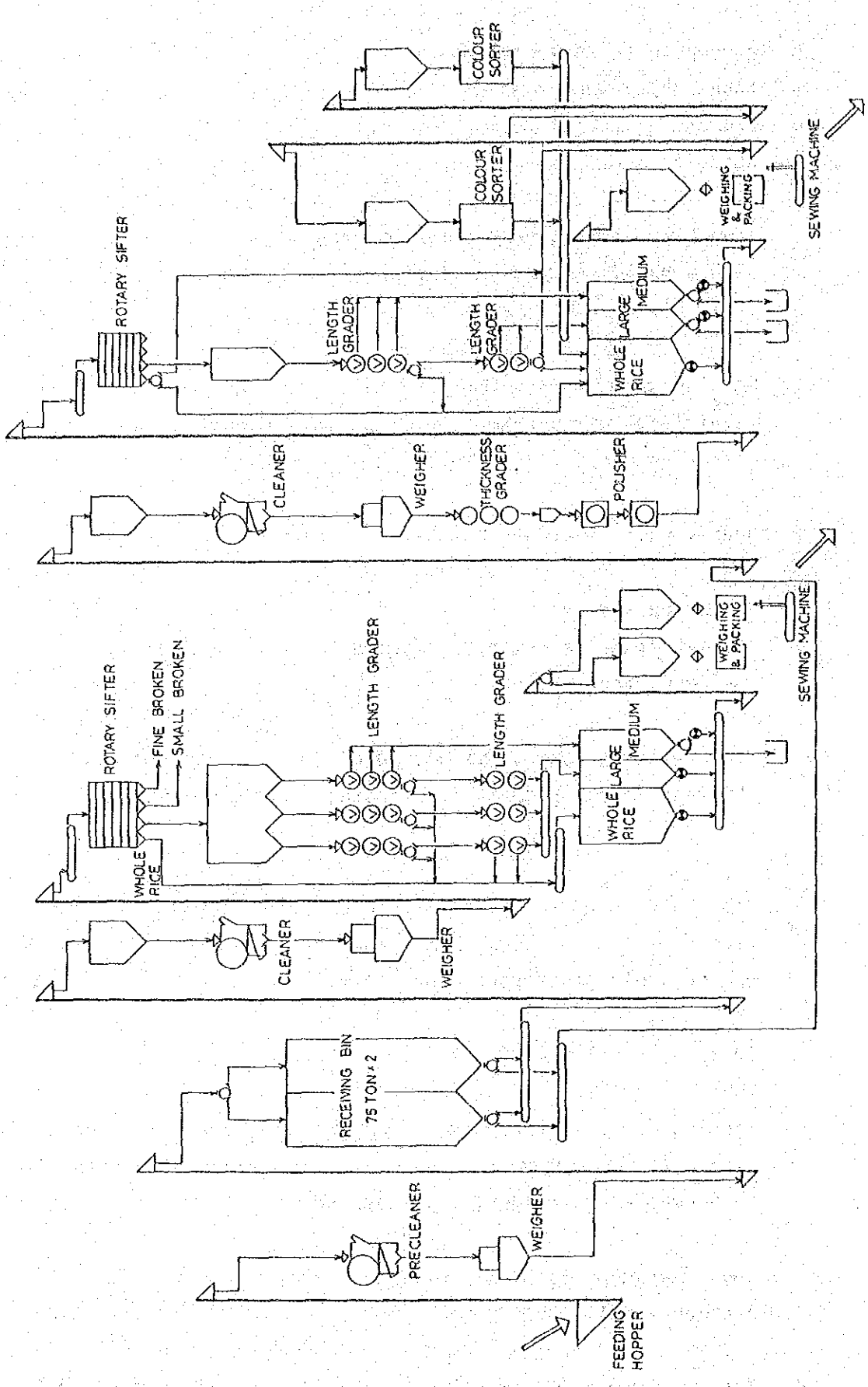
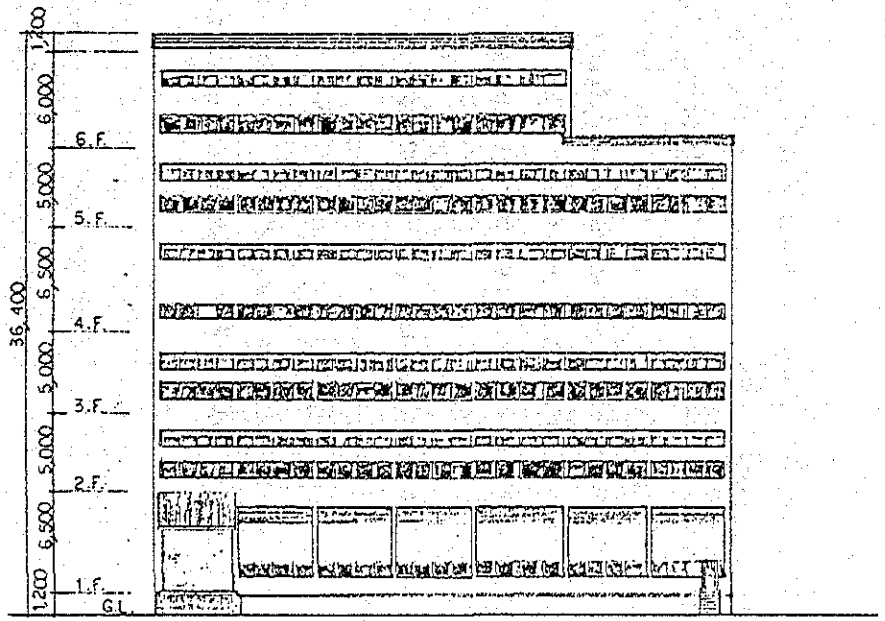
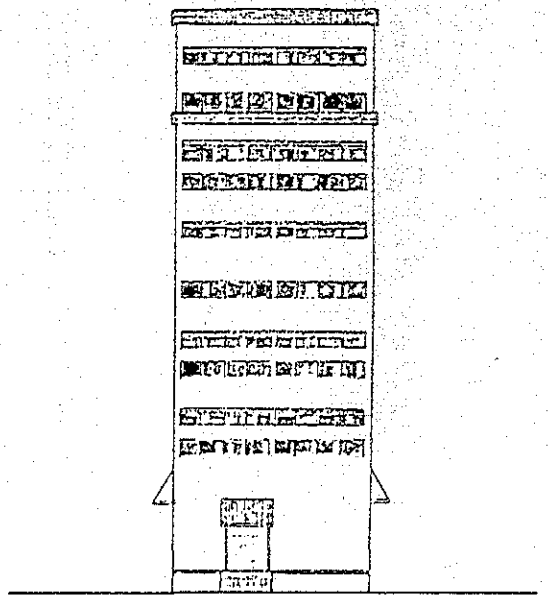


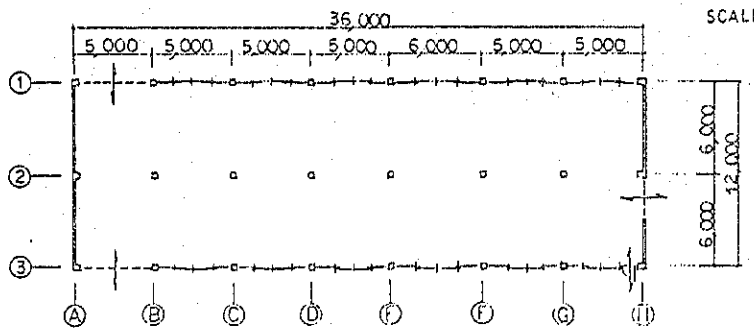
Fig. 8-12 Flow Chart of Rice Processing Equipment for Export Rice (Vertical Type), Nonthaburi



ELEVATION



ELEVATION



PLAN

SCALE 0 1 2 3 4 5 m 10 m

6 F	312 m²
5 F	432 m²
4 F	432 m²
3 F	432 m²
2 F	432 m²
1 F	432 m²
TOTAL	2,472 m²

Fig. 8-13 Machine Facility Building at Nonthaburi

9. Main components:

Receiving section

Feeding hopper, pre-cleaner, weigher, receiving bin

Grading, mixing, packing sections

Cleaner, weigher, rotary shifter, length grader, mixing device, weighing and packing device, bag sewing machine

Repolishing section

Cleaner, weigher, thickness grader, polisher, rotary shifter, length grader, color sorter

(2) Export Rice Processing Equipment at Rajburana Design Specifications

Design Specifications

1. 110,000 tons of export rice are planned for handling annually at Rajburana warehouses.

2. There are to be 300 annual operation days and an equipment scale is established. Regarding the processing volume, the daily change and seasonal change are not considered. The export rice shipment is usually concentrated continuously over a certain period, but it is uncertain throughout the year so that forecast processing covers the change. In order to satisfy the plan, the existing warehouse equipment capacity is to be allocated for temporary storage space.

Annual processing volume (110,000 tons)/Operation days (300 days)
≒ Daily production 350 tons

3. Working hour system is determined as daytime-one shift for receiving process and daytime and nighttime two-shifts for machine operation and packing processes.

4. The whole flow is to be set as two lines so that it can correspond to reductions in the handling volume. Fig. 8-14 indicates the flow.

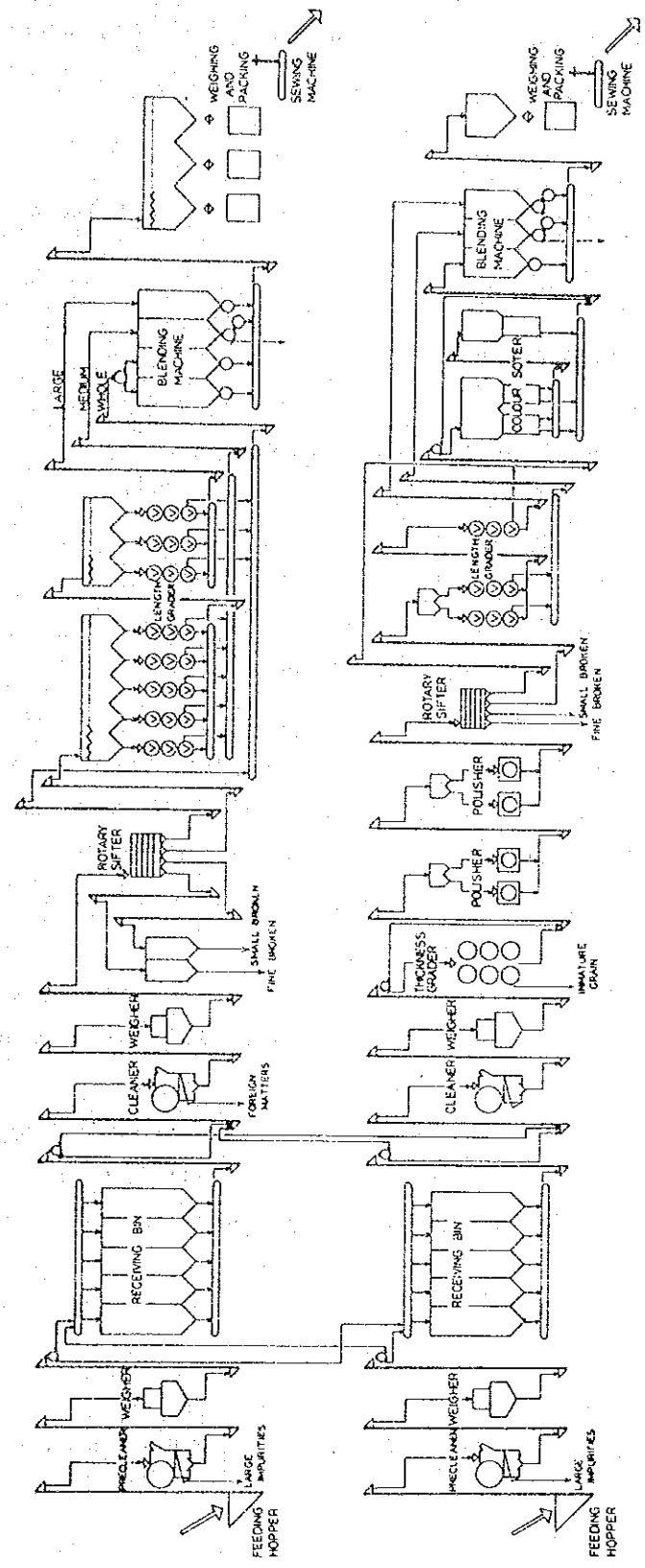


Fig. 8-14 Flow Chart of Rice Processing Equipment for Export Rice, Horizontal Type, Rajburana

5. The hourly processing capability for each process section in the plant:

Receiving section

300 tons (day)/8 hours/0.8 (operation efficiency) ≒ 50 tons

50 tons = 25 tons x 2 lines

Processing section

300 tons (day)/16 hours/0.9 (operation efficiency) ≒ 20 tons

20 tons = 10 tons x 2 lines

Repolishing section

25 percent of the processing capability is to be assumed.

20 tons (hour) x 0.25 = 5 tons

5 tons = 2.5 tons x 2 lines

6. As stated in the previous section, the facilities are to be installed in the fifth warehouse of the PWO Rajburana warehouses. Since the facilities are to be installed in an existing building, the flat type layout is employed. The layout is shown in Fig. 8-15.

7. Receiving bins (tanks) are to be installed in existing buildings by arranging them in a random order. This bin employs the indoor type of steel tank.

The tank capacity is set at a daily receiving volume (300 tons) and has a continuous processing capability during the day and night, after receiving products during the day.

8. Main components:

Receiving section

Feeding hopper, pre-cleaner, weigher, receiving bin

Grading, mixing, packing sections

Cleaner, weigher, rotary shifter, length grader, mixing device, weighing and packing device, bag sewing machine

Repolishing section

Cleaner, weigher, thickness grader, polisher rotary shifter, length grader, color sorter

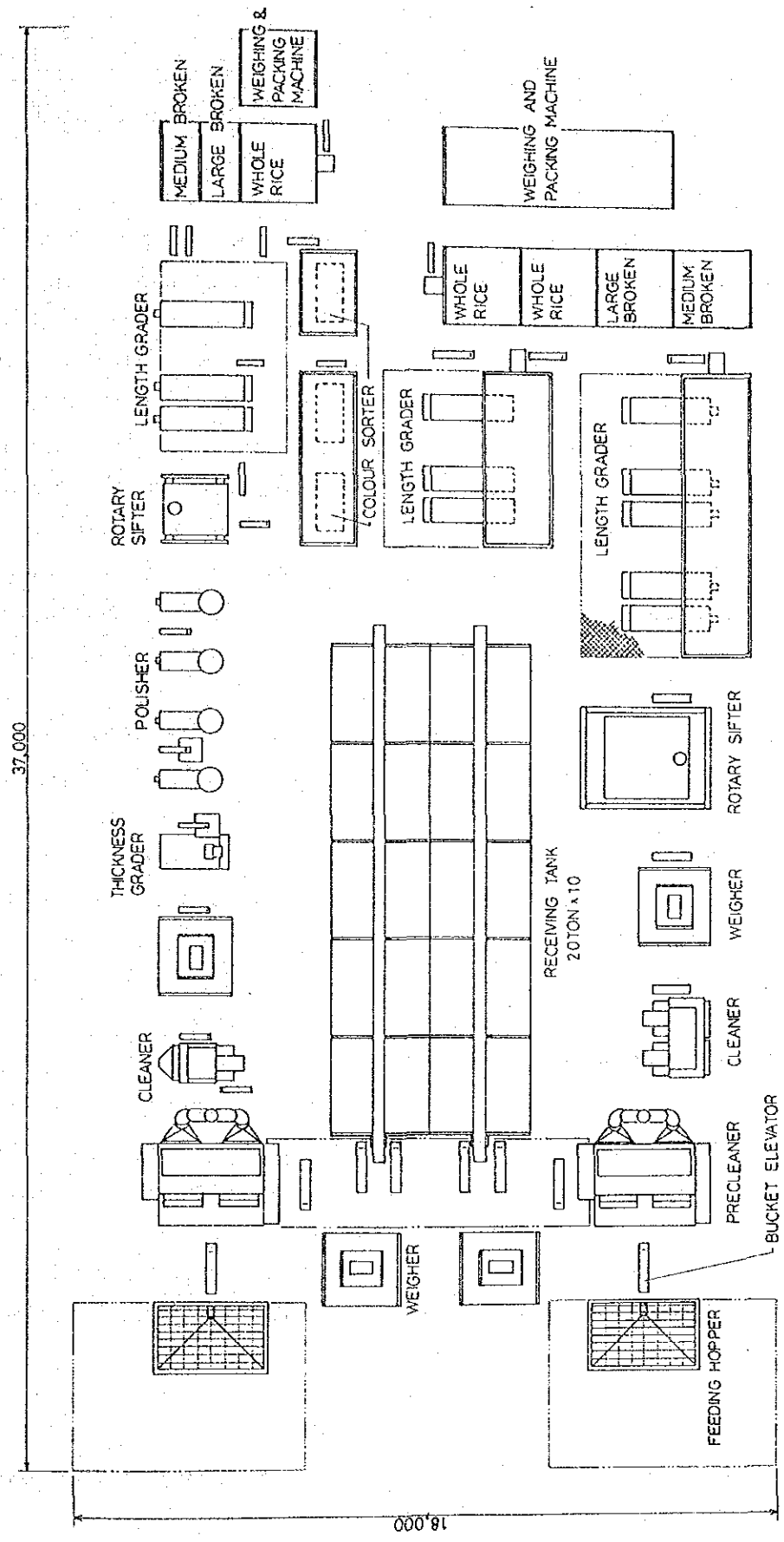


Fig. 8-15 Layout Plan of Rice Processing Equipment for Export Rice, Horizontal Type, Rajburana

(3) Export Rice Processing Equipment at Laem Chabang

Design Specifications

1. A warehouse being planned at the Laem Chabang is to handle 200,000 tons of export rice annually. Thus the equipments specifications are to be designed to process mainly export rice.

2. There are 290 operation days at the plant to reduce invested capital. After analyzing the actual export results at the Bangkok port, it has been clarified that the export volume is generally flat throughout year. Shipments are occasionally concentrated in a certain period but processing seems to be carried out as planned. As a result, the equipment seal is determined by assuming that the coefficient variation is 1.0.

   Annual processing volume (200,000 tons)/operation days (290 days)
   = daily production 700 tons

3. In order to carry out plant operation safely and stably, the equipment is basically composed of two lines. This permits economical correspondence for the reduction of the processing volume.

   700 tons/2 lines = 350 tons (line)

4. The same as for other equipment, the working hour system is determined as only daytime for the receiving process and day and nighttime for the processing process.

5. Processing capability per hour for each process section in the plant:

   Receiving section
   700 tons (day)/8 hours/0.8 (operation efficiency) ≒ 110 tons
   110 tons/ 2 lines = 55 tons
   Feeding is set at two locations per one line
   55 tons/2 locations ≒ 30 tons/hour/location

Grading, mixing and packing sections

700 tons (day)/16 hours/0.9 (operation efficiency) ≒ 50 tons

50 tons/2 lines = 25 tons (line)

In addition, this section is divided into two small lines.

25 tons ÷ 2 small lines ≒ 15 tons (small lines)

Repolishing section

The repolishing capability is to be planned as 25 percent of the processing capability.

50 tons x 0.25 ≒ 12 tons

12 tons ÷ 2 lines = 6 tons/line

6. For an ideal machine layout, a new machine equipment building is planned. The building form is to be the solid type due to the site restrictions of the port plan.

7. The receiving bin is to be designed as a unit type (RC type) to be installed indoors or outdoors.

8. Flowchart of the export rice processing equipment at the seaport is shown in Fig. 8-16.

9. Main components are the same as the equipment installed at Nonthaburi and Rajburana.

Receiving section

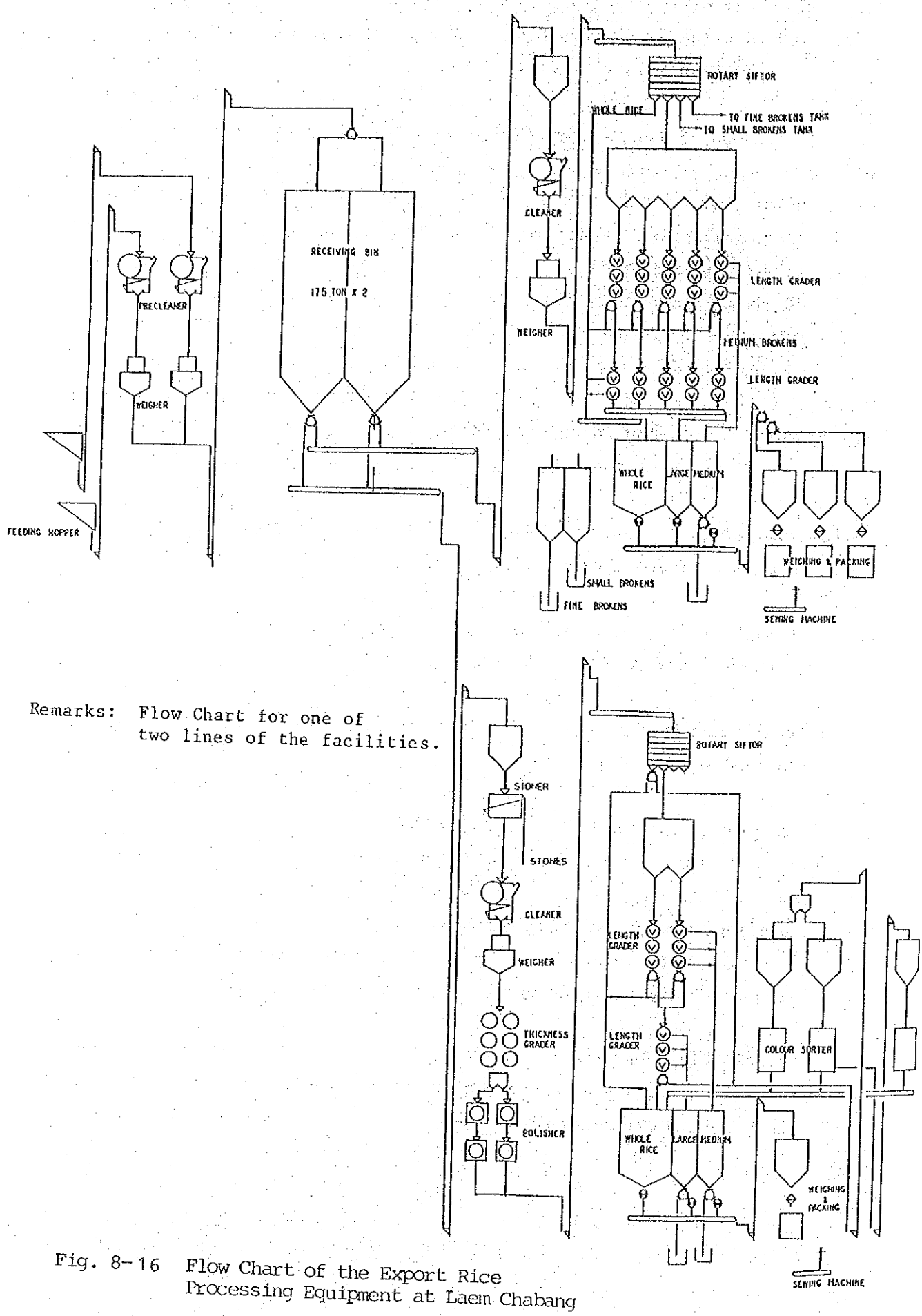
Feeding hopper, pre-cleaner, weigher, receiving bin

Grading, mixing, packing sections

Cleaner, weigher, rotary shifter, length grader, mixing device, weighing and packing device, bag sewing machine

Repolishing section

Cleaner, weigher, thickness grader, polisher, rotary shifter, length grader, color sorter



Remarks: Flow Chart for one of two lines of the facilities.

Fig. 8-16 Flow Chart of the Export Rice Processing Equipment at Laem Chabang

(4) Planning Rice Processing Equipment for Domestic Consumption Rice

As stated in the machinery and equipment preparation plan for existing warehouses of PWO, this equipment is planned for the warehouses at Bukkalo.

Currently small plastic bag packing for the domestic consumption of rice is carried out by PWO, by combining manual weighing and packing machines. The current method has caused the following problems:

- ° Directly packing milled rice containing harmful insects (egg or larva)
- ° Imperfect sealing due to poor packing machine

Cleaning and packing processes in the facilities are to be planned to resolve these problems.

According to the fundamental operating plan in this project, 90,000 tons of rice are to be delivered and processed annually at the warehouses at Bukkalo. The equipment is designed as follows:

Design Specifications

1. Since about 70 percent of the annual handling volume, 90,000 tons, is supplied to big customers with large bags, 30,000 tons are assumed to be processed for small bag packing at this plant. (For large type of packing; cleaning, mixing, weighing and packing processes seem to be required, but the actual status has not been clarified so that details are omitted in this paper.)

2. The equipment scale is to be planned on the assumption of 300 annual operation days at the plant.

   Annual handling volume (90,000 tons) x 1/3 = 30,000 tons
   30,000 tons/operation days (300 days) = daily production 100 tons

3. The working hour system is determined as one daytime shift for the receiving process and two day and nighttime shifts for machine operation and the packing process.

4. Hourly processing capability for each process section in the plant:

Receiving section
100 tons (day)/8 hours/0.8 (operation efficiency) ≒ 15 tons

Mixing and packing sections
100 tons (day)/16 hours/0.8 (operation efficiency) ≒ 8 tons

Repolishing section
25 percent of the processing volume is subject to processing.
8 tons x 0.25/0.9 (operation efficiency) ≒ 2 tons

5. Fig. 8-17 indicates the flowchart.

6. A new machine equipment building is planned for construction. The machine layout is arranged with the solid type to reduce the occurrence of broken rice and to reduce necessary space.

Fig. 8-18 shows the machine layout and a brief drawing of the building.

7. Main components:

Receiving section
Receiving hopper, pre-cleaner, weigher, receiving bin

Mixing and packing sections
Rotary shifter, mixing tank, mixing device, mixing and packing device

Repolishing section
Cleaner, rotary shifter, color sorter

8-4 Items on Machinery and Equipment at the Implementation Study Phase I

The following section describes the details of the suspension of the machinery and equipment plan at phase II, carried from the implementation study phase I.

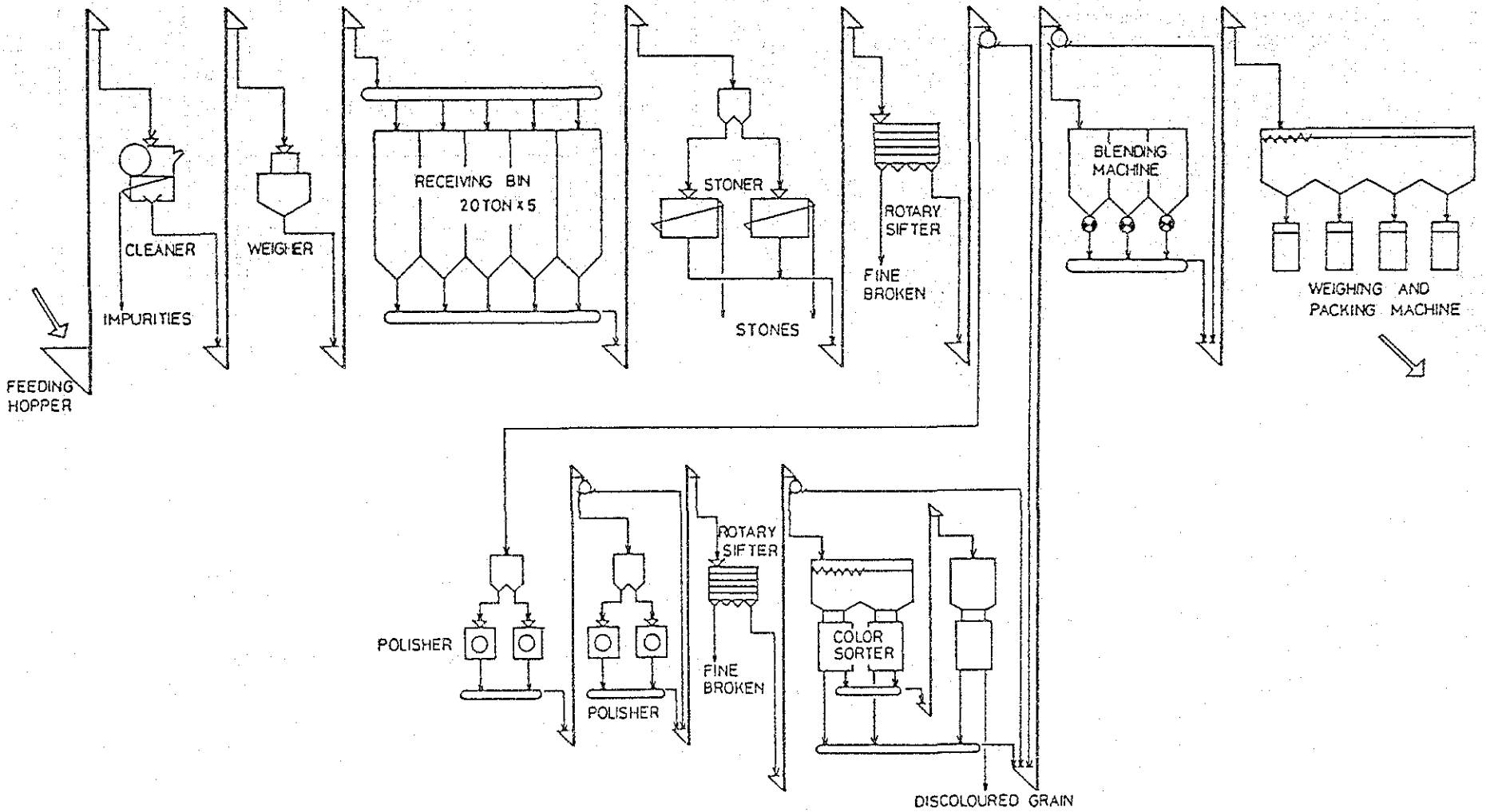
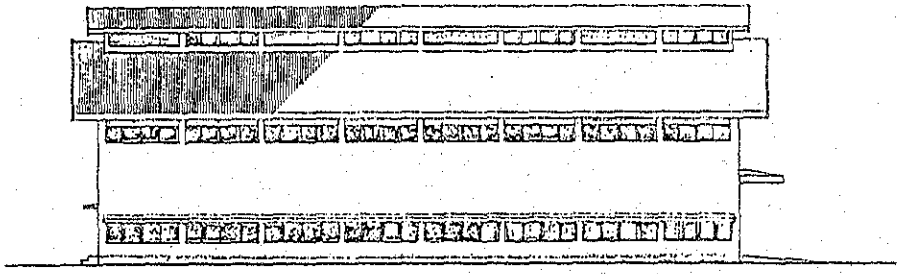
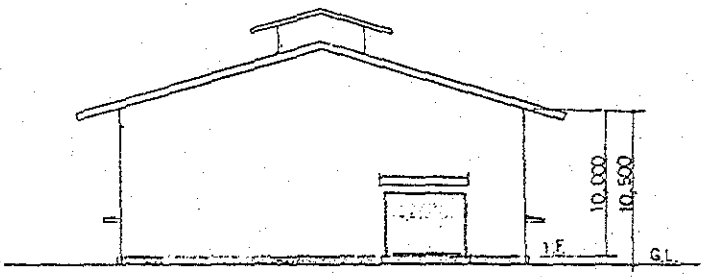


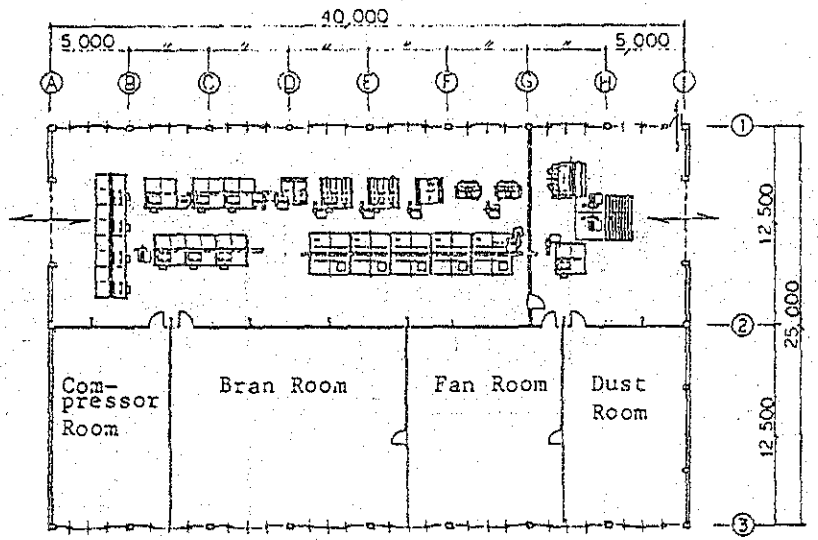
Fig. 8-17 Flow Chart of Rice Processing Equipment for Domestic Rice, Bukkalo



ELEVATION



ELEVATION



PLAN

SCALE 0 1 2 3 4 5 10

TOTAL 1,000 m²

Fig. 8-18 Machine Layout and Brief Drawing of the Building at Bukkalo

(a) Cleaning Process Prior to Storing Cleaning Rice

Generally the efficiency of milled rice storage is increased after removing bran. However, it seems to be very difficult to perform the actual cleaning process prior to storing the rice with current warehouse operations. Currently, clean rice is distributed in the bag form.

That is, received milled rice in bags is directly stored without cutting the bag so that when performing the cleaning process for storage, processed rice must be bagged again or stored in bulk. This causes other problems.

Cleaning processing before storage is useful in enhancing storage efficiency but provides other problems.

(b) Humidity Remover Installation to Reduce the Moisture of Milled Rice

This is an improvement approach designed to enhance the storage efficiency as material by equalizing the moisture of the rice with a maintained low temperature through the humidity removal operation in the warehouse.

To introduce this approach, a dehumidifier must be employed and the warehouse must be kept closed.

The warehouses involved in this project are basically the opened-type ones, so that it is impossible to improve humidity conditions.

(c) Bin (Silo) Planning for Storage in Bulk

Since there has never been extended storage of milled rice in bulk, technical problems have not been clarified at this moment. However milled rice can be broken with impact when throwing it into a silo. In addition, the rice may become poor quality. As a exceptional case, if the cleaning process and processing process for export rice are performed at the same location under the same management, milled rice after processing can be stored in a bin (silo). This storage

system permits the milled rice processing according to an export order and omits the intermediate bagging process. In this case, the bin functions as a material bin for a milled rice processing plant but this case does not apply to this project.

Silos for milled rice being planned by the private sector in Thailand are designed to increase the efficiency of loading works at port warehouses and the processing process or fumigation works, and are not for storing rice for a long period.

(d) Shipping Mechanization

The spiral shoot type ship loader is the sole example of export rice shipping equipment being installed at Tanakit warehouses in Bangkok port. Unfortunately, the equipment is not in a stage of implementation, so that adaptability from the technical viewpoint has not been clarified.

At seaport warehouses in this project, the rationalization and efficient operations for shipping works are urgently required, but loaders (including unloader) for bagged rice are not technically established. Thus the machinization must be suspended regardless of economic evaluations in this project.

(e) Milled Rice Storage and Transportation Plan

This plan requires approximately three times the construction expenses as compared with warehouses to be constructed on sites. This project has determined that this plan is not necessary to implement.

8-5 Expected Rate of Increased Export Prices Accompanying New Machine and Equipment Introductions

This section attempts to clarify to what degree the rice value is expected to increase when PWO applies the new machine and equipment to be installed in this project to increase quality.

PWO purchases various types of rice in production areas throughout the country, then it is stored in port warehouses and forwarded for the purpose of both domestic and overseas use after grading it to satisfy quality requirements based on purchase contracts. However, the current processing is accomplished by employing manpower and the intuition of the supervisor. Therefore, the processing can only upgrade the rice at a minimum range and produces products that are not well-uniformed in quality, thus causing Thai rice to lose its reputation in worldmarkets.

The modernized machine to be introduced in this project permits the upgrading of the original milled rice to two ranks of upgraded milled rice. For example, the machine provides the capability for removing broken rice from 25 percent of the milled rice, increasing the whiteness, and enhancing its whole external appearance by removing damaged rice. It can also process milled rice at 20 percent to 15 percent grade quality of milled rice.

In order to study to what degree the value of raw milled rice can be increased through quality improvement, the following "FOB Price List Classified by Grade" was referred to as basic data:

FOB Price List Classified by Grade (Dec. 1984)

White Rice	100%	1st grade	$275,000 *
	"	2nd grade	$240,000
	"	3rd grade	$235,000
	5%	super	$232,000
	"	ordinary	$230,000
	10%		$225,000
	15%		$223,000
	20%		$220,000
	25%		$215,000
	35%		$211,000

* "White Rice 100% 1st grade" means a brand for special markets such as Hongkong, Singapore, etc. Therefore, this brand has not been included in this study.

Case 1:

When 2 grades up is the improvement goal through the use of the modernized machine to be newly introduced in this project, a price variance between the 1st grade and the 2nd grade on the above list becomes $7.14 with the average value. This price

variance is equivalent to 3.17 percent of the increased price rate, if the price of 10 percent of the quality milled rice is specified as the standard.

Case 2:

When the 3rd grade up is placed as an improvement goal, the price variance becomes $10.5 with the average value and is equivalent to 4.67 percent.

Case 3:

"White Rice 100% 1st grade" is excluded from the study items but the machine to be introduced in this project can easily improve 2nd grade products to 1st grade products. The price variance between the 2nd grade and 1st grade is $35.- and the increased price rate is actually 15 percent.

This processing produces broken rice which has a commodity value as a by-product. However, its volume is limited and the selling price is inexpensive, so broken rice is excluded from the study.

The above are details of studies on quality and prices for the introduction of the machine for milled rice. However, PWO seems to be selling most of the milled rice to both domestic and overseas markets in the above case 1. Therefore, an expected increased price rate is regarded as 3.0 percent from the point of conservative view.

CHAPTER IX STORAGE TECHNOLOGY IMPROVEMENT AND TRAINING CENTER

CHAPTER IX STORAGE TECHNOLOGY IMPROVEMENT AND TRAINING CENTER

9-1 Purpose and Function

The Storage Technology Improvement and Training Center's aim is to develop activities necessary to improve various problems being involved with storage of agricultural products and to give proper guidance to these activities in order to make practical applications feasible.

The Center is not purely an academic institute where only scientific subjects are researched. Its purpose is to work out practical solutions for the various storage-related problems which Thailand faces in each stage of production, markets and export of rice. For this purpose, the Center will help the necessary activities and training.

Taking into consideration the importance of rice and the emergence of problems which must be solved, the Center will presently concentrate on storage improvement of rice. However, as the sufficient number of efficient staff members grows, and more experience is accumulated, PWO will develop various other activities regarding other kinds of agricultural products.

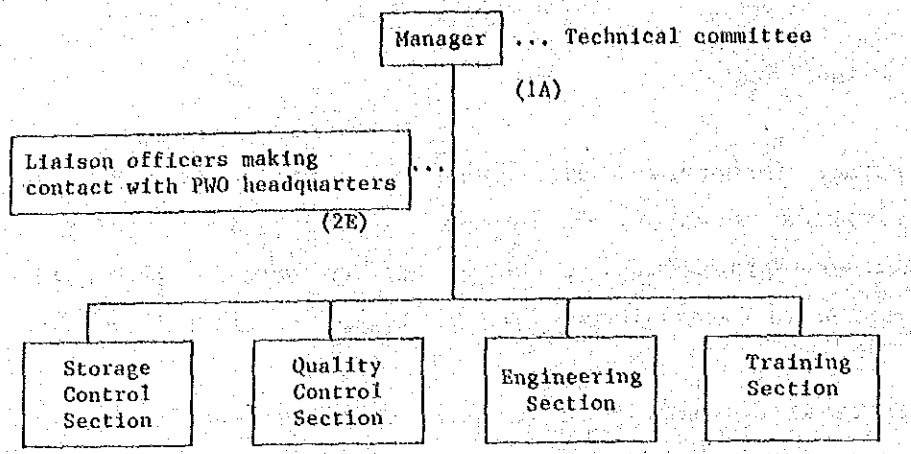
Activities undertaken by this Center are characterized by efforts to enhance technology in carrying out services related to PWO. Secondly, the knowledge of improved storage methods in the tropical areas acquired through these activities is to be shared among people concerned with storage work. The ultimate objective of the activities is to improve and expand the storage facilities of farmers, markets and export ports in Thailand and to improve technology.

9-2 Structure and Activities

9-2-1 Structure

This is a PWO institute and is under the direct control of the managing director of PWO. The Center is, however, operated by the "Project Committee", which comprises the representatives of the planning, financial and business departments of PWO until such time as the Center is firmly organized and begins to function independently.

Fig. 9-1 Storage Technology Improvement and Training Center



Storage Control Section	Quality Control Section	Engineering Section	Training Section
Chief: (1A)	Chief: 1A	Chief: 1A	Chief: (1A)
Warehouse control: 1B	Quality control: 1B	Machine design: 1B	Agricultural economy: (1B)
Assistant: (2C)	Pest & micro-organism control: 1B	Machinery maintenance management: 1B	Statistics: (1B)
Computer operator: (1B)	Assistant: (3C)	Assistant: 4C	Assistant: (2C)
Assistant: (1C)		Operator: 2D	
6	6	9	5

Attached warehouse

Persons in charge are not stationed, for each technology improvement section is mutually managed.

Model facilities for handling bulk paddy

The necessary staff will be dispatched from the above-mentioned technology improvement section when the facility is operated.

1B
1D
1E

Note: The figures indicated in parentheses show the number of staff members who have already been employed by PWO.
Figures not indicated in parentheses show the number of new workers to be recruited for the operation of this Center.

	Currently employed persons	New persons to be recruited	Total
A: Management	(3)	2	5
B: Researcher	(3)	6	9
C: Research assistant	(8)	4	12
D: Skilled workmen	-	3	3
E: Clerk	(2)	1	3
Total	(16)	16	32

The Center is simply and functionally organized, and is operated by the minimum number of necessary personnel. Although each staff member is entrusted with his own duties, he is not only responsible for that restricted and specific work, but also for overall activities. This means that he must participate in all of the work. The structure and allocation of personnel are shown in Fig. 9-1. The organization consists of four technical improvement sections, which are set up at the main office, and an attached warehouse proposed for the purpose of testing and training, and model facilities for handling bulk paddy. The general management sections of this Center such as the general affairs, personnel position, supplies, etc., are incorporated into the main PWO organization. The Center utilizes liaison men only to save expenses and rationalize management.

The Center performs a wide variety of activities assisted by other administrative organizations, public corporations involved, universities. In order to obtain more practical counsel, it is desirable to set up the "Technical Committee". This committee should consist of representatives from each PWO section, the ministry of Commerce, the ministry of Agricultural and Agricultural Cooperatives, BOT, BAAC, MOF, ACFT, universities, other related public organizations, and non-governmental organizations such as the Rice Millers Assoc. and Rice Exporters Assoc.

9-2-2 Contents of Activities

(1) Technical Improvement Sections for the Storage Technology Improvement and Training

The outline of activities performed by each section is as follows. Details of anticipated activities are described in the Appendix I-1.

1) Storage Control Section

a. Studying actual condition of storage
b. Establishing Inventory standarization
c. Planning expansion of warehouses

2) Quality Control Section

a. Improving quality control on paddy and rice in storage management

b. Establishing grading unit in PWO operations

c. Improving the quality of rice to be exported

d. Assumption of damage caused during storage

e. Study on preventive measures

f. Planning actual measures against damage by insect, microbes, birds and rats and realize the plan

3) Engineering Section

a. Collecting wide knowledge of the warehouse and rice processing machinery and equipment

b. Introducing proper machinery necessary for controlling the internal environment of a warehouse

c. Improving the mechanical processing method of rice and other agricultural products

d. Improving packing methods and introducing new technology

4) Training Section

a. Giving basic knowledge

b. Training with various technology of storage

c. Various extension activities

(2) Attached Warehouse

a. Testing at a low-temperature warehouse

b. Testing at a natural temperature and humidity control warehouse

c. Testing at a fumigation warehouse

(3) Model Facilities for Handling Bulk Paddy

a. Improvement by the handling system of paddy using model facilities

b. Developing technology on the processing (such as drying and cleaning) of paddy

c. Testing and technical research on paddy storage in modern facilities

d. Technical review of flat warehouse storage and silo storage

9-2-3 Basic Activities

The activities performed by the Center include study and training for improving storage techniques, especially on agricultural products, centering paddy and rice in the tropical areas.

If we consider the expansion of rice storage facilities, the following matters must be considered.

1) To investigate how paddy and milled rice are actually stored at present,

2) To study how this condition is reflected in economic, distributive and social situations,

3) To find out the technical standard of storage facilities and the cause of loss during storage,

4) To design a standard warehouse which is economical and functional in tropical areas,

5) To improve organization necessary for the storage management,

6) To provide training for a storage technique,

7) To review guidance on how to store agricultural products and what is to be improved,

8) To clarify the priority order of improvement, which includes post-harvest technology applications with emphasis on drying agricultural products for storage, quality, marketing, etc.,

9) To propose the necessary measures for storage at each level of farmers, markets and export through which the quality of agricultural products is maintained and upgraded, and

10) To feed back the perspective into progress in this whole status; to again review realistic storage methods and to make the plan more feasible

9-2-4 Trainees

Employees to be trained in these techniques are as follows: PWO staff, the related personnel of ministry of Agriculture and Cooperatives, Agricultural Cooperative Federation of Thailand (ACFT), Marketing Organization for Farmers (MOF), Bank of Agriculture and Agricultural Cooperation (BAAC) as well as the technical staff members of governmental organizations, non-governmental organizations and various organizations relating to the warehouse business. Regional representatives from farmers nationwide are also eligible, as it is necessary to urge storage at the farmer's level. The number of potential trainess reaches several hundred a year, as the needs for developing and spreading this kind of technology are very high.

9-3 Outline of Planned Sites

9-3-1 Nonthaburi

(1) Proposed Site

Construction is planned in Bankasor, Nonthaburi province which is located about 20 km north of Bangkok. As this area is adjacent to the north of Bangkok, it belongs to the Metropolitan area of Bangkok, characterized as a satellite city of Bangkok.

The site is situated along the east bank of the Chao Phraya River. Its shape is close to a rectangle and the area covers 77,408 m^2. On the east side of the site, an unpaved road about 6 m in width runs along the site. Traffic and transportation facilities are well serviced to Bangkok and other areas, for the river and the road can be utilized. The carbide plant is on the south side of the site. On the north side, both banks of the river are studded with private homes.

There was once a jute factory on the site, but now only debris and desolate factory buildings, generator stalls, and buildings used for houses or dormitories of workers remain, along with the pond (8,690 m^2) which may have been formed as a result of removing earth for levelling the ground. On the north side of the site and along the river, there are ten old warehouses, eight of which are still used as PWO warehouses. The land is now rented from the Treasury Department. PWO once planned to build a headquarters. Thus, most of PWO's main facilities will be constructed on this land in the future, and it is necessary to effectively utilize this site.

(2) Natural Conditions

This site climatically belongs to the tropical monsoon zones where the rainy season and dry season are distinctly separated. The annual average temperature in Bangkok is around 27.7°C, and the difference in the average temperature between the hottest month and the coldest month is 4.2°C, relatively small. Although annual precipitation is not the same every year, it is about 1,500 mm, 80 to 90 percent concentrating in the rainy season which is from May to October.

The site lies on the alluvion of the Chao Phraya River and the weak strata of a delta are widely distributed. Therefore, strong, supportive soil cannot be expected and each foundation needs piling work.

(3) Infrastructure

EGAT (Electric Generating Authority of Thailand) performs generation, transmission and transformation of power, and distribution is made by MEA (Metropolitan Electricity Authority) in the Metropolitan area and by PEA (Provincial Electricity Authority) in provincial areas. The transmission voltage is 220/380 V and the frequency is 50 Hz. In the construction-planned area, power is distributed to warehouses and offices at present, and three-phase transmission lines run along the road.

Telephone lines are laid near the site and there are no future potential problems.

Waterworks are not provided at present and water is supplied from wells, which are recommended as the water supply to the Center.

There is no sewage and there is no choice other than to drain sewage into the Chao Phraya River after it is cleaned. Gas is not supplied to the site at present, and propane gas is used at warehouse and offices.

9-3-2 Chai Nat

The planned site is situated about 7 km north of the city of Chai Nat. Provincial warehouses with a 5,000 ton capacity will be constructed on the site.

This site stretches from west to east and the west side faces the 6 m-wide paved road for a distance of 200 m. The site located in hilly area and foundation works is not much necessary. The site is well-opened and is not vulnerable to nearby fires or fumigation.

Three-phase transmission lines is only available at 2 km away from the planned site. Waterworks and sewage are not provided, so it is necessary to provide the site with wells, elevated tanks and infiltration tanks for sanitary purposes.

9-4 Basic Plan for Equipment and Building

9-4-1 Basic Planning

The Storage Technology Improvement and Training Center should consist of the Center main building, various warehouses for testing, model facilities for handling bulk paddy. The following basic plans have been established taking into account the effective use of facilities and their functions.

1) Facilities must be functional.

Facilities must provide the proper size and structure to permit the performance of practical training and to enhance rice-storage technology. Each section must be able to communicate with others to effectively perform research and development and to inform other staff members.

Personnel belonging to the facilities must be able to engage in their work in pleasant working conditions.

2) Facilities must be maintained and easy-to-use.

Facilities must be arranged and planned so that they allow for changes in expansion and the reorganization of activity plans. The management department must be able to closely communicate with each department, and facilities must be easily maintained and managed at low expense.

3) Buildings must fit the natural conditions in Bangkok.

Facilities must provide for amenities, taking into consideration the climatic conditions and building environment in the City of Bangkok.

4) Construction costs must be kept at fairest levels possible based on Thai Construction Standards.

Construction costs must be kept at a fair level, and construction standards enforced in the country must be followed to the most feasible extent possible. Furthermore, construction materials must be procured within the country whenever possible. Construction costs can be decreased by positioning buildings as close as possible and shortening lines for power supplies and pipes for water supplies.

5) Construction must be completed in a short time.

The best construction method must be employed to complete construction in a short time.

9-4-2 Plan on Materials and Equipment

(1) Plan on Selecting Materials and Equipment

A sufficient quantity of materials and equipment necessary for building the facilities which are capable of serving the purposes of this project must be provided. Materials and equipment made in Thailand must be used as much as possible. Foreign products can be used only when Thai products are unavailable.

The foreign products must be selected by taking into consideration the supplying method of worn or damaged parts and the repair of these parts.

As regards materials, materials to be used for planning, management and advertisement, which ensure efficient and correct work should be procured. Such works as accounting, classification, copying, entry, retrieval, etc. should be processed by proper and useful machines instead of depending on cheap labor. Heavy reliance on labor may cause many errors and lower efficiency as a whole.

Machinery and equipment for research must suit the purposes of activities performed at the facilities. There are various types of machinery and equipment for research in terms of prices and accuracy, but reasonably-priced ones which can meet the purposes of the research should be selected. The quantity of the above should be decided by taking into account the number of personnel and their ability, as well as the scope of activities performed by each.

(2) The Materials and Equipment to be Used by Each Section or Department

1. Management

1) Materials and equipment for personnel, facility management, operation and accounting sections

(Typewriters, copying machines, mimeographers, document shelves, interphones, office supplies and others)

2) Materials and equipment for a library

(Books, magazines, other publications, bookshelves, book racks, retrieving equipment, micro-film, reading equipment and others)

3) Materials and equipment necessary for a meeting or lecture

(Acoustical instruments, tape-recorders, video tape recorders, cineprojectors photographing equipment, large blackboards, dark rooms, desks, chairs and others)

4) Materials and equipment for transportation and communication

(Telephones for outside lines or extension lines, etc.)

5) Materials and equipment for daily life, welfare, safety and others

(A mess-room, cooking facilities, water-supplying, ventilation & air-conditioning facilities, fire-prevention and safety facilities, etc.)

6) Facilities for maintaining environmental safety

(Materials and equipment for maintaining and repairing buildings, trees and plants, water supplying and draining pipes, tools for repairing roads within the site, power-receiving/distributing/generating facilities and others)

2. Storage Control Section

1) Materials and equipment for controlling warehouses

(Documents, coefficient units, various types of measuring instruments and others)

2) A set of middle-sized office computers

(Central control relating to stored goods, analysis of data, and cost and quality control)

3) Materials and equipment for storing/preserving various samples

(Sample vessels, shelves, and others)

4) The exhibition of various warehouse models and specimen

3. Quality Control Section

1) Materials and equipment for physical analysis

(Milling machines for testing, various inspection and grading instruments and tools for testing and analysis)

2) Materials and equipment for chemical analysis

(Various chemical analysis tools, chemical materials and others)

3) Materials and equipment for collecting and preserving various samples

(Sample vessels, shelves and others)

4) Materials and equipment for eliminating pests, microbes and harmful animals

(Fumigating equipment, chemicals and various pesticide ... These materials should be placed in fumigation test warehouses.)

5) Materials and equipment for checking pests and microbes

(Insect testing facilities, analyzing equipment, microscopes, experimental tools and others)

6) Materials and equipment for displaying pests, harmful animals and damaged bodies

(Exhibition rooms, exhibiting tools and others)

4. Engineering Section

1) Materials and equipment for low-temperature storage tests

(Air-conditioning facilities for controlling temperature and humidity ... These facilities should be installed in the low-temperature test warehouse.)

2) Materials and equipment for mechanizing the work within the warehouse

(Belt conveyors, fork lifts, etc. ... They should be installed in testing warehouses.)

3) Materials and equipment for controlling warehouse 's internal conditions

(Ventilating machines, air-conditioning facilities for controlling temperature and humidity ... They should be installed in natural temperature controlling warehouses.)

4) Materials and equipment in workshop

(Workshop machines, metal tooling machines, casting machines, electrical machines, manual tools, various measuring instruments, painting tools, work desks, tooling shelves, etc.)

5) Materials and equipment for handling bulk paddy

Model facilities for handling bulk paddy are constructed in Chai Nat where is a center of rice double cropping. 3,000 tons of paddy are planned for drying in one crop season. These facilities are utilized mainly for processing of rainy season harvested wet paddy as a model plant.

Design Condition

Total processing volume	3,000 tons/crop season
Total operation days	45 days/crop season
Max. receiving volume	80 tons/day
Volume subject to drying	Max. receiving volume x 0.7
Moisture reduction	Max. 10% (from 20 to 10%)

Main Components

Receiving hopper, paddy cleaner, hopper scale.
Reserve and tempering tank, Silo, paddy storage

Fig. 9-3 shows the machine layout. A rough sketch of the building is indicated in Fig. 9-4.

5. Training Section

Materials and equipment necessary for this section are described in the previous section "Ordinary Management".

9-4-3 The Necessary Functions of Buildings and Facilities

(1) Functional Classification

Necessary facilities can be classified broadly into the following with emphasis on their functions.

1) Facilities to be used for activities performed in each technical section.

Each laboratory room, analyzing, testing & assessing rooms and computer operating rooms

2) Facilities to be used for activities concerning management, operation, meeting, information collection, training, exhibition and advertising:

Office rooms, meeting rooms, lecturing rooms, libraries, exhibition rooms, workshop

3) Facilities containing attached warehouses and model facilities for handling bulk paddy

4) Facilities for providing workers, visitors and trainees with daily activities and rest:

Rest rooms, mess-rooms, dormitories, etc.

(2) Sizes of Facilities

Although the sizes of facilities necessary for each section are not the same, the following facilities are planned by taking into account the activities and the number of staff members to be allocated to each section and the types of work they perform.

Types of Buildings	No. of Facilities		Area
Main building	1		1,762 m^2
Testing warehouse	1		
	Low-temperature test warehouse		100 m^2
	Fumigation test warehouse		200 m^2 (100 m^2 x 2)
	Natural temperature/humidity controlling warehouse		300 m^2
	Workshop		100 m^2
	Total		700 m^2
Model facilities for handling bulk paddy (drying, cleaning, storage)	1 set	1,500 tons	Silo
		1,500 tons	Flat
	Total	3,000 tons	
Trainees' dormitory	1		1,200 m^2
Mess-room	1		195 m^2
Guards' room	1		3 m^2
Employees' dormitory	3		156 m^2
Manager's dormitory	1		120 m^2
Garage	1		60 m^2

The basis for calculating the area of each building is shown in the *Appendix I-2*.

This plan is subject to later changes determined by reviewing the details and feasibility.

(3) Construction Plan

Buildings will be constructed in Nonthaburi and Chai Nat. There are warehouses with a 20,000-ton capacity and export rice processing facilities in Nonthaburi. Buildings in Chai Nat adjoin the warehouse to be established with a capacity of 5,000 tons.

The total layout plan was established including these various facilities.

As the purpose of these facilities differ, separate entrances and exits were laid out and wells, water-supplying towers and power-receiving facilities were also provided separately.

Regarding the main building, though a one story house plan and a two story house plan were discussed, the two story building plan was adopted by considering the effective use of land and increase in cost of piling, etc.

As for the attached warehouse, though both the independent-warehouse plan for each test and integrated-type-warehouse plan were discussed, an integrated type was adopted with respect to cost saving.

(4) Construction Method and Plan for Materials

The main buildings in Nonthaburi are the two story building, the attached warehouse and dormitories.

In Chai Nat, the buildings are the model facilities for handling bulk paddy.

Although Thailand is little affected by horizontal forces such as earthquakes and the wind, these cannot be ignored. The unfavorable conditions in this area are that the basin of the Chao Phraya River is weak as a whole.

In planning construction, climatic conditions are great factors. In this area where the dry and rainy seasons are distinctly separated, the sun, ventilation and precipitation greatly influence the buildings.

Roofs

As roofs are greatly affected by the sun, they must be designed to resist strong sunlight and heavy rain. In addition, to prevent heat from rising in rooms, it is desirable to install heat insulating materials between the roof surface and the rooms.

In constructing these buildings, the roofs are sloped at 4/10 or more and the length of the eaves is 2.5 to 3.0 m. Wave asbestos slate was used and, in some buildings, heat insulation materials are

used separately in the ceiling and under-roof materials to shut off radiant heat.

Walls

Walls are also greatly affected by the sun and rain. Usually, materials are used which have a great resistance to heat transmission, and louvers and eaves are installed as a means of shutting out the sun. In this district, however, natural air-flow is provided thanks to monsoons. Only specific rooms are air-conditioned. It is best to use blocks as wall materials and to coat perlite mortar on both sides of the walls as a heat insulating material. Workshop should be slated and it is recommended that low-temperature warehouses be built, natural temperature/humidity controlling warehouses and fumigation test warehouses in a reinforced concrete structure to attain a closed system.

Floors

In the rainy season, this area is often flooded. Therefore, the floor level must be high enough not to be affected by floods.

If the main building is constructed on soft ground, raft-type floors should be adopted. The floor of a warehouse should be made of concrete. The floor of the center building should also be made of concrete and the inner surface of the room should be coated with concrete mortar. In the computer room, the wood floor should be installed 200 mm above the concrete surface. The floor of a warehouse should be of concrete mortar.

In Chai Nat, the floors of a bulk paddy storage warehouse should be of concrete and concrete should be applied to the surface of these warehouses.

Concrete piling should be applied to the foundation. The calculated load of a center building should be 400 kg/m^2, that of a warehouse 4,000 kg/m^2, and the drying warehouse 100,000 kg/m^2. The foundation must be designed as a direct foundation.

Ceiling

The ceiling should be installed only at the necessary points. It should be of asbestos or plywood.

As mentioned above, a construction method suiting the climatic conditions of the planned site should be adopted, thus ensuring the durability of the buildings.

(5) Facility Planning

Plan on Electric Facilities

Planned electric facilities include heavy electric facilities such as power receiving/transforming facilities, power facilities, lamps and outlet equipment as well as light electric facilities such as telephones, broadcasting facilities, etc. The following sections describe the details of these facilities.

Power Receiving/Transforming Facilities

In Thailand, 22 kV is mainly adopted, occupying about 85 per cent of the current used. Only in the southern part is 33 kV distribution adopted. Electricity for ordinary purposes is lowered by transformers installed to poles. 230 V is used for lighting and 400 V for motive power.

Power Facilities

Power for ordinary purposes and experiments is supplied. The voltage should be ϕ3 400 V.

Lamps and Outlets

Fluorescent lamps are generally used and incandescent electric lamps are also used in some parts. Switches should be mounted at the entrances of rooms, to lighten the window side and the inner areas of the rooms. Outlet voltages should be 230 V in principle, and such equipment as a measuring instrument which operates only at a different voltage (ex. 100 V) should be equipped with SLIDAC. Each outlet should be grounded to allow for changes in voltage.

Telephones

The main terminal board for telephones should be installed in the main building and domitories. A small switchboard should be set up in the office. Telephones should be put in the manager's room, each study section and offices.

Broadcasting Facilities

Broadcasting facilities should be provided as a means of sending messages from the main building. The amplifier should be installed in the office room to provide for ordinary broadcasting, emergency broadcasting, work-start buzzing, etc.

Water-supplying Facilities

As waterworks are not provided, wells (150 m in depth) must be dug as a water source, and a water-supplying tower covering 30 m^2 must be installed. In Suphan Buri, the water source to be constructed by the State should be utilized.

Drainage

In the construction site, sewage and mixed dirty water should be drained off separately. Sewage should be sent to the BAKKI type cleansing tank (100-people tank) installed outdoors and it should be mixed with other dirty water after it is cleansed. Drainage is made by the pump installed in the drainage tank.

Fire Extinguishers

A hydrant should be installed within the room as a fire extinguishing facility within the main building. Water should be supplied from the pond into hydrants installed at four places in the room by a pressure pump. Each hydrant is equipped with 30 m-length hoses and a nozzle, and the pressure pump is activated by pressing the push-button switch of each hydrant.

Air-conditioners

Natural wind ventilation should be satisfactory in ordinary cases, but air-conditioners or ventilators should be provided when they are needed for carrying out special research.

9-5 Plan for Executing the Project

9-5-1 Executing Bodies

The competent authority in Thailand responsible for performing and planning this project is the PWO.

9-5-2 Scope of Construction

(1) Facilities Constructed by Foreign Investments

1) Main Building

2) Warehouse for Testing and Traning

It is divided into the low-temperature warehouse, the fumigation warehouse, the natural temperature/humidity controlling warehouse and the workshop.

3) Model Facilities for Handling Bulk Paddy

This contains machine facilities relating to drying, cleaning and storage, a corrugated iron plate cylindrical silo and a one story bulk storage warehouse.

4) Dormitories for Trainees

(2) Facilities Constructed by Local Investments

1) Mess-room

2) Manager's dormitory

3) Staff's dormitory

4) Garage

5) Guard's room

6) Other facilities constructed by local investment

a) Disassembling work (Removal of the existing buildings)
b) Basic civil engineering (Soil piling, fencing)
c) Sewage cleansing tank
d) Waterworks, sewage, rain drainage, power facilities, telephones
e) Supply of construction power and water to be used temporarily
f) Furniture, utensils, curtains, carpet
g) Site construction work (gardens, gates and fences)

9-5-3 Operation and Management

(1) Materials & Equipment, Buildings and the Management of Facilities

The management of PWO headquarters will manage material, equipment and buildings. Materials and equipment concerned with each technology improvement sections should be managed and repaired by these sections in cooperation with headquarters. This means that the responsible section should actively manage these materials and equipment, prepare the list of these materials, the instruction manual, parts list and the description of these materials and equipment. The sections are also responsible for distributing the copies of these documents to the other sections and the departments concerned.

The replacement, supplement, repair and re-modelling of parts should be recorded on the required format. The management department should understand the quantity of used parts, materials, chemicals and experimental materials so that the details may be understood by each responsible section.

As activities performed by each research section expand, facilities and materials/equipment will be fully utilized and consumed. Each section should inform the management section of how much of these materials was consumed and the schedules for their repair, if necessary. The management section will make a budget based on these reports. Fixed assets should be depreciated in this budget.

(2) Maintenance and Operation Costs

Salaries to be paid to the staff of this Center and warehouses, or to laborers, are handled by PWO. It is not necessary, therefore, to include these salaries in the budget of the Center. It is also assumed that model facilities for handling bulk paddy will also be managed and operated by the business departments of PWO.

The expenses necessary for operating this Center must be assessed in detail, but they should be estimated around 3,730,000 Bahts at the time of study conducted as shown in the Appendix I-3. However, this figure may change as more machines will be needed, the maintenance costs of buildings and machines will increase and expenses required for activities, electricity, etc. will increase in the future.

9-5-4 Estimation of Construction Costs

The following is the estimation of construction costs based on the prices made on December, 1984 for these facilities. Further details are explained in the Appendix I-4.

(Unit: 1,000 Bahts)

	Foreign Currency	Local Currency	Total
Building construction costs	46,209	8,071	54,280
Materials and equipment	31,104	-	31,104
Designing and managing costs	10,745	3,429	14,174
Total	88,058	11,500	99,558

In view of the public nature of this Project, import custom duty and other related taxes are not included in the above expenses.

9-5-5 Plan on Construction Process

The construction schedule for these facilities is shown in the attached "Construction Process Table".

9-5-6 Measures to be Taken by PWO Concerning this Project

(1) The existing buildings and obstacles in the site must be removed.

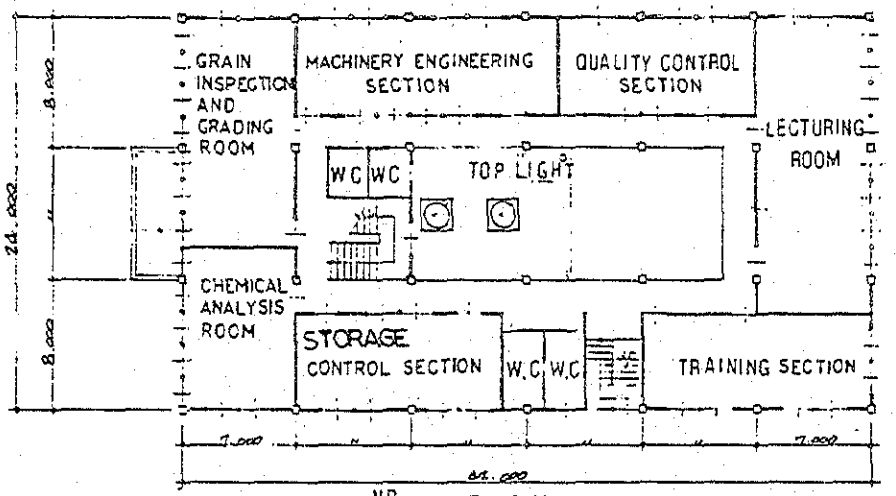
(2) The site area must be levelled to the planned height.

(3) The budget for this project must be secured. Expenses to be handled by Thailand and operational expenses after the Center is completed must be secured.

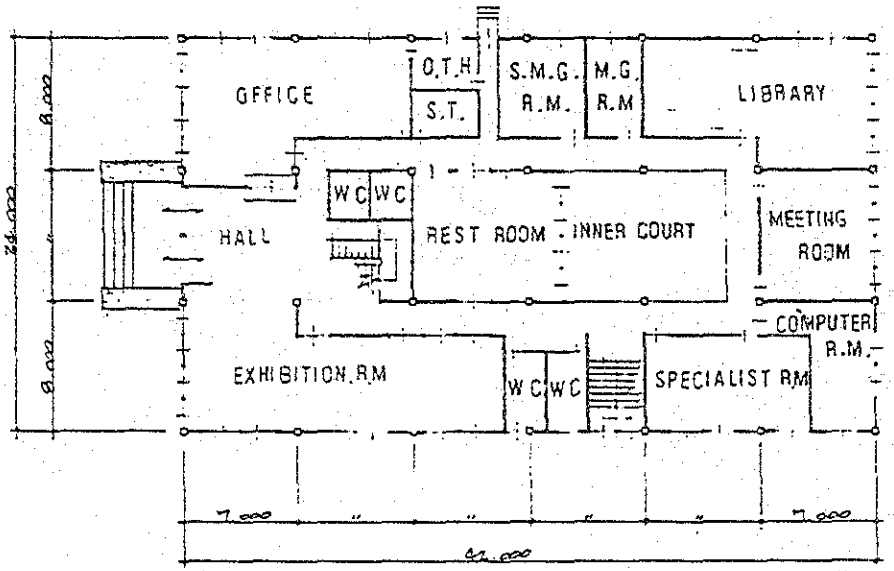
(4) Staff must be trained to enable them to acquire the necessary techniques for utilizing materials and equipment.

(5) Model Facilities for handling bulk paddy would be required high level of operational skills. It is therefore necessary to train the workers to enable them to fully utilize these facilities.

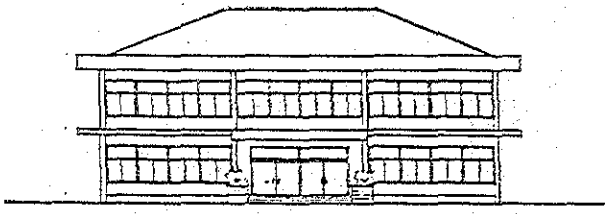
(6) To exempt import tariff and other duties for the materials and equipment required for this project.



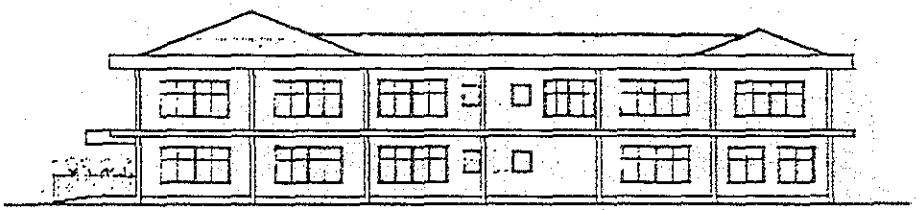
2ND FL PLAN



1ST FL PLAN



ELEVATION



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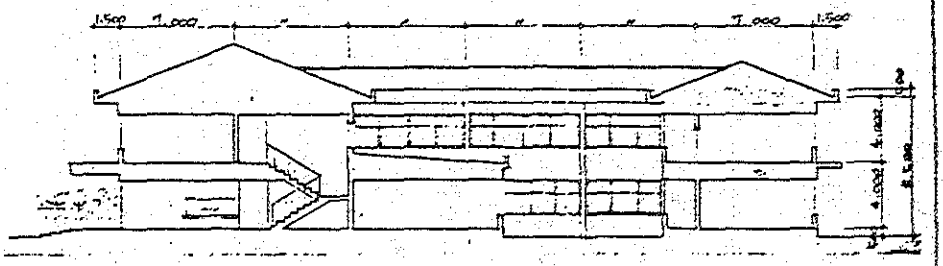
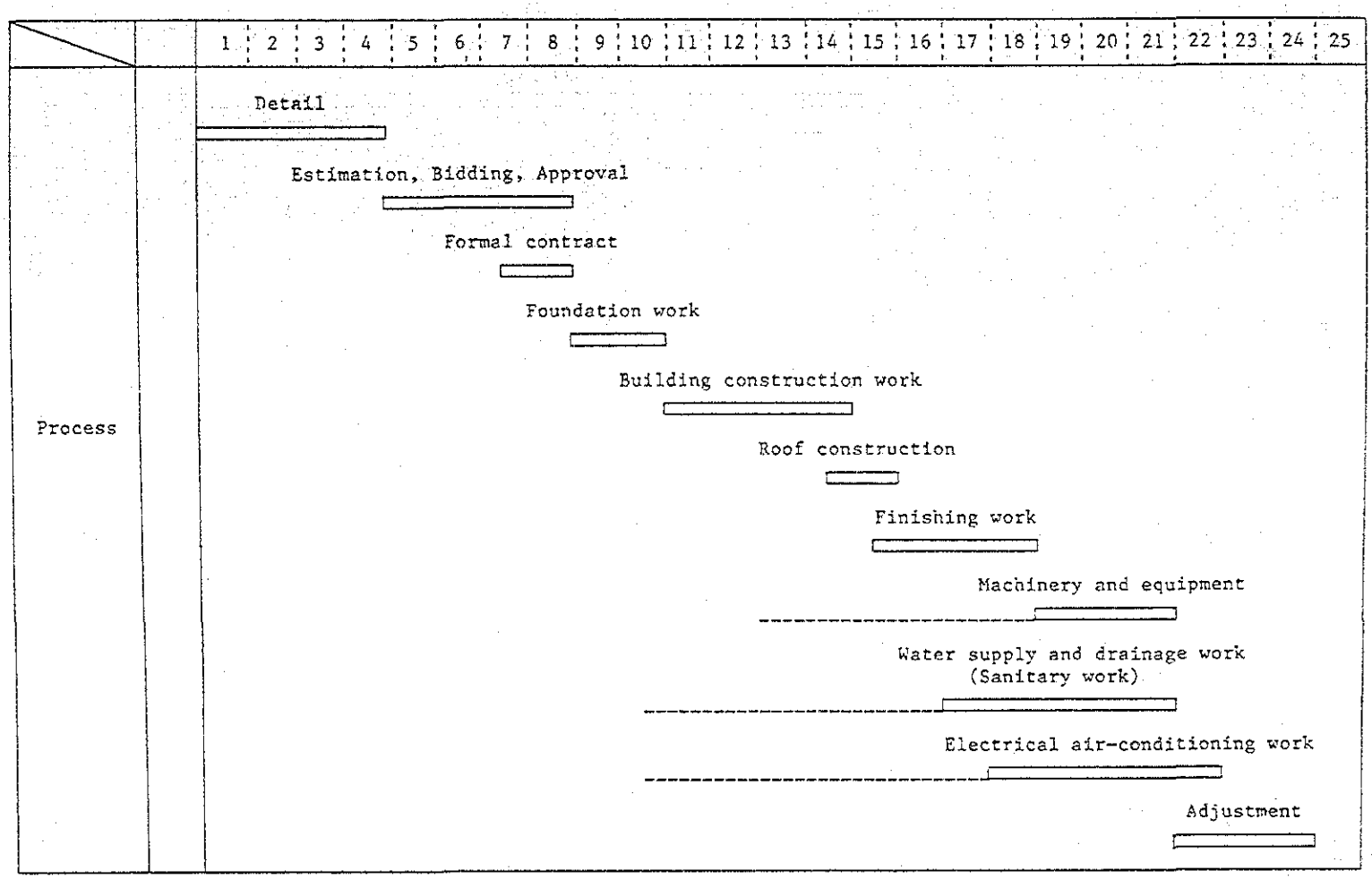
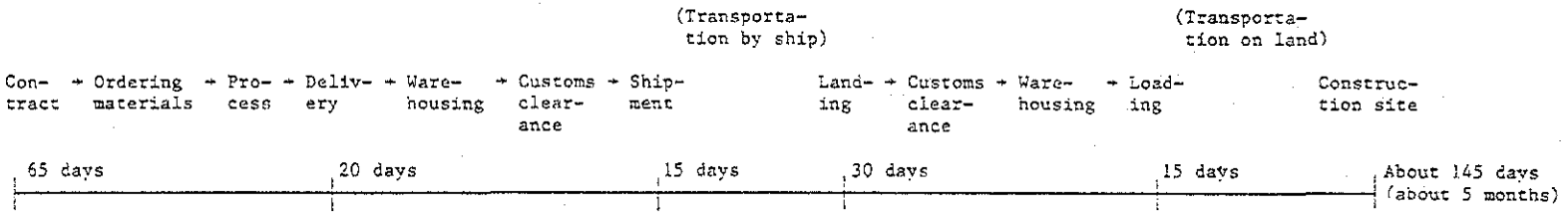


SECTION

Fig. 9-1 Storage Technology Improvement and Training Center

Fig. 9-2 Construction Work Process Table





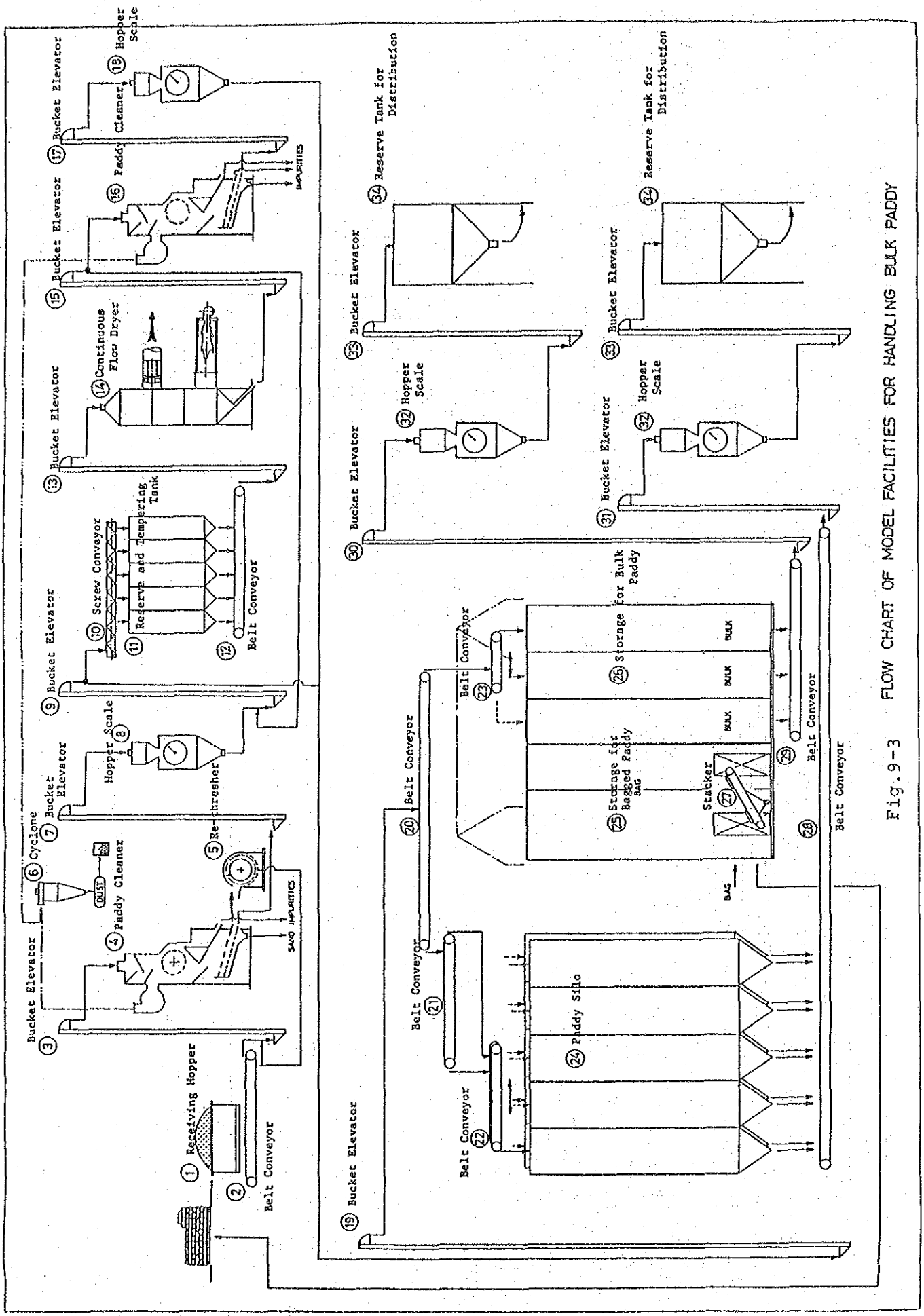


Fig. 9-3 FLOW CHART OF MODEL FACILITIES FOR HANDLING BULK PADDY

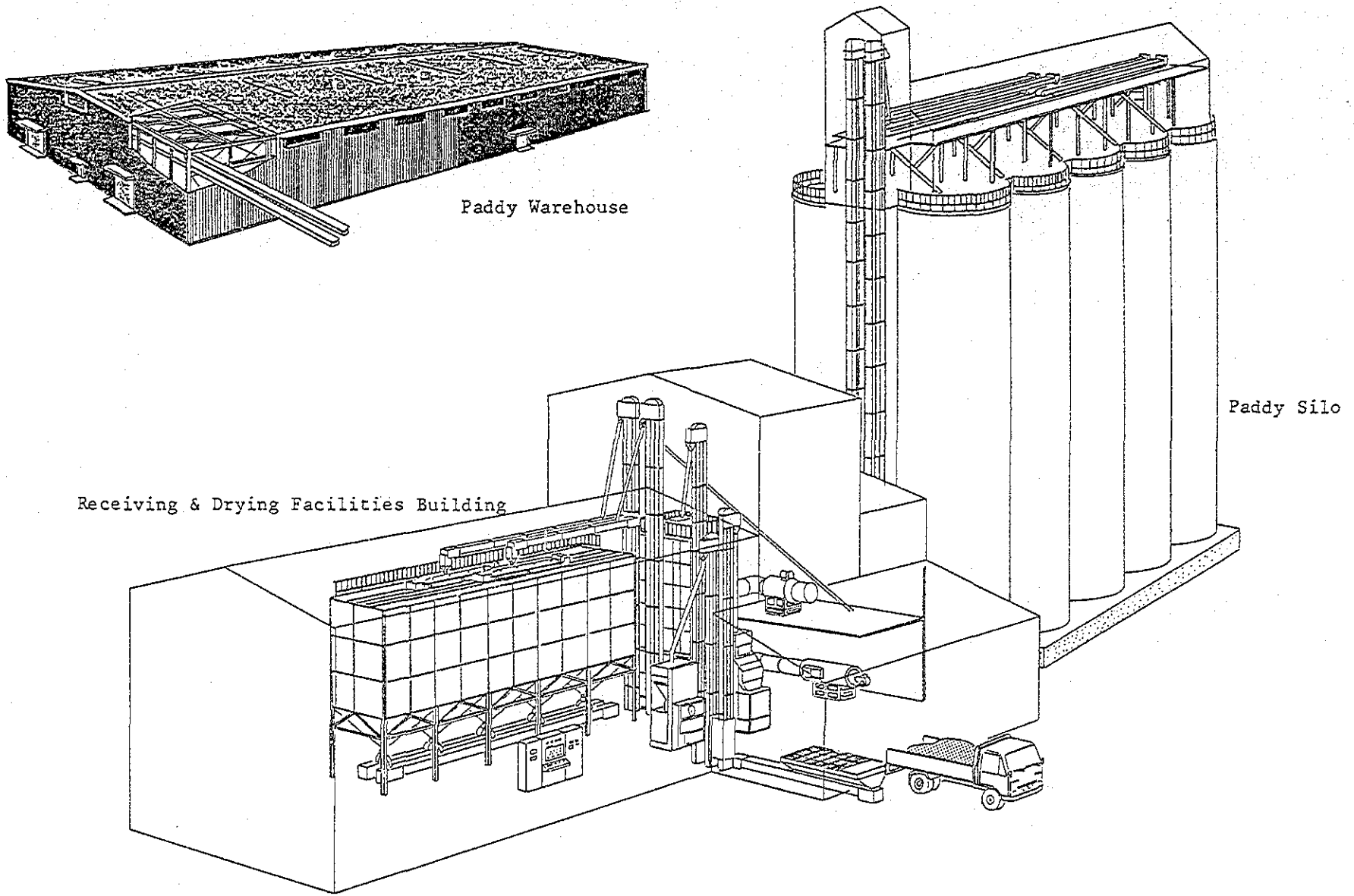


Fig.9-4 Model Facilities for Handling Bulk Paddy